

ABSTRACT

Title of Document: FIREFIGHTING IN THE NEW ECONOMY:
CHANGES IN SKILL AND THE IMPACT OF
TECHNOLOGY

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To better understand the shift in workers' skills in the New Economy, a case study of professional firefighters ($n=42$) was conducted using semi-structured interviews to empirically examine skill change and the impact of technology. A conceptual model was designed by both introducing new ideas and integrating traditional and contemporary social theory. The first component of this model categorized firefighters' skills according to the job-context in which they occurred, including: fire related emergencies, non-fire related emergencies, the fire station, and non-fire non-emergencies. The second component of this model drew from Braverman's (1998/1974) skill dimension concept and was used to identify both the complexity and autonomy/control-related aspects of skill in each job-context. Finally, Autor and colleagues' (2002) hypothesis was adapted to determine if routinized components of skill were either supplemented or complemented by new technologies.

The findings indicated that skill change among firefighters was clearly present, but not uniform across job-contexts. A substantial increase in both the

complexity and autonomy/control-related skill dimensions was present in the non-fire emergency context (particularly due to increased EMS-related skills). In fire emergencies, some skills diminished across both dimensions (e.g., operating the engine's pump), yet others had a slight increase due to the introduction of new technologies. In contrast to these two contexts, the fire station and non-fire non-emergency job-contexts had less skill change.

Technology played a major role in the skill change experienced by firefighters. Surprisingly, aside from the introduction of computerized engine pumpers, the technology introduced did not diminish skill by replacing routinized tasks (Autor et al. 2002), and also did not create an overall decrease in firefighters' skill as would be suggested by Braverman (1998/1974). Instead new technologies tended to create new skills for firefighters, especially in the fire and non-fire emergency contexts. Similar to the consistent level of skill used in the fire station and non-fire non-emergency contexts, with only few exceptions (e.g., computers) technology's impact on firefighters' skill was found to be rather limited in these two dimensions. Using the tenets detailed in the conceptual model, a more elaborate understanding of skill change and technology's impact was able to be realized.

FIREFIGHTING IN THE NEW ECONOMY: CHANGES IN SKILL AND THE
IMPACT OF TECHNOLOGY

By

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Chapter 1: Introduction

As the existence and effects of the New Economy¹ continue to be debated by a wide array of social scientists, there is one thing that is not contested – the drastic impact technology has had on the labor force over the past twenty years. In fact, it is hard to imagine a business, organization, or occupation which has *not* been impacted by technology. Everything from the automotive industry (Fine and Raff 2001), computer/software industry (Linden, Brown, and Appleyard 2004), clothing manufacturers (Agnew, Forrester, Hassard, and Procter 1997), and service workers (Glen and Feldberg 1995) have all had their job requirements and tasks changed due to the influence of technology. While technology's influence on these industries might not be surprising, some people may be shocked by some of the industries that have felt technology's impact. A prime example is provided by Brennan (2002) who discusses advances in communication technologies and their effects on the business of sex workers. Thus, technology's impact is everywhere, whether we have become so familiar with its integration that its effects go unnoticed, or it occurs in places we would never think to look.

One of the effects of technology which may tend to go unnoticed, or be taken-for-granted by the average person, is its continual influence on the skills needed by individuals to complete their occupation's required tasks. This is an important topic which can impact (either positively or negatively) a variety of areas: education

¹ The term "New Economy" is defined here as the post-1990 era which saw an increase in productivity growth through accelerating changes in information (IT) and other technologies, and corresponding changes in business organization and practices. This definition is derived using a synthesis of the definitions laid out by Alcaly (2003) and Gordon (2000).

(Form 1987; Giret and Masjuan 1999; Spenner 1985), wages and income (Attewell 1990; Egger and Grossman 2005), workers' dignity and value (Hodson 2001; Spenner 1990; Rogers 1999), job stability (Rogers 1999; Smith 2001), unionization (Isler 2007; Vallas and Beck 1996), gender inequality (Steinberg 1990; Vallas 1990; Weinberg 2000), training (Hodson, Hooks, and Rieble 1994; Marls and Scholarios 2007), and policy (Vallas 1990). However, even with all of these related issues recognized, from the sociological researcher's perspective skill has not been a primary focus in work/labor-related research (see Abbott 1993).

This is not to imply that it has been completely absent. Often crediting Braverman (1998/1974) with renewing modern interest in "skilling research," a base of social science literature focusing upon this phenomenon does exist, with a large portion of it studying this topic through the lens of some specific occupation or industry. Because it is rather difficult to capture the daily tasks and skills that are required in a single occupation (Autor, Levy, and Murnane 2003a; Spenner 1985), this consideration has encouraged a majority of sociological researchers to use a series of case studies to provide a detailed examination of technology's effects on the requirements of particular occupations. No clear direction of the change in skill has been found from these case studies; however, a loose claim can be made that both past (Spenner 1985; Vallas 1990) and contemporary (Autor et al. 2003a; Szafran 1996) research has seen an overall trend which shows a slight downskill among workers.²

² It should be noted that an issue of terminology exists here when referring to the nature of an individual's skill decreasing. A variety of terms are often used to indicate the decrease in skills or skill-level of an individual including: downskilling, downgrading, deskilling, or simply decreasing. For

While a large portion of current sociological research uses case studies to approach this topic, larger, multi-occupational quantitative studies have also been conducted by researchers. These quantitative studies have arguably been more common in economic research (Autor et al. 2003a), but have also been present in sociological research. Similar to the qualitative case study approach, the collective findings from these quantitative studies have also been mixed. However, the general claim made by these studies has been contradictory to the case studies. Research using quantitative methodologies has found that overall the more general pattern of skilling is increasing, or upskilling (Autor 2003a; Spenner 1985; Szafran 1996; Vallas 1990).³

Taken as a whole, this body of literature has laid a foundation for the understanding of technology's impact on the skill of workers. However, there is still much room for future research to build upon. One manner in which the above body of literature falls short is that certain aspects of its conceptual approach may be in need of improvement. This occurs in a number of ways. First, an assumption is often made by researchers that skill is a term that needs not be defined. When an examination of skill takes place, it may often be unclear what exactly is being measured. We are often left with measurement issues of validity, and a general uncertainty. Second, claims are also made by researchers that the skills required by an occupation can either increase, decrease, and/or change (also referred to as reskilling) (for example,

clarity's sake, the term downskilling is used by the author when reviewing the literature to represent all of these terms.

³ Similar to downskilling, an issue of terminology exists here when referring to the nature of an individual's skill increasing. A variety of terms are often used to indicate the increase in skills or skill-level of an individual including: upskilling, upgrading, or simply increasing. For clarity's sake, the term upskilling is used by the author when reviewing the literature to represent all of these terms.

see review by Spenner 1990). Without precise and clear conceptualizations, assessing change in skill can be problematic as claims are being made in regards to the direction/manner of change without first defining the concept being measured. In addition, a uniform vertical direction of movement is used to view the change of skill without questioning its conceptual validity.

Finally, another manner this research falls short is that it has only explored skill by assuming that occupations occur in a single location, or context. On the contrary, there are a variety of jobs and occupations that require different series of skills depending in which context this occupation is presently operating. For example, a dental hygienist performs her/his occupation not only in the examination room when a patient is having their teeth examined, but also at the administrative area in which s/he is collecting patient information on insurance, scheduling appointments, etc. Thus, in each of these job-contexts there may be different sets of skills required, and the potential for each skill set to change in a different direction.

Another missing piece of the puzzle occurs as a result of the scope taken by previous case studies. The majority of these research studies have maintained a focus of examining the changing skill of workers in either manufacturing industries or in a professional office environment (i.e., a traditional “white-collar” context). Both of these environments have allowed a better understanding of this phenomenon, but at the same time are limited in their ability to generalize past these specific environments. While these studies have produced a richer description of skill and skill change (in comparison to quantitative studies), future research is needed which broadens the scope of generalizability past these two particular environments

(manufacturing and “white-collar”) and onto examining occupations in industries and environments differing from those mentioned above. With a wide array of occupations that do not neatly fit into the manufacturing or professional categories, there is much room left to explore.

With the above considerations in mind, it is the purpose of this present research to address both of these issues (improvement of conceptualization and expanding generalizability of case studies past manufacturing and “white-collar” occupations) by a comprehensive examination of firefighters. This specific occupation is selected because it is an ideal occupation for the advancement of research on skill. First, this occupation is not contained in the industries and environments which have been explicitly examined by past research. Firefighting falls into the public service sector, which to my knowledge has not yet been examined.⁴ It is not part of a capitalistic enterprise, yet through its large numbers of employed personnel is an important part of the U.S. economy. Finally, firefighters often operate in a variety of different job-contexts: at the firehouse, at fire related emergencies, at non-fire related emergencies, and at non-emergencies. By using firefighters as the occupation of focus, both an extension of generalizability to an

⁴ It should be noted that a recent ethnography by Desmond (2006, 2007) has focused specifically upon wildland firefighters, and their negotiations of taking the risks involved with performing this occupation. However, in considering the sociological literature on skill, two important points should be made here. First, the main focus in his research only touches upon skill, and does so using Bourdieu’s concept of *habitus*. This leads the author in the direction of considering embodied histories, internalized/forgotten socialization, and practical sense (Desmond 2007:12). Secondly, firefighters involved in handling wildland fires and those firefighters involved in handling fires occurring in residential/community environments possess different sets of skills. Some skills do overlap, but due to the nature of these different jobs there is a great deal of differences. In particular, the four job-contexts in which the firefighters in the following study perform their tasks may not all be present in the occupation of wildland firefighter (e.g., non-emergencies).

unexplored job/occupation/sector and a more complex examination of skill can be achieved and help to advance the current body of research.

In an effort to accomplish these stated tasks, prior to the literature review I ask two general research questions which will aide in the review of past studies, and an empirical analyses of the data. The first question asks: How have the skills used by firefighters to complete the tasks required by their occupation changed in the New Economy? In order to answer this question, the concept of skill will have to first be clearly conceptualized and defined. This definition will take into consideration a variety of items such as the type/variety of skills used, past research from multiple disciplines, how to accurately assess if a true change has occurred, and the variety of different contexts in which firefighters perform the tasks required by their occupation. The second research question asks: What has been technology's role in the change of skill used by firefighters to complete the tasks required by their occupation? Because of the widespread use of technology in the U.S. economy, its continual and rapid evolution (Carr 2003, 2008), and its particular history in the occupation of firefighting (Coleman 2004), its impacts on workers' skill is an important topic of study.

Chapter 2: Literature Review

Patterns and Causes of Skill Change

Sociological literature

The work of Karl Marx (1976/1867) provides a good starting point in which to begin understanding sociological claims made about skill. While Marx did not directly define the concept of *skill* in his work (similar to the term *social class*), Marx did make claims that capitalism would seek to alienate the working class such that they lose autonomy over their work. He claimed this would happen during instances where large capitalists employed numerous workers, and not due to the actual manufacturing process itself (Marx 1976/1867). However, while this environment of massive worker employment spawned the loss of autonomy, it did not occur in all environments. Marx indicated that one way in which workers could retain their skill was by maintaining their control over the work process (Attewell 1990). These Marxian roots to understanding skill remained a dominant intellectual force for some time; however, after WWII his arguments were updated by contemporary claims about the pattern of skill change leading to what we think of as the more contemporary skilling debate. Although this contemporary debate has been detailed elsewhere (see Spenner 1983, 1995; Vallas and Beck 1996), its tenets are still important to discuss.

Within this debate, the first contemporary theoretical argument saw that technology would act as a mechanism of upskilling for the worker (Blauner 1964; Kerr, Dunlap, Harbison, and Myers 1964). Because of the assembly line, most

workers were thought to be operating in jobs which required standardized and routine procedures. In this instance, technology (particularly automation) would break workers from these monotonous and routine tasks allowing them to gain a broader, more diverse set of skills than had previously plagued them. This would in turn lead to less direct supervision and more control over the workforce (Spenner 1983). While this argument itself had gained some recognition, a response to this thesis made in the work of Braverman received arguably more attention. In *Labor and Monopoly Capital*, Braverman (1974/1998) made “technologically deterministic” (Vallas 1990) claims that capitalism would use technology to strip workers of as much skill as possible in an effort to increase productivity and capital. As with Marx, Braverman never explicitly defined the term skill, but his work implied that skill included two specific dimensions: the complexity of tasks performed and the amount of autonomy individuals maintained over their work (Adler 1988). It should be noted here that while Braverman (1974/1998) saw this pattern (i.e., deskilling) as a general tendency for the majority of workers, this was not the case with everyone. While deskilling was occurring throughout most of the labor force, a limited number of individuals in jobs at the summit of this worker hierarchy would actually experience upskilling, resulting in a polarization of the workforce. These arguments have been widely acknowledged, both in a positive and negative light (for specific criticisms of Braverman see Meiskens 1994; Stark 1980; Wilkinson 1983).

With these antithetical, theoretically-based patterns of skill change established, there next came a position in the debate which was based primarily on empirical evidence rather than theoretical arguments (Spenner 1983, 1995). At this

time in the skilling conversation, researchers began to notice a large body of empirical research existed which did not provide any sound support to either the upskilling or downskilling claims. This has become known as the contingent, mixed-change, or conditional argument (Spenner 1983, 1995; Vallas and Beck 1996). In the studies often cited (see Spenner 1995 for a list), depending on definition, measurement, methods, and timing of a study, different conclusions were reached. While these inconsistent empirical findings encouraged researchers to move away from providing support to previous theoretical claims, it can be argued that a dependence on empirical evidence also resulted in negative consequences. This inconsistent support resulted in sociologists and other researchers moving away from basing their research on sound theoretical arguments. The body of research made a fundamental shift to using methodological, conceptual, and operational considerations as the driving explanatory force. This shift was also expedited with the more widespread use of strong quantitative data allowing a more comprehensive study of skill (particularly the *Dictionary of Occupational Titles [DOT]*, see Cain and Treiman 1981; DoL 1991; Spenner 1983, 1985; the National Longitudinal Study of Youth [NLSY79] also began at this time, see Leigh and Gifford 1999). Therefore, sociological and other theoretical arguments took a back seat to the empirical findings that were being produced.

In response to this atheoretically driven focus, a variety of researchers set to reintegrate theory into the skilling debate. While acknowledging the claims of past research, this next argument looked to information technologies (IT) as creating new patterns of skill. With the adoption of IT, the nature of capitalism had changed from a

highly specialized focus. Arguments are made that capitalistic organizations themselves have been drastically changed by adopting new technologies and computers (known as “technocratic organization”; Burris 1999). In turn, this is requiring a different type of worker (for example see “symbolic analysts” in Reich 1991, or the knowledge versus craft discussion in Marks and Scholarios 2007). Capitalistic organizations have begun to seek workers who are able to synthesize mental and manual tasks/functions, and not necessarily be controlled but rather develop a strong bond with their workplace through organizational and corporate commitment (Walton 1986; Zuboff 1988). This shift in the focus on skill has not only been due to IT, but also to the nature of the global economy becoming highly service-oriented. It is at this point where current sociological examinations have remained.

Economic literature

While these patterns of skill change have dominated and informed the sociological debates, a parallel argument of the nature of skill change has ensued in economics. While this debate has its similarities to the sociological arguments, there are also differences (Autor et al. 2003a). Both of these literatures have recognized the importance of technology to the skills of workers. With this similarity in mind, Autor et al. (2003a) claim that economics also receives criticism from sociology due to its (a) vague definition of skill, (b) limited emphasis on the role of managers and organizational design in adapting and implementing technology, and (c) technological determinism (pp. 121-122). Thus, to understand how this difference has risen, and whether or not it has the potential to continue, we must turn to the time in the late

1980s/early 1990s when IT and computer networks began to exponentially increase in the workplace.

With a concern for the effects on wages and education, an argument was made by economists that the use of computers at work was inherently biased (Bound and Johnson 1992; Katz and Murphy 1992). At its basic level, this claim, known as the skill-biased technological change (SBTC) hypothesis, argues that changes in technology towards computerization tend to replace lower skilled workers (Pianta 2005). Simultaneously, this new technology tends to show a bias towards workers with higher skills in that it requires higher skills and knowledge for current technologies to be effectively used (Piva, Santarelli, and Vivarelli 2005). The bias introduced by this hypothesis has often been used in an effort to explain and discuss wage inequality (Bound and Johnson 1992; Katz and Murphy 1992) and higher levels of educational attainment (Pianta 2005). The SBTC hypothesis had gained much momentum in the economic literature, especially through the booming integration of computers and IT in the workplace; however, (as with the case of sociological claims on the impact of technology) evidence has been found that contradicts its claims (Pianta 2005; Piva et al. 2005). This evidence contains many limitations also found in the sociological literature, as shown by a statement made by Pianta (2005) that these inconsistencies in some manner have to do with the measurement of skill. In turn, this implies that further consideration is needed to be given to its conceptualization and operationalization (also noted elsewhere by Preece 1995).

A response to the SBTC hypothesis followed, and recognized that skill not only hinges on technology, but also on the decisions made by management and on the

organization of the workplace. Here it has been argued that management has sought to adapt and implement trends which focus on decentralization and delayering, collective work, and multi-tasking (Caroli 2001). This has spawned the skill-biased organizational change (SBOC) hypothesis. The SBOC hypothesis states that new organizational changes and management procedures have encouraged upskilling (or higher levels of skills) among workers (Piva et al. 2005). While this hypothesis can be pitted against SBTC, more recent studies have found that SBTC and SBOC may often act as compliments in understanding the increasing levels of worker skill (Piva et al. 2005).

At this point, these two hypotheses can be taken in unison to show that an increasing or higher level of skill was valued in the labor force due to the increasing use of IT and computers and the corresponding nature of organization and management. While evidence has been found for both the SBTC and SBOC hypotheses, conclusions are similar to the sociological literature and do not produce a sound explanation of the nature and causes of skill change. This is shown by Piva and colleagues (2005) in a review of the literature on these two hypotheses where empirical support has varied by temporal period and country/area of focus.

While the SBTC has played an important role in the economic literature, it has received criticism from sociologists for a variety of reasons (Autor et al. 2003a). However, intradisciplinary criticism has also surfaced. In a series of research projects and papers, Autor and colleagues (2002, 2003a, 2003b) spoke to the fact that the SBTC hypothesis is too deterministic and does ignore management's role of

influencing worker's skill. They sought an alternative way to understand the influence of computers in society, by making the claim that:

...the introduction of computer-based technology creates strong economic pressure to substitute machinery for people in carrying out tasks that can be fully described in terms of procedural or 'rules-based' logic and hence performed by a computer. This process typically leaves many tasks to be performed by humans, and management decisions play a key role – at least in the short run – in determining how these tasks are organized into jobs, with potentially significant implications for skill demands” (Autor et al. 2002:433).

The notion here is that computerization and IT are able to either supplement or compliment different tasks and the skills that are needed to achieve them. Autor et al. (2002) detailed this in a case study of a bank which adopted new technologies. Here, the authors show that computers are used to automate tasks which run on “rules-based” (Autor et al. 2002) or “IF-THEN-DO” (Levy and Murnane 2004), logic. In these instances, various tasks were supplemented by this new computer-based technology, and thus the skills required to perform them were eliminated. At the same time, a variety of new and old tasks were left which could not be supplemented by computers. However, not everyone's skills were increased due to the adoption of this technology. With the goal of increased productivity, management played a pivotal role in the organization of the bank workers which directly impacted whether or not a worker's role led to a higher or lower level of skill use: one department was led to adopt a broader range of skills, while another department adapted more narrowly defined skills to conduct simplistic, non-routine tasks (Autor et al. 2002).

In recent research by Goos and Manning (2007) this finding (termed by the aforementioned authors as the “ALM routinization hypothesis”) was taken and

applied in a large scale quantitative examination of the workforce of Britain in the late 1990s. Their findings lent support to the argument that the workforce was being polarized. It was argued by the authors that this polarization was occurring because the majority of jobs which consist of routine tasks accounted for by the ALM routinization hypothesis fall in a middle stratum among the occupational hierarchy. Therefore, the tasks of these jobs are able to be supplemented by computers leaving only the higher and lower tiers of occupations which workers are to fill (Goos and Manning 2007).

Thus, both the sociological and economic theoretical propositions and empirical studies have resulted in skill to be examined through a wide variety of manners. Taking into account this wide array of literature, I would argue that two findings remain consistent. The first is that the collective findings of research on skill change have consistently found the evidence to be inconsistent. For each theory stated, there exists empirical evidence that can be used to either support or contradict its stated tenants. Secondly, due to the varying (and sometimes incomparable) conceptualizations and operationalizations of skill (and there are many; Adler 1988), a more explicit focus needs to be given to the movement from theory onto its empirical testing.

The Conceptualization of Skill

When studying the skill levels of workers, all researchers are faced with the dilemma of how to conceptualize skill. Three factors tend to place limitations on how skill is conceptualized. The first factor which limits conceptualization is that the literature itself often provides a shaky model on which we must base our efforts. The

unofficial starting point for guidance on conceptualization is Braverman (1998/1974) who hinted at what exactly skill entails (Adler 1988), but himself never explicitly defined this term. When referring to skill, this use of ambiguous terminology (and related concepts) is something that has continued in research (Barley 1990). Second, because skill is not something that is easily measured in empirical research, various data and methodological considerations have driven our definition of skill (Spenner 1983), perhaps more so than theoretical arguments. For example, in some instances the dialogue of the conceptualization and operationalization of skill is discussed simultaneously (Spenner 1983, 1985, 1995; Vallas 1990). Although this may initially have sought to *clarify* the meaning of the term “skill,” it may in fact *perpetuate* the confusion by blurring the lines of how skill should ideally be conceptualized and how researchers must settle on an operationalization. Finally, publishing bias may also be an additional factor in the conceptualization of skill (as with any research topic; see Wilson 2008). Because much emphasis is generally given to the second-half of studies (i.e. the results, discussion, and conclusion portions), the front-half may sometimes get overlooked or minimized due to space constraints.⁵ The literature summaries/reviews and methods sections which tend to hold the details of skill’s conceptualization may be unclear to the reader and leave him/her with unanswered questions.

Braverman’s conceptualization

While skill can be looked at as a possession by individuals (Spenner 1990), it can also be defined as requirements of a specific job/social role (Sadler 1970;

⁵ Although I would argue this is less the case with sociological-oriented publications.

Spenner 1990). The distinction stems from various schools of thought: positivism, ethnomethodology, Weberian, and Marxian (see Attewell 1990 for a description of each of these). Because of the large Marxist tradition in the literature on work and skill, Marx's view on skill as related to human nature and the effects of work (Form 1987) has lent the majority of research to interpret skill as the demands and requirements of a job. This view was adopted by Braverman (1998/1974) who did not explicitly state what he had implied by the term *skill* in his work *Labor and Monopoly Capital*, but did recognize two dimensions of this term which are often correlated: substantive task complexity and autonomy/control (Adler 1988:3; Spenner 1985:135). When skill is addressed by the sociological literature in a purely non-empirical manner, these two aspects of skill are almost surely to appear. However, this does not imply that other dimensions have not been added to the conceptualization. For example, both Parcel and Mueller (1989) and Szafran (1996) use alternative dimensions (described below in the following subsection).

Throughout past research, the most conceptually consistent of Braverman's dimensions of skill has been substantive complexity. As defined by Spenner (1985), substantive complexity "refers to the level, scope, and integration of mental, interpersonal, and manipulative tasks in a job" (p. 135). This concept is truly at the heart of not only sociological skill research, but also research falling into other disciplines (Rolfe 1990). Thus, a wide central tendency of agreement appears over this particular dimension, and most research on skill, whether or not the term is defined or the dimension of substantive complexity is specifically mentioned, does examine this dimension.

Although a near uniform agreement on the dimension of substantive complexity may exist, Braverman's second dimension – autonomy/control – is more controversial. To again quote Spenner (1985), autonomy/control can be given the basic definition of “the discretion available in a job to initiate and conclude action, to control the content, manner, and speed at which tasks are done” (p. 135). However, a clear understanding and definition of this concept has not been universal. Form (1987) comments on this dimension through an argument that autonomy is not a particularly useful dimension in the conceptualization of skill. One reason he gives is that having autonomy and a direct control over one's tasks does not imply any true notion of skill. The example given here is that of a maintenance worker, or custodian. In this position there is much autonomy, but it is not to say that a high level of skill is involved in the basic tasks required by this particular job. While this argument is based upon a conceptual reasoning, his second argument is more empirically driven. In this argument he states that since empirical evidence has shown autonomy/control to be highly correlated to complexity (found in Spenner 1980), complexity reigns as a superior operational measure and thus no need may be given to using autonomy as an empirical measure (Form 1987).

Alternative dimensions

As mentioned above, researchers have also argued that other dimensions of skill exist besides substantive complexity and autonomy/control. These dimensions appear to be empirically driven, in many instances using the different categories/arrangements of the *DOT* and associated statistical techniques such as factor analyses. These dimensions have included motor skills (Cain and Treiman

1981; Cronshaw and Alfieri 2002; Parcel and Mueller 1989), which have been further proposed as being broken down into fine and gross motor skills (Szafran 1996); social interaction (Szafran 1996); physical activities (Cain and Treiman 1981; Parcel and Mueller 1989); undesirable/hazardous working conditions (Cain and Treiman 1981; Parcel and Mueller 1989; Szafran 1996); and adaptive skills (Cronshaw and Alfieri 2002). Because of the empirically driven nature of these dimensions, and data availability, they have been more specific to researchers who have used the *DOT* as a data source. In addition, with the replacement of the *DOT* by the *Occupational Information Network (O*NET)*, a database which contains a new skill taxonomy (see Mariani 1999; Peterson et al. 2001), alternative dimensions that have been used to conceptualize skill may in the future expand to include new dimensions such as technical skills, problem-solving skills, etc. It may also be argued that this may not be the case. For example, one study by Hadden, Kravets, and Muntaner (2004) use the *O*NET* to create skill dimensions similar to that of the *DOT* which allow for comparison. Regardless of their specific name, it is clear these dimensions are quite different in their very nature than those acknowledged by Braverman.

Occupation-specific skills

Another manner of conceptualization which has existed (particularly in case studies) has been examining the skills specific to a certain job (for example, see Autor et al. 2002; Bartel, Ichniowski, and Shaw 2003; Cronshaw and Alfieri 2003; Smith 2001). In Smith's (2001) work (a series of case studies), the specific tasks detailed are those needed to complete photocopying procedures, wood-products processing, and clerical work. These tasks and their nature are described in great detail using

qualitative methods in an effort to understand the precise procedures that go into a particular job. Taking this view of skill, a very good understanding of the tasks specific to an individual in a particular job are described. However, the generalizability is somewhat limited to not only that specific occupation, but also to that specific job. Thus, the far too familiar trade-off between detail and generalizability is an issue (as it is when comparing any type of quantitative and qualitative study, in any topic being researched).

Others have found using alternative research methods can allow for a greater generalization to skills that move past the job level and are more occupation-specific. An increasing generalizability allows for a broader understanding of the tasks and skills required by specific occupations (Reiter-Palmon et al. 2006). One may even go a step further in arguing a need for broader skill level examinations are needed. These may have potential to generalize not only to a particular occupation, but also to a large organization/corporation, industry, and even the general labor force (Rotundo and Sackett 2004).

The notion of conceptualizing skill by the particular level in which one is focusing (i.e., job, occupation, industry, general labor force) has been an important consideration in research. In many instances different studies are addressing change at different levels of skill (Spenner 1985) which can lead to problematic or inaccurate comparisons. This is due in part to both the lack of understanding between these different levels and their inability to speak to one another. Obviously, this does not imply that any one level is more valuable than another, but rather that (a) each level is

needed to be considered when it is a possibility, and (b) caution should be given in comparing different levels of skill.

Routinized/non-routinized skills

One final manner of conceptualizing skill is by whether or not a task follows a rules-based logic (Autor et al. 2002, 2003a, 2003b). This conceptualization is particularly useful if examining the effect of computers on skill change, and is explained thoroughly in the work of Autor and colleagues (2002, 2003a, 2003b). As it has already been detailed above, this manner will not be reiterated again.

The Measurement of Skill

Just as the conceptualization of skill poses an issue, its operationalization is no different. This operationalization has consistently been a challenge for researchers, and (as mentioned above) at times has even overridden the theories informing the conceptualization of skill. Therefore, there is no doubt that just as much attention should be given to creating measures of skill which can allow for accurate operationalization in empirical research. Although operationalization tends to be particular to the data source being used, there are some general patterns and commonalities found in the skilling literature. One of these described by Vallas (1990) is the nature of the methodology used. A second pattern discussed by Spenner (1990) is based on the type of measurement used. While both of these operational characterizations discussed by Vallas and Spenner differ, they share a basic commonality for allowing us to understand skill measurement. In addition, the wide use of the *DOT*, a data source which in itself has also maintained an important place

in the skilling research of both sociology and economics, has also driven operationalizations of skill.

Methodological categorization

Although noted elsewhere (Autor et al. 2003a; Spenner 1985, 1990), Vallas (1990) gives focus to the dichotomy of aggregate versus case study methods in empirically examining skill.⁶ While any trained researcher understands each of these has different shortcomings, this acknowledgement has been particularly important in the skilling literature as the varying degrees of support given to the major theoretical propositions of skill change by empirical studies has been highly dependent on the methodology used. The first methodology includes aggregate, quantitative studies of a larger scale. These studies allow for a broad generalizability and have collectively (although not consistently) found loose support for the increase in worker's skill (Autor et al. 2003a; Spenner 1985). These types of studies are not job-specific or even organization-specific, but rather focus upon the broader levels of industry and the labor force. It is through this broader focus that large scale, generalizable claims can be made about the nature of skill change. At the same time, it has been advised that even when using the best aggregate data available, limitations still exist. It appears the most commonly cited limitation is in the loss of detail that occurs through aggregating skill (see Spenner 1983). In fact, as pointed out by Vallas (1990), the work of Penn (1982) went so far as to say that the real significance of skill cannot be found through aggregate studies but only through a narrower and localized context.

⁶ The importance of this distinction is also noted by Barley (1990) who suggests that inaccurate inferences are made due to researchers not accounting for the level of analyses. Barley suggests that by combining different methods of study these inaccuracies can be addressed and a more comprehensive understanding of the relationship between skill, technology, and organization can result.

The second categorization that Vallas (1990) discusses is case studies. In this category both quantitative studies with a narrower focus (i.e., quantitative studies focusing on a specific industry or organization) and qualitative studies are placed. The strengths of these methodological approaches enable researchers to address some of the shortcomings of large scale aggregate studies. They enable researchers to examine skill through a variety of skill dimensions (Vallas 1990), but at the same time use different conceptualizations (e.g., occupation-specific, routine/non-routine) to alternatively describe and understand skill. In addition, while aggregate studies are able to detect patterns in skill change, it is through these case studies that the mechanisms to which these changes can be attributed can be identified.

At the same time, case studies also have their weaknesses. Obviously one is generalizability (Spenner 1983; Vallas 1990). Claims can only be made to the specific instance that is being studied, with some ability to loosely speculate past each specific case. Depending on the research this generalization may be only to workers in a specific office/sector at a particular corporation, or at the somewhat broader level of a particular organization or industry. In addition, this generalization is further limited by the fact that only certain types of occupations have been explored. Based on the interest in technology's effects on skill, a large majority of case studies have examined occupations in manufacturing (traditional manual labor environments) or in professional (traditional white-collar office environments). The generalizability of these studies cannot be applied to other sectors; for example, the public service sector, or the military (the biggest employer in the U.S.). In addition to the issue of generalizability, larger labor force trends tend to go undetected in these case studies.

While these trends may be important factors in influencing how skill changes, the narrower focus of case studies may cause researchers to not account for these patterns (Vallas 1990).

Measurement categorization

Another manner used to address the operational issues that are present in skilling research is by looking at the type of measures used to operationalize the concept of skill. Spenner (1990) provides a basis in which this is accomplished by stating that skill has been measured in three distinct ways. The first manner (an “indirect” manner; Spenner 1990) is taken by not truly measuring skill. Simply put, this absence of measurement occurs when a researcher takes an occupational title or grouping such as manager, laborer, blue-collar, pink-collar, white-collar, etc. to be indicative of skill. This leaves many issues on the table, including validity, and leaves the reader guessing exactly what the term *skill* implies in these instances. This indirect manner may also not allow for an accurate comparison of findings from one study to other skill research.

The measurement of skill is strengthened to some extent in Spenner’s (1990) second category of indirect measures. These types of measures are common in social science research, especially when dealing with more abstract concepts (e.g., identity, efficacy, etc.). A wide variety of indirect measures have been used in both sociological and economics literature and include things such as educational attainment (Giret and Masjuan 1999; Green, Felstead, and Gallie 2003; Robinson and Manacorda 1997) and on-the-job training (Grimshaw, Beynon, Rubery, and Ward 2002; Leigh and Gifford 1999). These indirect measures are not ideal, and Spenner

(1990) claims that movement away from this type of operationalization has occurred in the sociological literature; however, it has remained the norm in economics research. Contradictory to Spenner's claim, it could also be argued that a movement away from indirect measures is also occurring in economic research on skill as can be seen with more recent economic publications focusing on skill (Agnew, Forrester, Hassard, and Proctor 1997; Autor et al. 2002, 2003b; Ballantine, Jr. and Ferguson 2003).

A final category described by Spenner (1990) is that skill can also be measured directly using "empirical operations and/or explicit protocols for the designation of skill level" (p. 408).⁷ Direct measures have been achieved in a variety of manners, including expertly through the use of job analysts, outside observers (including researchers), and self-reports. The use of these types of measures has become fairly commonplace in social science research, with one of the most dominant sources of measurement being the U.S. Department of Labor's (1991) *DOT*. Because of its dominant role as a common direct measure, it is worth while to give specific focus to this data source.

The *DOT* and *O*NET*

The *DOT* was first published in 1939 after the Great Depression by the Department of Labor in an effort to meet the demand of the public employment service to create standardized occupational measures that could aid in job placement (DoL 1991). By the time the fourth edition was produced, the *DOT* contained 44

⁷ It should be noted here that in this quote Spenner (1990) is discussing skill level in an absolute manner. This differs from the discussion I had earlier of skill level which implied the relative context in which skill is being described (i.e., job level, organizational level, etc.).

variables/measures for over twelve thousand occupations (Spenner 1990). Perhaps its most useful feature is the *DOT*'s ability to be linked to data sources which contain a respondent's occupation. This linkage (although often time consuming) may be completed to give researchers the ability to directly measure skill among data which did not originally have these measures present. These measures include a variety of concepts including worker functions, training times, aptitudes, temperaments, interests, physical demands, and working conditions (DoL 1991). Because of the *DOT*, skilling research has been able to measure various dimensions of skill in large scale quantitative studies, something that otherwise may have remained limited to the use of qualitative methodologies.

While having benefits, the *DOT* is not without its critiques. It has been well advised that researchers need to take caution in using the *DOT*, particularly certain measures it contains (Spenner 1983). Cain and Treiman (1981) list three specific limitations of the *DOT*. First, the *DOT* measures are based on the on-site analyses of jobs by experts. This is problematic for two reasons. First, the notion that a job does not necessarily allow for the explicit generalization to the broader occupation. Second, if taking the conceptual notion made earlier that occupations can operate in different contexts (such as firefighters), this is also problematic because not all of these different contexts are necessarily being accounted for. A second limitation with the *DOT* is that newer editions use previous editions to update occupation measures. Using the occupation of firefighter as an example, in the revised fourth edition of the *DOT* (DoL 1991), this occupation had not been updated since 1977. A final limitation acknowledged by Cain and Treiman (1981) is that the *DOT* categories can be

redundant. Since the time these weaknesses have been detailed by Cain and Treiman (1981), another limitation has also arisen. The last edition of the *DOT* is over 15 years old. Because its original conception was based in a period of automation, contemporary jobs which have appeared in the New Economy have not been detailed. In addition, the widespread infusion of IT and computers into the majority of occupations has not been accounted for in the *DOT*.

In an effort to address these limitations, the *DOT* was retired and replaced by the *O*NET*. The *O*NET* made use of the new Standard Occupational Classification System (SOC; see Levine, Salmon, and Weinberg 1998 for details) to create a wide variety of occupational measures. Table 1 provides a brief overview of how the *DOT* and the *O*NET* compare as data sources. Although the measures of the *O*NET* allow for dimensions of skill to be operationalized similarly to those realized in the *DOT* (Hadden et al. 2004), the two data sources cannot be directly compared due to their differing nature (Rotundo and Sackett 2004). This consideration aside, there are arguably four advantages to the *O*NET* – all four assumptions for which its creation was based (Peterson et al. 2001). The first is that because the nature of U.S. economy has moved from production of materials to an IT-infused, global service economy, the actual occupations present in the economy have changed. Therefore, the *O*NET* is meant to capture these newly created occupations (Mariani 1999).

[Table 1 about Here]

A second advantage is that the *O*NET* uses “multiple windows” to examine the labor force. Thus, multiple measures are found in a wide variety of categories, including: tasks, work behaviors, abilities, skills, knowledge areas, and work context

(Peterson et al. 2001). A third advantage of this data source is that it provides a common language to describe different occupations such that new systems collect occupation-specific information but do so by arranging it under broader descriptors. Finally, the *O*NET* uses taxonomies and hierarchies to allow for different levels of description, increased validity, flexibility in choosing descriptors, and the ability to address future unanticipated features (Peterson et al. 2001).

Although the *O*NET* has a variety of advantages, researchers should be wary of its potential disadvantages: its full range of validity and reliability has not been adequately confirmed, its continual updates (only documented by year changed) may not allow researchers to adequately compare studies using the *O*NET*, it cannot be directly compared to the *DOT* (Rotundo and Sackett 2004), and it has not yet been extensively researched in the areas of sociology and economics.

Technology and Skill in the Context of Firefighting

As with any occupation, the change in technology and need for specific skills has long been a part of firefighting in the U.S. Beginning in Jamestown in 1608 with the first recorded U.S. fire, it was quickly noted that fighting fires was no easy task (Smith 1978). The efforts by early colonial settlers at this fire were seen as completely unorganized and lacking any skill at successfully combating fire. As a result, the entire community in which the fire erupted was left in a state of destruction. With the occurrence of this and other early fires, communities made better strides at fire prevention. In 1631 the first ever fire regulation was enacted (Smith 1978). As the U.S. expanded and spawned new cities, more fires such as the one in Jamestown occurred, and new preventive measures and firefighting techniques

were a result. This process of destruction leading to innovation seemed to repeat habitually, and has therefore been painted as a “tale of progress” (Hazen and Hazen 1992:121).

While destruction may have often been seen to encourage the development of new technology, it is these new technologies which are perceived to spawn new skills. Perhaps the first clear indication of this was in 1852 with the invention of a reliable steam-powered fire engine created by Alexander Moses and Finley Latta (Hazen and Hazen 1992; Smith 1978).⁸ Because of the increased complexity of this steam-powered engine, a new series of skills were needed to properly operate it. These skills were not thought to be in possession of volunteer firefighters, and as a result, in 1853 the city of Cincinnati created the first paid fire department (Smith 1978). A few years later (in 1856), using their new steam-powered engine this Cincinnati fire department challenged a New York volunteer fire company and their human-powered engine to a public competition (Hazen and Hazen 1992). The result was a victory for steam-power and a widespread use of this type of engine in the U.S. when fighting fires. By 1876, approximately 275 U.S. fire departments were using steam-power (Hazen and Hazen 1992). At this point it seems that a true movement of the role of firefighter from volunteer to professional occurred based on the assumption of “true” skill being needed for this occupation.

Fast-forwarding to more recent times, the destructive force of fires may have ceased to spawn technological innovation, but technology continues to influence skill.

⁸ While Moses and Finley’s engine is the first effective and reliable steam-powered fire engine, it was not the first ever invented. It is generally believed that George Braithwaite constructed the first steam engine in London in 1829. In the U.S. the first steam-powered engine was commissioned for creation by New York City fire insurance companies in 1841 (Hazen and Hazen 1992).

In an examination of the folklore of firefighters, McCarl (1985) takes time to briefly examine the different techniques required of this occupation. These tasks and skills are different depending on the type of fire company in which a firefighter works (i.e. engine versus truck), and what responsibilities this individual has in that company (e.g., driving the vehicle, maintaining hoses, controlling the ladder, etc.) (McCarl 1985). In this example, because of the use of a wide array of tools and technologies, a variety of skills are needed. Furthermore, depending on what tool or technology one is currently using, a set of unique skills may be needed. Finally, depending on what type of fire one is fighting, a completely different set of firefighting techniques and skills may be needed. For example, while some skills may be shared to combat urban fires, a different set of skills are required to handle wildfires (Desmond 2006, 2007).

Within firefighting, the consistent fusion of technology with skill continues into the present day. Computers and IT have now begun to be used in training simulators. These simulators have capabilities of allowing for the scientific study of the elemental properties of fire and its interaction with natural and man-made environments (Emmons 1990), but also to simulate situations in which firefighters must be trained to operate (Marchant, Kurban, and Wise 2001). The implications for adopting these technologies are multifaceted: they can minimize costs to local/state governments, minimize risk of injury/death of firefighters, and improve the scientific study of fire and fire-related technologies themselves. In addition, these technologies have also led to research and technology centers to be created, in some instances including related higher education programs (Shields 2003).

While technological innovation has continued to be a driving force in firefighting, its adoption is not always smooth. Coleman (2004) makes note of this by saying that whenever a new technology is introduced to firefighting, it is not universally adopted. There are two factors that can play an important part in technology's adoption. The first is that there needs to be a certainty that the specific technology is useful and effective (Coleman 2004). Until this is the case, technology may not be widely accepted among fire departments. A second factor hindering the adoption of technology is its acceptance by individuals. Even when an organization adopts a new technology or procedure, the individuals do not always use this technology. This acceptance/non-acceptance tends to be driven by the underlying culture of the individuals employed at an organization (Dadayan and Ferro 2005; Vallas 1998). In fact, this issue of acceptance of new technology has been present among fire departments since the 1800s when the steam-powered engine was introduced (Smith 1978). In a more contemporary example, Weinschenk, Ezekoye, and Nicks (2008) provide a description of using standard operating guidelines by firefighters to complete a variety of tasks required by the job; however, they do acknowledge that even with these guidelines instituted by a fire department, actually adhering to these guidelines may be more of an issue of acceptance by a fire department than their formal implementation.

While one may most often equate the skills and technology used by professional firefighters to the actual task of fighting a fire, there are different skills that are needed and tasks to be completed when a firefighter is not at the scene of a

fire, and rather in a different context (Coleman 2004). Vielkind (2007) provides a good example of this by quoting a question from a New City Fire Department exam:

“As a rookie firefighter you are responsible for cleaning the kitchen. You arrive for the beginning of your shift to find the kitchen area is a mess. And there is a bowl of chili spilled on the floor from the firefighters from the previous shift. The reason the kitchen is such a mess is due to the previous crew having gone out on a call to a fire during their dinner, and they are still actively fighting the fire...What should you do with the following circumstances?”

While the above question is rather controversial (see Vielkind 2007 for further details), it is used here to show that a wide variety of tasks are needed to be completed by firefighters, and the skills that they require are often overlooked when studying this particular occupation. Skills and technology do not only impact the tasks firefighters must complete at the scene of a fire, but also at the firehouse (see NFPA 2007 Chapter 5), at the scene of other types of emergencies (e.g., automobile accidents, medical calls) (see NFPA 2007 Chapter 5), and perhaps even in other situations which occur outside of the firehouse and are not emergencies (e.g., installing and maintaining smoke detectors in residential homes). In addition, because this occupation is one that operates in multiple contexts (as opposed to a bank teller, for example), and uses a wide variety of skills in these different contexts (Coleman 2004), there may be a much more complex pattern of how technology is influencing skill than has been accounted for by past research.

Chapter 3: Theoretical and Conceptual Arguments

Theoretical Argument

The body of literature on skilling is extensive. A wide array of theoretical and empirical research exists which has focused upon the nature of skill change, technology's influence on skill, organization and managerial influence on skill, different conceptualizations of skill, and the methodologies and measurements used in skill research. While we have learned much from these studies, it is sometimes disheartening to see that we are left with as many questions as there are answers. With this in mind, the following section seeks to use past research to create a better understanding of skilling and skill change not only by building upon past research, but also proposing new theoretical and conceptual arguments.

In the present research, I plan to adopt some of these existing arguments to build a conceptual model which will act as a guide for understanding skill change and technology's impact on firefighters. In addition, a new conceptualization is proposed which further develops this literature. It is this integrative conceptual model that I will follow in the present research to create a comprehensive understanding of skill change and technology's impact in firefighting.

The job-context skill level

As noted above, it is important for a researcher to clarify the level of skill being examined. The term skill level is used to refer to the level of analyses in which the skills being examined can be generalized. This clarification may prevent inaccurate generalizations (Spenner 1985) which would result in making comparisons

between skills at broader levels (i.e., industry, general labor force; for example see Rotundo and Sackett 2004) and at micro levels (i.e., occupation, job; for example see Bartel et al. 2003; Smith 2001). For example, focusing on the broader occupational level skills required by a firefighter as a public service sector employee may overlook the micro job-context level skills needed by a firefighter. Thus, I take this particular conceptual element of skill level as the building block of my conceptual model.

Although a variety of skill levels have been discussed (Rotundo and Sackett 2004; Spenner 1985), I find the present conceptualizations of skill level to be lacking. I argue that when focusing at the more micro levels, a full understanding of the manners and intricacies of skill change may be overlooked. In turn, this limits the ability to make generalizations in regards to skill change. To better understand the changing nature of skill further conceptualization is needed. Thus, I propose that in addition to the industry, organization, occupation, and job levels of skill discussed in the past literature (Rotundo and Sackett 2004; Spenner 1985), there is an additional skill level which past research has not considered: the *job-context level*. To further understand this level, I will take as an example the particular job of interest in this study - firefighting.

Based on the traditional conceptualizations of skill levels, at the *job* and/or *occupation* levels we could expect firefighters to possess a specific set of job skills. The set of skills that would first come to mind are those related to the tasks needed to be completed in controlling and suppressing residential and commercial fires. However, this occupation requires a variety of additional skills which are not necessarily part of these particular tasks (e.g., from understanding how to use an

automated external defibrillator [AED]; filing standard reports; running fire drills at local schools; even the cliché of rescuing a cat stuck in a tree [see Maile 2004]). Therefore, these additional skills may be overlooked, yet are important to this particular occupation. To better account for these skills I argue that depending on the *context* in which a firefighter is operating, a unique set of skills is needed to complete the tasks that are required within that particular context. In the case of the firefighter, I claim these skill sets may fall into four distinct job-contexts: (1) at a fire station (or firehouse), (2) at the scene of a fire related emergency, (3) at the scene of a non-fire related emergency (e.g. EMS call for an automobile accident), and (4) a non-fire non-emergency (e.g. checking residential smoke detectors) (**Figure 1**). By using this new skill level of “job-context”, I believe that a more accurate and intricate understanding of the nature of skill change in firefighting is able to be achieved.

[Figure 1 about Here]

While the claim is made here that these four job-contexts are distinct, this is not meant to imply that overlap does not occur. There may be some particular tasks which require similar skills which occur at (for example) a fire station and at the scene of a fire emergency; or at a non-fire emergency and at a non-fire non-emergency. However, it is argued that in each job-context the larger set of skills which are required and used are distinct to that particular context. Thus, by failing to acknowledge the job-context, or unconsciously only acknowledging one (or even two) of these contexts, the result may be that an entire set of skills is overlooked. In turn, a false understanding of the skills, how they have changed, and how technology

has impacted this change could be missed by the researcher and result in inaccurate conclusions.

On a final note, while I have been explicit about the use of the conceptualization in the present research, it is important to make clear that the implications of this novel conceptualization of the job-context skill level are not limited to firefighting, or even the public service sector. Many other jobs and occupations operate in multiple job-contexts. A few occupations which are prime examples of how this job-context skill level conceptualization can better the understanding of skill include: police officers (i.e., at a police station, during non-criminal offenses, during criminal offenses, etc.), accountants (i.e., at main office/corporation, at a residence performing private tax consulting, at a business performing business organization consulting, etc.), and even military officers (i.e., at a military base, in combat situations, in non-combat situations/missions).

Skill dimensions

The above discussion of skill level and the argument for use of a job-context level to truly understand skilling does not exhaust the theoretical approach used in this research. However, I do use skill level as a conceptual basis in which I further create a model and build my theoretical argument. While (to my knowledge) this job-context level I am proposing is something entirely new, there is a further need to specify what is being measured in each context. For this, I first turn to the skill dimensions suggested by Braverman (1998/1974). Assuming the existence of different skill dimensions creates a basis to determine how precisely skill is changing. While a variety of dimensions have been proposed (i.e., motor skills [Cain and

Treiman 1981; Parcel and Mueller 1989; Szafran 1996], physical activities [Cain and Treiman 1981; Parcel and Mueller 1989], adaptive skills [Cronshaw and Alfieri 2002], etc.), I believe that Braverman's (1998/1974) proposed dimensions remain the two central dimensions of skill.

Braverman's dimensions (substantive complexity and autonomy/control) parallel each other and provide a unique method for understanding skill. My argument for using these two dimensions over other proposed dimensions is based on two specific justifications. First, these dimensions have been widely used, and I believe they act as a basis for understanding skill as the demands and requirements of a job. This view follows the Marxian approach to skill and its relation to human nature and its effects on workers (Form 1987). At its core, I feel this understanding takes not only a correct definition of skill, but also a concern with the importance of skill, and why it is an important topic of research in the social sciences. The second justification is that Braverman's dimensions were theoretically informed and do not fall into the trap of using empirical findings as the sole driving force in their conceptualization. Braverman drew upon both theoretical literature (influenced by Marx) and empirical observations (his personal experience in manufacturing) to guide his conceptualization. Thus, his dimensions – substantive complexity and autonomy/control – are different in nature from those alternative dimensions proposed by more recent research which may use a more atheoretical basis for guiding their creation (Spenner 1985).

It is also important to be explicit in what precisely is implied by these dimensions. As mentioned by Spenner (1985), a majority of past research has taken a

rather uniform view of Braverman's (1998/1974) dimension of substantive complexity. As stated by Spenner (1985), this "refers to the level, scope, and integration of mental, interpersonal, and manipulative tasks in a job" (p. 135). This understanding of the dimension of substantive complexity is what I adopt in the present research.

The second dimension I am adopting in my research is that of autonomy/control. This dimension refers to "the discretion available in a job to initiate and conclude action, to control the content, manner, and speed at which tasks are done" (Spenner 1985:135). Unlike the more widely agreed upon dimension of substantive complexity, the dimension of autonomy/control has been questioned. For example, in an assessment of the sociological research on skill, Form (1987) discusses whether or not this autonomy/control dimension should be re-thought, or even abandoned. While I do agree with the proposition that a re-thinking of autonomy/control may be in order, I do not believe that completely abandoning this dimension is a proper course of action.

The issue I have with the conceptualization of the autonomy/control dimension stems from the question of what exactly is skill. In taking skill to be defined by the tasks needed to be completed in a particular occupation, and (per Marx) the effects that they have on human nature, I do not think that the autonomy/control dimension at face value is *indicative* of skill, but rather only *related* to skill. In particular, having discretion over one's job does not equate in itself to a set of tasks which need to be completed: having more or less discretion does not translate to having more/less tasks, but rather the influence of other circumstances outside of

skill (e.g., organizational structure, type of work one is completing, signifier of occupational status). However, having more or less discretion does affect a worker's decision-making, problem-solving, self-control, and other discretion-related action needed to perform a particular task. Therefore, these are the particular autonomy/control-related skills which I seek to understand in this dimension. Thus, for clarity's sake I will refer to this dimension as *autonomy/control-related*.

For a better understanding of how these two dimensions parallel on another, I will use an example of one task that was mentioned by firefighters as an important skill: using a ladder. This skill has been a basic skill in firefighting even when only local volunteer brigades existed (Smith 1978), and continues to be important in the current day (Maile 2004; NFPA 2008). In using a ladder, a particular amount of complexity exists. This may vary not only according to the task being performed (i.e., ventilation, rescuing victims, etc.), but also the particular type of ladder being used (i.e., ground ladder, aerial ladder, etc.). At the same time, the use of a ladder also requires a particular amount of decision-making and discretion (i.e., when to raise the ladder, placement of ladder, etc.), all related to the autonomy/control of a firefighter when completing that particular task. Thus, one particular skill such as using a ladder simultaneously contains each of these two dimensions of skill.

The last clarification needed is exactly how I apply these two skill dimensions to the job-context skill level. Their integration is fairly simple in that I argue for each job-context, separate substantive complexity and autonomy/control-related dimensions exist (**Figure 2**). For example, the set of skills used at the fire station have both substantive complexity and autonomy/control-related dimensions. The same

holds true for fire related emergencies, non-fire related emergencies, and non-fire non-emergencies.

[Figure 2 about Here]

Routinization/non-routinization classification

The final component adopted in the current research is Autor, Levy, and Murnane's (2002, 2003a, 2003b) routinization hypothesis (also called the ALM hypothesis). This hypothesis is useful in the examination of firefighters because it gives a particular focus to computerization. This hypothesis states that tasks that follow a rules-based logic are able to be programmed – thus supplemented – by computers, or IT, eliminating the repetitive/routinized skills needed to perform them.⁹ More recent research has produced findings which provide support for this hypothesis (Goos and Manning 2007), and it appears that this categorization is useful in understanding the manners in which current technologies are affecting and changing the skill of workers.

I believe that using this classification in the current research is particularly beneficial when examining the impact that technology has had on skill change of

⁹ It should be noted that Autor et al. (2002) also argue that management's decision plays an important role as to whether or not this technology is initially adopted. Therefore, even if computers/IT are able to supplement rules-based tasks, this does not necessarily imply that management will automatically adopt this technology. Therefore, technological determinism does not necessarily occur. In specific regards to firefighters, it has been noted that technology adoption is mediated by organizational or cultural acceptance (Dadayan and Ferro 2005; Vallas 1998), and in some instances this may be hindering the ability for technology to have an effect on skill. In addition, accounting for the time period of interest, broader organizational changes have been instituted which have changed the number of skills which are needed by firefighters. For example, as stated in the literature, with the attacks of September 11th a new set of skills have been institutionalized into the fire service which addresses how to effectively recognize, handle, and address terrorism (Hawley 2004). Thus, while this process of management/organizational adoption of technology is an important aspect in studying skill, and it is acknowledged as an important variable in skill change and the impact of technology, it falls outside of the scope of this current research. It obviously will be discussed if needed to be, but will not be empirically examined in any great detail.

firefighters in the New Economy. In particular, this conceptualization often provides a way to assess how technology (specifically computers and IT) has changed the tasks performed by firefighters and the skills used to complete them. It is important to note that this categorization cannot be applied to all tasks and skills that are used. By definition, this hypothesis will only be used to determine how computerization and IT have impacted skill. Thus, its scope is narrower than the other conceptual components detailed above (i.e., skill level and skill dimensions). However, using this categorization in combination with these theoretical and conceptual elements I have previously discussed provides a more complete model for understanding skill change and technology's impact.

As displayed in **Figure 2**, I argue that four different job-contexts exist, each with two different skill dimensions. However, to account for the ALM hypothesis, this model needs to be further developed. Thus, I argue that for each dimension, in each job-context, this routine/non-routine categorization can be applied to further account for skill change resulting from technology (**Figure 3**). To again clarify, I will use an example discussed by a few of the firefighters I interviewed: navigating vehicles to the scene of a fire.

[Figure 3 about Here]

To perform this task, firefighters must have the skill to navigate their vehicles to the scene of a fire. Both dimensions are present here: substantive complexity (i.e., knowing how to operate a fire engine/truck, etc.) and autonomy/control-related (i.e., providing/following the actual navigational directions, making decisions on which route to take to the scene of a fire, etc.). However, with the (sometimes controversial)

introduction of global positioning systems (GPS) computerization has had a direct impact on the skills used to perform the task of navigating vehicles to the scene of a fire. The potential to affect both the substantive complexity dimension and autonomy/control-related dimension is present. Controlling and driving a vehicle (substantive complexity) may be more instinctual and non-routine, and thus GPS technologies may not substitute skills used to manually operate a fire engine/truck. However, the ability of the GPS technology to give directions (autonomy/control-related) for which specific roadways to follow has the potential to supplement this skill dimension to some extent. While this particular technology is only provided here as an example (and should not be interpreted as findings of the research), it does provide a brief example of how the routine/non-routine categorization can be applied to both dimensions of skill to enable a more comprehensive understanding.

Through the development of a new level of skill (job-context), the modified adoption of Braverman's (1998/1974) skill dimensions, and the adoption of Autor et al.'s (2002, 2003a, 2003b) routinization hypothesis, it is believed the resulting conceptual model provides a more holistic, theoretically informed platform on which to examine skill change in the New Economy. While used in this specific situation to study the skill change of firefighters, the potential of its use expands beyond this current occupation of interest and to various other occupations.

Summary

Based on a review of the theoretical and empirical literature across multiple disciplines, and a specific consideration of the occupation of firefighter, I have devised a conceptual model which will act as a blueprint for the exploration of the

two research questions of this current project: how have the skills used by firefighters to complete the tasks required by their occupation changed in the New Economy; and what has been technology's role in the change of skills used by firefighters to complete the tasks required by their occupation? In answering these questions, the model will allow for movement past the up/down dichotomy and theoretically stagnant research that continues to play a role in the description of skill change.

Chapter 4: Methodology and Study Design

In order to answer the stated research questions, data was collected from professional firefighters at two different fire departments in the state of Maryland: the Waterville City Fire Department (WCFD) and the River City Fire Department (RCFD).¹⁰ The reasons for selecting these two fire departments are two-fold. First, both fire departments consist of a very high proportion of *professional* firefighters as opposed to *volunteer* firefighters.¹¹ While the difference is arguable, there exist alternate training programs for both volunteer and professional firefighters, with professional firefighters receiving a larger amount of training than volunteers (Zigmont 2007a, 2007b). Because this would have a direct impact upon the nature and level of skills which are possessed by a firefighter, the sample is drawn only from the professional firefighters at these departments. The second reason in which these two fire departments have been selected is to allow for more heterogeneity in regards to the amount of technology that has been introduced to the fire department, the size of the fire department, and the setting in which these departments operate. This will allow for not only a better understanding of how technology has impacted the skills of firefighters, but also extend the ability to generalize the findings which result.

¹⁰ Names of these departments are fictional.

¹¹ “Professional” firefighters may often also be referred to as “paid” firefighters, or even “municipal” firefighters. Due to the fact that in some situations volunteer firefighters are paid for their services, I use the term “professional” to help clarify this distinction.

Context and Fire Department Background

The WCFD context and background

Waterville City, located in western Maryland, was founded in 1762. It has a rich history, including a role in the U.S. Civil War, historical railroads and railroad companies (e.g., the Baltimore and Ohio Railroad), and the Chesapeake and Ohio Canal. While the city is not a massive metropolitan area, it is of a respectable size. According to the U.S. Census Bureau (2008), approximately 36,700 individuals resided in Waterville City in the year 2000. The residents of this city reside in just over 17,000 housing units. Of these units, 7.3% are vacant (slightly lower than the year 2000 national average of 9.0%) (Census 2008).

Responsible for these residents and housing units is the WCFD. The WCFD is a city-wide fire department which is run by the local government of Waterville City and serves within the city's boundaries. Like Waterville City, the WCFD also has a long history dating back to the late 1700s. As with any fire department (Coleman 2004), the WCFD has a mission statement, which is as follows:

“To improve the quality of life through fire prevention, fire safety education, fire suppression, rescue and other special services to all the people who live, work or invest here.”

The WCFD has numerous firehouses; however, only six of these stations are active (or working stations). The others remain as historic buildings. In addition to these fire stations, the WCFD has an administrative building centrally located within the city. This building is connected to a local farmer's market and is near other local government buildings. This administrative building houses offices for the WCFD fire chiefs and administrative workers. In addition, a conference room, training

classrooms, and an equipment/vehicle storage garage are also part of this building. This building is also where many in-house training classes are held and the shift meetings occur.

The six fire stations serve as home for seven different active apparatuses used by the WCFD. Five of these apparatuses are engines, and two of them are trucks.¹² Although not housed at a station (but rather at the administrative building), a utility vehicle (Ford Crew Cab) is also used for emergencies that also remains in service and responds with the apparatus. While these vehicles are standard to fire departments, WCFD is unique in that it does not currently have any ambulance/emergency medical service (EMS) vehicles under its care/possession – something that has increasingly become an integrated part of fire departments across the U.S. (Walter 2004). Waterville City remains using an ambulance service separate from the WCFD when emergencies occur. This partnership of the WCFD and a separate and independent ambulance or EMS provider is based upon a long partnership between these two parties, and from my data collection shows no sign of changing in the future.

Operating these buildings and vehicles are approximately eighty professional firefighters. Although not part of the sample of interest in this current research, it is worth mentioning that the WCFD also does have active volunteer firefighters on staff (approximately 20-25).¹³ All of these firefighters operate on three different shifts (A,

¹² An engine and truck (also known as ladder) are two distinct types of companies (i.e., teams of “firefighters with apparatus assigned to perform a specific function in a designated response area” [Wutz 2004:26]). Engine companies are charged with providing water to the scene of a fire, securing hoses for the water supply, and attacking/extinguishing fires. Truck companies transport firefighters who are charged with search and rescue, forcible entry, ventilation, using ladders, and securing utilities (Wutz 2004:29).

¹³ *Active volunteers* refer to those volunteer firefighters who have been trained and certified and can ride on an apparatus to an emergency call. This terminology is used to distinguish from those other volunteers who serve the WCFD as administrative and support staff. Because the focus of this research

B, and C). Each shift works a rotating schedule, where a firefighter works a 24 hour shift and does not have to report back for duty until 48 hours after his/her shift (i.e., 24-on/48-off). As for the chain of command (see Wutz 2004 for a description of the chain of command concept), the WCFD is run by a Fire Chief who oversees the entire WCFD. Serving under the Chief is a Deputy Chief who handles the day-to-day operations and equipment maintenance. Both of these individuals do not work on the 24-on/48-off schedule, but rather a standard day schedule (Monday to Friday, 9:00AM to 5:00PM). Both of these positions are administrative in nature, and thus they do not regularly participate in emergency response calls.

Under these two individuals are battalion chiefs and captains. Each WCFD shift has its own battalion chief and captain who direct and manage each shift, and are involved with the management of any emergency calls that occur during their respective shifts. They also serve as the link between the firefighters and the administration. Finally, under the battalion chiefs and captains are the professional firefighters. The only distinction among firefighters is that some of them are fire apparatus operators (FAOs, or simply called “drivers”). The FAOs are the firefighters who drive the apparatuses to the scene of an emergency. WCFD firefighters are able to become FAOs based on their (a) seniority, and (b) through a bidding process within the WCFD. In addition to the various chiefs, captains, and firefighters mentioned above, the WCFD also has a number of individuals who are employed to serve other types of duties: fire prevention, public education, administrative support, etc.

is on professional firefighters, these active volunteer firefighters will not be discussed for the remainder of the manuscript.

The RCFD context and background

Founded in the early 1700s, River City is one of the oldest cities in the state of Maryland. As with Waterville City, it also has quite a rich history, stemming all the way back to the Revolutionary War and including a devastating fire which destroyed a large portion of the City's downtown area. During the height of industrialization, River City was heavily involved in the U.S. manufacturing and shipping industry. As with many urban U.S. cities, the spawn of post-industrialization took its toll and manufactures began to close. The movement of these businesses brought a decrease in population in River City, a shift in the demographics, and an increase in poverty and violence. In recent decades, this population has again begun to change as pockets of gentrification have sprung up throughout River City. This has subsequently resulted in large socioeconomic disparities between certain areas of city blocks (or neighborhoods, as they are referred to by the River City government and its residents).

The RCFD is a city-wide fire department which is run by the local government of River City and serves this specific city. As with River City itself, the RCFD has long history and recently celebrated its 150th year anniversary. The RCFD was initially established as a completely volunteer department up until the mid-1800s when five paid fire companies (one truck and four engines) were established. River City is a large metropolitan area and in 2006 contained over 631,000 residents (Census 2008) for which the RCFD is responsible. The residents who reside there are

located in approximately 296,000 housing units contained in the city, 19.7% of which are vacant (fairly higher than the 2006 national level of 11.6%).

The current structure of the RCFD has shifted drastically over the past few years due to changing personnel in the fire chief position, budgetary issues, and also the increase in the number of non-fire emergency calls. This evolution is ongoing, and was even felt during the final stages of data collection. In fact, while I was conducting interviews with firefighters at the RCFD, budget issues forced the closing of a truck company. At the same time, two new medic units were added to the RCFD roster to help meet the annually increasing number of medical calls which needed a response. Thus, after this organizational change, the RCFD consisted of 41 fire stations. Apparatus and rescue vehicles were stationed at 39 of these houses – one served as the RCFD’s headquarters, and the other the department’s communications building. RCFD had a variety of apparatuses. Thirty-six of these apparatuses were engine companies, and (following the disbandment of the single truck company mentioned above) 18 were truck companies. Unlike the WCFD, the RCFD does have medic units within its department. Twenty-four medic units were included in the RCFD (this includes the two recently added units). In addition to these apparatuses, RCFD also had a number of specialty units including a heavy/specialty rescue vehicle, a hazardous materials vehicle, multiple fire boats, mobile command vehicles, aerial rescue, and others.

The RCFD has approximately a total of 1,700 employed professional firefighters, and no active volunteers. These firefighters work on four different shifts (A, B, C, and D). Firefighters in the RCFD work an eight-day rotating schedule. The

first two shifts in their schedule consist of two ten-hour day shifts (approximately from 6:00AM to 4:00PM), the next two days consist of two fourteen-hour evening/night shifts (approximately from 4:00PM to 6:00AM), and in the remaining four days in a RCFD firefighter's schedule s/he has off. Therefore, every day in this eight-day rotating schedule, a shift change occurs where the firefighters from one shift replace those firefighters from another shift. This rotating schedule is established so firefighters from a specific shift always replace firefighters from another specific shift (**Table 2**).

[Table 2 about Here]

With the large size of the RCFD, the Department's command structure is rather extensive. Overseeing the Department was a Fire Chief who had two assistant chiefs underneath him. One of these chiefs oversaw operations, while the other planning/administration. The Assistant Chief of Operations oversees four shift commanders and the EMS Deputy Chief. The Assistant Chief of Planning and Administration oversees five different support divisions, each headed by its own Deputy Chief: the Fire Academy, Community Risk Reduction (includes the Fire Marshal and the Fire Investigation Bureau), Information Technology Services, Logistics, and Support Services.

At any given point in time, one of the four shift commanders is on-duty and supervising all firefighters currently on-duty. This includes a battalion commander for each of RCFD's five battalions (battalions are distinguished by geographical location). In each battalion there exist a particular number of apparatuses. Each apparatus has a captain that serves as the officer of that fire company operating the

apparatus, which includes the firefighters working that engine on all four shifts. On the three shifts a captain does not work, he has a lieutenant who serves as the commanding officer (three lieutenants in total). For example, if a captain is on-duty for Shift A, one of his/her lieutenants will serve as the commanding officer on Shift B, one on Shift C, and one on Shift D. When active, all engines and trucks have four firefighters on them at any one given point in time. One of these firefighters is the commanding officer (either captain or lieutenant). One is the driver of the apparatus (called a pump operator, or PO, for the engine; called an emergency vehicle driver, or EVD, for the truck), while the other two are simply firefighters working under the commanding officer.

As for the EMS vehicles (ambulances) operated by the RCFD, they are operated by two firefighters. One of these firefighters is trained as a full-fledged paramedic. The other may be trained as a paramedic, or may only be certified to provide basic life support (i.e., is an EMT-B). In this instance, the EMT-B firefighter is there to provide support to the firefighter trained as a paramedic.

Data Collection Procedures

Procedures for the WCFD

While similar methods of data collection were used for both the WCFD and RCFD, the procedures in which these data was collected did slightly differ. The data collection process for WCFD began in November 2008, and continued in January/February 2009. The data collection began as I was put in contact with a battalion chief and captain pair by my WCFD key informant. Once this contact was established, arrangements were made for me to visit Waterville City and observe the

activities which occur on a daily basis at the Fire Department. During this initial observation, I was able to sit down and talk with this aforementioned pair about the WCFD, observe and talk to a number of firefighters working that day, and attend an hour-long monthly shift meeting. The shift meeting also served the function of allowing me to introduce myself to approximately one-third of the WCFD firefighters, and explain the research I was conducting.

This initial observation occurred in November, and I did not start conducting interviews until January. The reason behind this was that during the end of the calendar year, many of the firefighters had accrued overtime and needed to use the vacation time they had accrued by the end of the calendar year (i.e., “use it or lose it”). Thus, a large number of firefighters were taking off during the month of December (the end of the calendar year), which limited the number of interviews that I could conduct at that time, and placed limitations on the number of experienced firefighters who would be available to participate in interviews. In addition, the shifts of individuals who used their vacation time were subsequently covered by firefighters who did not regularly work that specific shift which made it more difficult for the battalion chiefs and captains to know who would be working when, and assist me in setting up interviews. Therefore, the interviews did not begin until after the end of the calendar year.

For some interviews, the firefighters volunteered to sit down with me and participate. These types of interviews were arranged through the shift meeting I attended during my first observation at WCFD, or as I was out at fire stations conducting other interviews. However, the majority of the interviews were arranged

through the Battalion Chief and Captain pair with whom I was in frequent contact. These individuals spoke with certain firefighters who agreed to spend some time during one of their shifts talking with me. The majority of the interviews were arranged by the Battalion Chief and Captain. This arrangement was made at the request of the pair, as they believed it was a more efficient manner in arranging interviews, and allowed for the flexibility needed when dealing with the various emergency and non-emergency tasks that were to be performed during each shift. While most firefighters at the WCFD I interviewed were very willing to participate without hesitation, there were two participants who did have some hesitation about the interview process.

All of the interviews with WCFD firefighters occurred at either one of the six fire stations in Waterville City, or at the main office/administration building. With three of these six fire stations (and the main building) being located in a main downtown area, and the other three just outside this downtown area, on any given day the data collection process could involve a combination of walking and driving between different stations. Thus, by constantly moving between different sections I was able to see a large majority of Waterville City itself. In addition, depending on the station and time of day, these interviews could be conducted at various areas of the fire station – the kitchen area, vehicle bay (i.e., garage where the apparatuses were stored), firefighters' quarters, and/or training rooms.

Each interview was also conducted while the interviewee was working a shift, to the knowledge of WCFD. However, since these individuals were working a shift while interviews were being conducted, this did help facilitate gaining access to the

population. At the same time it did also present a difficulty in that it was hard to schedule an interview in advance. The very nature of the tasks required by the firefighting occupation sometimes made it difficult to schedule interviews. Emergencies faced by firefighters are “dynamic and complex” (Van der Vecht, Dignum, Meyer, and Neef 2008:83), and both fire and non-fire related emergencies could occur without warning. On a handful of occasions the interview I was conducting was delayed or interrupted by an incoming call (which may or may not have needed a response from the interviewee). Therefore, through the very nature of the firefighter occupation, as the interviewer I needed a larger degree of flexibility compared to conducting interviews with other populations. While the WCFD and its firefighters knew which days I would be in Waterville City to attempt to conduct interviews, once I arrived in the City the ability to interview a firefighter truly depended on a variety of variables I simply could not control.

In addition to this initial observation and 20 interviews, I was also able to observe another monthly meeting, and ride along on a non-fire emergency response call in the WCFD utility vehicle. It should be noted that the result of this response call was a fatality due to cardiac problems, and as the utility vehicle I was in approached the scene, it was no longer needed and put back into service (i.e., freed to respond to another emergency call if the situation arose). However, this did allow me the opportunity to observe the procedures used by the two firefighters to navigate and operate a Fire Department vehicle through traffic.

Procedures for the RCFD

Initial data collection for RCFD began in November 2008 with two observations at one of the 39 fire stations. This particular station housed three vehicles (an engine, truck, and medic unit), and was where my key informant for the RCFD was stationed. During each of these observations, I was shown around the station and the apparatuses. These visits also included having dinner with the firefighters at the station. It quickly became apparent that dinner was an important part of the shift for the firefighters in River City. With each fire station having at least four firefighters on every shift (usually more as there tended to be more than one apparatus in a fire station), this served as a time when the firefighters could all sit down and socialize. As all my data collection occurred during RCFD's evening shifts, this was a good method for building a rapport with these firefighters. Thus, whenever I visited a fire station I had not yet been to, sitting down for dinner with the firefighters was something to which I was normally invited. The majority of the meals were spent with local news on in the background, and this stimulated many comments and remarks about local events, sports, and politics. In addition, for every meal that I shared with River City's firefighters, a portion of the meal was spent with the RCFD firefighters discussing my research and answering any questions they may have had.

From February through July 2009 I interviewed 22 individuals at the RCFD. To arrange these interviews, the key informant had put me in contact with various officers (either a captain or lieutenant) of a specific fire company to arrange a time for an interview. It is important to note here that the number of calls the firefighters in River City would respond to was rather high, especially compared to WCFD.

Therefore, even further flexibility was needed when interviewing firefighters at this location. Subsequently, arranging a *time* for an interview was not so much as a specific time per se, but rather an evening that I could come up to a station for an interview. This would tentatively be set before or around dinner, but the specific time an interview was conducted varied depending on the number of calls they would have that evening.

Through the course of my interviews, I visited five different fire stations throughout various neighborhoods within River City (this included the one at which I did my initial observations). Some of these stations were located in areas with high poverty and crime (I did witness an illegal drug activity occurring directly next to a fire station as I was walking on my way to conduct one interview). Others were located in areas with rapid gentrification occurring, and even during devastating economic times they contained small refurbished row homes still selling for \$300,000 and higher. Thus, while only visiting a portion of the stations in River City, there was obvious variation between the neighborhoods and persons each of these houses served. Twenty of the 22 interviews were conducted at fire stations, occurring in different areas of these stations – the vehicle bay, watch room, kitchen, personal quarters, and offices of a commanding officer(s) – depending on with whom and when I was conducting the interview. For the other two interviews, one was conducted at the residence of the interviewee, while the other was conducted at a volunteer fire station in a county bordering River City where the firefighter being interviewed was currently volunteering.

Sample

This research drew two independent samples of firefighters, one from the WCFD and one from the RCFD. While the method used in creating samples for these two different departments was similar, it also differed slightly for each one. This difference existed for two reasons. First, there were structural differences which played a role. For example, department structure, department size, personnel, and city environment all had a hand in determining the exact method used to create each sample. Second, the relationship with the individuals who served as my key informants from each respective department also had a role in determining the sample. For the WCFD, I was put in contact with the key informant via a mutual colleague. Thus, this relationship was new, and was developed within a professional context. However, as for the RCFD, the individual who served as my key respondent was known to me on a personal level, and a relationship here had already been developed.

Sample of WCFD firefighters

Twenty individuals from the WCFD were included in the final sample. This sample included 18 standard firefighters (14 which were also FAOs), a Battalion Chief (also certified as a firefighter), and the Fire Prevention Officer (also certified as a firefighter but does not actively engage in fire suppression – only on rare occasions). The sample was rather homogeneous; however, based on observations and interactions with other WCFD firefighters this appeared to be very representative of the WCFD firefighter population. All 20 firefighters interviewed were white males, with their age ranging from the early 20's through mid/late 50's.

Sample of RCFD firefighters

As for the RCFD, the sample of interviewees included 22 individuals, all certified as firefighters. For eighteen of these firefighters, a regular shift included being on active duty and regularly running calls. Of these 18, three were captains, and three were lieutenants. Two were also certified past basic life support as full-fledged paramedics. The remaining four individuals interviewed consisted of a deputy chief who served as a shift commander, two captains who were current serving as fire investigators with the Fire Investigation Bureau, and an ex-RCFD firefighter (also certified as a paramedic) who recently retired only two months prior to being interviewed. The sample was more heterogeneous than that of the WCFD; however, the majority of individuals interviewed at RCFD were still white males (17 interviewees). The remainder of interviewees included four black males and one black female. One individual interviewed in the late 20's, but the remainder of RCFD interviewees fell in the age range from mid/late 30's to early 60's. These demographics were not specifically representative of the RCFD, but rather only the older, more seasoned firefighters who had numerous years of service in the RCFD and were able to discuss skill change in RCFD over the past 20 years. It should be noted that while the majority of the sample was still Waterville males, the demographics of the younger firefighters in River City were more diverse.

Interview and Questionnaire

It could be argued that to ideally observe the skills used by firefighters in each job-context, and the impact of various technologies at each of these contexts, observations would be a good method of data collection. This method is not

impossible, and has been used successfully to study *wildland* firefighters (albeit ethnographic methods; Desmond 2006, 2007). In fact, perhaps it could be more readily used to study firefighters in two of the four proposed job-contexts: the fire station and non-fire non-emergencies. However, due to the unpredictable nature and danger involved in the remaining two job-contexts (fire emergencies and non-fire emergencies), it is rather difficult to use observations as a primary method of data collection. While some observations were conducted in the present research at both the WCFD and RCFD, interviews were relied upon as the dominant data collection method.

The proposed conceptual model (see **Figure 3**) was used as a guide when constructing the questions contained in the interview questionnaire. However, because the firefighters were being interviewed for specific details on changes in the tasks they need to complete, new and updated tools/technologies that have begun to be used in their job, when these changes occurred, etc., it was sometimes difficult for the individual to recall this precise information. This issue can further be complicated when a firefighter has worked at more than one fire department, or is simultaneously working for either the WCFD or RCFD and a volunteer company (something that was somewhat common for firefighters in the WCFD). Therefore, each interview started with using a version of a life history calendar (LHC) which highlighted the interviewee's career in the fire service. LHCs have been shown as effective tools in helping to increase the ability of an individual to more accurately recall the order of different life events (Axinn, Pearce, and Ghimire 1999; Belli 1998). In the present research, the LHC captured not only the length of time an individual spent in the fire

service by month/year, but also the different lengths of time at specific fire departments, and the different companies they served on while working for each fire department. Once completed, they were able to be used as a reference during the interview by either the interviewee or interviewer. The idea of beginning each interview with a LHC came from the questionnaire pre-testing for this present research (detailed below).

After completing the LHC, a semi-structured questionnaire was used to ask the interviewee questions in regards to skill change and technology (see **Appendix A**). A semi-structured approach was chosen for the interviewee with a specific rationale in mind. This was because that for each firefighter, the specific tasks in which they needed to complete on a regular basis varied both between firefighters and departments. The specific fire department, shift worked, officers, fire station, assigned apparatus, and even the position on the apparatus have potential to play a role in determining the tasks that each individual firefighter needs to complete on a regular basis, and the tools and technologies that they may encounter while performing these tasks. The strength of using a semi-structured format is that it allows for more flexibility when interviewing (Barriball and While 1994), specifically important when accounting for the unique role a firefighter has in his/her respective fire department.

A similar series of questions was asked for each of the four job-contexts detailed. For each context, there were two streams of inquiry used. The first was having the firefighter “walk through” the time spent in each specific job-context. For example, when discussing fire related emergencies, each firefighter was asked to

discuss the actions taken from the time they receive a call at their fire station and responded to this call to the time they had finished suppressing the fire and were pulling the apparatus back into the station. After this was detailed, further questions were asked about the specific tasks completed throughout this process to better understand the specific method of completing the task, the level of autonomy in this context and during specific points of the process, and the manners in which it may (or may not) have changed. A second series of questions was asked in regards to specific technologies that were used in each respective job-context. This allowed more elaboration on exactly how certain technologies were used, when they were introduced to the fire department, the manner(s) in which they altered the performance of specific tasks, and how they impacted the firefighters' set of skills. In addition, per the ALM hypothesis (Autor et al. 2002, 2003a, 2003b) a specific focus was given to the impact of computerization. The interviews ended with a series of questions on an individual's demographics, and training. These questions were not essential to the research questions; however, they helped provide a background context for better understanding each firefighter's individual experiences.

Preparation and pre-testing

Three specific procedures were used in an effort to prepare the semi-structured questionnaire used in this study. First, I read a number of materials to familiarize myself with the different tasks, tools, and technologies used by firefighters. These materials included reading professional trade journals (i.e., *Firehouse* and *NFPA Journal*), reviewing training materials and standards for firefighters, reading websites and firefighter blogs related to the fire service, and

reading books on the specific histories of the WCFD and RCFD. Second, as detailed above I also was able to perform preliminary observations at both the WCFD and RCFD before I began interviewing at each site. This allowed me to better familiarize myself with the locations themselves, and more importantly included time to meet and chat with some of the firefighters at each department.

Pre-testing of the questionnaire was also completed as final step in preparation for the interviews. This was done by interviewing a few firefighters outside of the WCFD and RCFD. The pre-testing resulted in two specific noteworthy (but not major) changes. As mentioned above, the first of these was the introduction of the LHC at the beginning of the interview. The second change was made in that the order in which the firefighter was presented with questions regarding the different job-contexts was altered. It was quickly apparent during the pre-testing that the firefighters would identify most with the fire related emergency job-context (perhaps not too surprising). Initially this context was not the one which the interview first touched upon; however, after making this discovery it was decided it would be best to ask about this context prior to the other three. This measure acted as a mechanism for preventing the interviewee from providing minimal detail on the job-contexts proceeding fire related emergency, as the firefighter would tend to provide shorter answers for other three contexts until this one (fire related emergency) was reached. Once the fire related emergency job-context was discussed, the firefighters tended to provide more detail to the remaining three contexts.

A Final Note on Interviewing

As a final note, it is important to stress that conducting interviews on a sample of individuals who have an unpredictable and sporadic schedule does present some unique considerations. I quickly realized this during the interview process. The most important consideration was that at any given time during an interview, it could be interrupted. The most common method of interruption was for the interviewee having to respond to an emergency call. This was more of an issue when conducting interviews in River City, as the RCFD had a much larger number of calls for which response was required. Thus, a degree of flexibility was needed when interviewing firefighters, and the recognition that an interview could be interrupted without a moments notice. Furthermore, there was no guarantee that an interview would be able to be continued at a later point in time. Luckily, there were only two instances (one in WCFD, one in RCFD) in which I was not able to complete the full interview as it was interrupted by an emergency call.

Aside from these two interviews, all other interviews which were interrupted were able to be completed at a later point in time during the same day/evening shift of the firefighter. In these instances I was able to remain in the fire station and wait for the firefighter to return from a call to complete the interview. As mentioned above, another consideration was that it could be somewhat difficult to actually schedule interviews. For example, a participant may agree to meet me at Fire Station One at 6:30PM; however, there was no guarantee this would be able to happen. In numerous instances emergency calls requiring response would create scheduling conflict. This was not only due to an emergency call being received at the time of the interview (in

this example 6:30PM), but perhaps one occurring at 10:00AM the same day had a domino effect. An early response may have pushed back other scheduled tasks a firefighter needed to complete on his/her shift, and as a result affected the scheduled interview to a point where it was not able to be completed until a later point in time, or even until some other day.

Finally, since all of these firefighters were interviewed during a work shift, during the interview they were still “on the clock.” Although the chiefs, assistant chiefs, and deputy chiefs for both the WCFD and RCFD supported the research being conducted, the firefighters still had many other tasks that all needed to be completed by the firefighter during his/her shift. This was further complicated with issues such as having limited “manpower” (particularly WCFD; term used verbatim by the firefighters I interviewed), and having a larger number of response calls (as with the RCFD). For example, some of these interviews were conducted while a firefighter was on watch (i.e., at the station’s communication center where calls were received), cooking/preparing dinner, or training new firefighters (in a classroom environment). From the researcher’s standpoint, these may result in potential complications and create a non-ideal situation in which to interview; however, they are the reality of conducting research on a population which works in an occupation that may often be unpredictable. Therefore, as the interviewer I had to be as prepared as possible when entering the field for data collection and dealing with these challenges.

Coding

Once completed, all interviews were transcribed so that they could be systematically coded in a manner that would facilitate accurate data analyses. The

coding took place in three stages. First, the specific job-context to which the skill or tool corresponded was identified. Second, the coding of the data was then refined to identify each individual skill and tool/technology that was discussed by the interviewee. Finally, each transcript was again examined, processed, and refined through a third stage of coding. This included coding that identified for each skill or tool/technology any instances of skill dimensions (i.e., substantive complexity or autonomy/control-related) or routinization/non-routinization. Analytical software – ATLAS.ti version 6 – was used for all coding and throughout the data analyses.

Chapter 5: “The Wet Stuff on the Red Stuff” – Fire Related Emergencies

Brief Introduction to the Results Chapters

As stated in the first chapter, two broad research questions were asked regarding the skills used by firefighters in the New Economy and the impact that technology has had on these skills. The first question asked: how have the skills used by firefighters to complete the tasks required by their occupation changed in the New Economy? The second question asked: what has been technology’s role in the change of skill used by firefighters to complete tasks required by their occupation? In order to answer these two questions, past literature was consulted and a three-tiered, integrative conceptual model was created to use as a guide to more thoroughly and systematically answer these questions. The first portion of this model states that in the firefighter occupation, four distinct job-contexts exist. These include fire related emergencies, non-fire related emergencies, the fire station, and non-fire non-emergencies. For each of these job-contexts, the skills that are used to complete required tasks within these contexts each have two dimensions: substantive complexity and autonomy/control-related. These two dimensions are derived from the work of Braverman (1998/1974) and pertain to the level of mental, interpersonal, and manipulative tasks in a job (i.e., substantive complexity; Spenner 1990), and the decision-making, problem-solving, and discretion related actions needed when performing a task (i.e., autonomy/control-related). Finally, the third portion of this conceptual model draws from Autor, Levy, and Murnane’s (2002, 2003a, 2003b)

hypothesis that routinized tasks (i.e., those that follow a rules-based, or IF-THEN-DO logic; Levy and Murnane 2004) and the skills required to perform them have the potential to be replaced by computers or computerized devices. Here, the routinization hypothesis could affect either of the two dimensions which compose of one's skill.

With these two research questions in mind, this three-tiered conceptual model was used to discuss in detail the various skills used by firefighters to perform the task required by their occupation. This was done by examining each individual skill that the firefighters I interviewed claimed was needed to perform the required tasks of their job. Thus, in order to understand each individual skill, first the manner in which each individual skill was performed was detailed. Throughout the process of detailing each skill, the complexity and autonomy/control-related dimensions of this skill were discussed. This included whether or not any change in these dimensions had occurred in recent (i.e., the past 20) years. Finally, any types of new technology that were present and used while performing this skill were also detailed. This discussion included whether or not these technologies impact one's skill according to the logic discussed in Autor et al.'s (ALM) (2002, 2003a, 2003b) hypothesis, but also included any affect these technologies may have had on either of the two skill dimensions. Instances in which skills among the Waterville City Fire Department (WCFD) and River City Fire Department (RCFD) differed will also be discussed. Finally, each skill will be discussed in detail along with other skills used in its corresponding job-context. Thus, collectively these examinations of individual skills will allow for

generalizations to be made regarding the overall change in skill for that particular job-context, and the impact that technology has had on that particular context.

Thus, the remainder of the dissertation will be structured as followed. This present chapter will discuss the skills used by firefighters in the WCFD and RCFD during fire related emergencies following the structure discussed in the preceding paragraph. Following this, three chapters will use a similar structure to examine skills used in the remaining three job-contexts in which firefighters perform their jobs: non-fire related emergencies (**Chapter 6**), the fire station (**Chapter 7**), and non-fire non-emergencies (**Chapter 8**). Finally, **Chapter 9** will draw conclusions from the data and discuss (in a broad sense) the overall skill and skill change of firefighters, and the impact of technology by comparing the findings from each individual results chapter. This will also include relating the findings of this study back to the past body of research literature, discussing the limitations faced when conducting the present research, and also citing broader generalizations and implications for future research to consider.

Introduction to Fire Related Emergencies

Firefighters operated in four different job-contexts, often within the time frame of a single shift. Somewhat surprisingly, out of all four of these contexts, fire related emergencies were where firefighters spent the least amount of time during any given shift. In fact, during one interview with a RCFD captain, he produced his fire company's record book and showed me that over the past few years the amount of fire related emergency calls that firefighters responded to had been steadily decreasing. While the individual history of this particular company cannot make

broad generalizations to the rest of the RCFD, the WCFD, or any other fire departments for that matter, there is national evidence showing that since the late 1970s there has been a steady decrease in the number structure fires in the U.S. (Karter, Jr. 2009). Increasing emphasis on fire prevention; more widespread use of fire prevention technologies such as smoke detectors, alarms, and sprinkler systems; and other safety measures such as increased public education programs and local government mandates were a few issues that were discovered throughout the interviews as playing a role in this trend. Thus, it would appear that these widespread prevention efforts have proven effective in lowering the destruction caused by fires.

With this decreasing trend in mind, there are two items that should be noted. First, although the least amount of time of a firefighter's shift was spent fighting fire, it was the defining characteristic to these firefighters of their occupation. This was rightly so: the skills required to fight fire were something completely unique to this occupation, and they are the defining characteristic of firefighters. Many firefighters I spoke with clearly stated that they *never* wanted a fire to occur in somebody's home. However, if one did occur, they wanted to be one of the persons there attacking the fire, and assisting the residents who needed this help. For almost all firefighters, even with the large number of other non-fire related skills required and tasks to perform, and the number of fires regularly needing to be combated decreasing, the reason they became a firefighter was to fight fires.

The second point that is important to be made clear was that the amount of *time* spent fighting fires was not indicative of the amount of *skill* used. As will be detailed, fighting fires requires a large number of tasks to be performed, each with

their own levels of required substantive complexity and autonomy/control-related skill dimensions. Because every minute it takes a fire department to respond to and begin to suppress fire can lead to increased destruction and injury, the first ten to 15 minutes of firefighting are when the large majority of these skills are being executed. While to the unassuming viewer many of these tasks may appear rather simple, a rather high level of skill is needed to successfully perform them. In this chapter, a number of skills will be detailed. The first skills are those used in preparing for a fire. These include receiving an emergency call, navigating/driving to the scene, and sizing up the fire. The second series of skills are used at the scene of a fire, most of them within the first few minutes of arriving to the scene, and are specific to the particular type of apparatus at which a firefighter is positioned. For those firefighters on an engine, this includes establishing water supply/operating the engine and suppressing the fire with this supply. For those on the fire truck, this includes forced entry, search and research, using/throwing ladders, and ventilation. Another series of skills that are used during a fire scene are more ongoing, revolve around newer technologies, and are needed throughout the firefighting process. These include properly using the personal protective equipment (PPE) and the self-contained breathing apparatus (SCBA) with its integrated personal alert safety system (PASS) device. Finally, a series of skills are needed after the fire has been “knocked down.” These include performing overhaul, salvage, fire inspection, and a final equipment/apparatus check.

Preparing for a Fire Related Emergency

Receiving an emergency call

As with any type of emergency call, the first task of a firefighter when responding to a fire is to receive the location of the fire and prepare to arrive at that location. It generally takes less than one minute for firefighters to perform this task. In fact, the firefighters I interviewed stated they ideally aimed to complete this task within 30 to 45 seconds. Thus, while it might not be the most difficult task to perform, successfully and efficiently executing any task in such a limited time frame is in itself a noteworthy feat. In addition, considering that unsuccessfully completing this task (e.g., receiving the wrong address of the fire, not knowing where) could have adverse effects on subsequent tasks, its successful completion is quite important.

The first aspect of this task important to discuss is the manner in which the firefighters actually received the call. As could be assumed from the media's portrayals of firefighters, an emergency call was initially received by a loud bell, or gong (as it was referred to by the firefighters) going off, reminiscent of a bell that indicates a round of a heavyweight boxing match coming to an end. The gong went off during any emergency call.¹⁴ After spending time in numerous fire stations with these firefighters, it was clear that this bell was loud enough to get every firefighters attention. However, following this gong there were a series of radio tones that indicated the specifics of that individual emergency response such as what type of

¹⁴ Responding to an emergency was a skill that also fell in the non-fire emergency job-context. While the general process was the same, there were some rather minor and subtle differences that did change the process of completing this particular task. The task as detailed in this chapter refers specifically to responding to fire related emergencies. In the next chapter (Chapter 6), responding to non-fire related emergencies will very briefly be touched upon.

emergency call it was, and what fire companies needed to respond. Along with these tones, an announcement from the 911 call center was also provided that gave a brief description of the emergency response.

As I mentioned during the methods section, there were instances in which interviews were interrupted by these emergency responses. However, in addition to my interviews at times being interrupted by these responses there were also numerous times in which an incoming emergency call did not immediately pertain to the interviewee's fire company. Sitting through these instances during the interviews, I was able to experience firsthand the process of a firefighter receiving an incoming call, and discerning whether or not it was related to him/her. As I was sitting down with a firefighter conducting an interview, when the gong went off, the interviewee would quickly pause the interview and enter a fully alert state. This heightened awareness may not only have included a verbal pause, but in some instances it could be seen through the direction of the interviewee's eyes, whether it be a glance upward, or even just a focused stare given right towards me, as though the firefighter was staring right through me. This alertness would remain until the tones began, at which time the firefighter would know even before the call was voiced by the operator if it pertained to him. However, it is important to note here that as I was interested in interviewing more experienced firefighters who could discuss changes throughout the New Economy (i.e., over roughly the past 20 years), this alertness and rapid response could have been something more unique to those with more experience working at their respected fire station.

In total, this process had literally lasted one to five seconds, yet it was extremely surprising to see the amount of skill that these firefighters used to discern if the call pertained to them, and what type of call it was. As far as substantive complexity was concerned, during this situation a firefighter would use their sense of sound to mentally process the incoming call within seconds to such an extent that they knew how to physically respond to the call. In addition, within these few seconds a number of autonomy/control-related aspects were also present, such as making the decision if the call pertained to oneself, deciding what gear is needed to be worn to a specific type of call, and what specific seat one needs to sit on in their respective fire engine or truck. Thus, while these tones dictated precisely what types of incident the firefighter needed to respond, there was still a large number of decision-making and discretion available to the firefighter during the reception of an emergency call.

During the instances in which this call is received, for all firefighters this task involves properly dressing in one's own PPE gear. This specifically involves one's boots, pants, coat, and helmet. In addition, depending on the position in which a firefighter is riding on the apparatus (detailed later this chapter), this may also involve donning the SCBA. In some instances, if firefighters are not properly dressed at the time their apparatus is leaving, this process is finished inside the apparatus.

This skill of receiving an emergency call has long been needed by firefighters, and has not changed over the past 20 years. In completing this task, it is not overtly complex, and there is little room for the firefighters to decide what equipment is needed to be worn. For each fire emergency, the PPE (and potentially SCBA) needs to be immediately equipped before one leaves for the fire. In addition, PPE

technology has not changed in the New Economy to the point where it has affected the method in which this task is performed. New synthetic materials have been used to construct PPE; however, this has yielded no real change in the process of getting equipped and donning the gear needed to respond to and properly address a fire related emergency. Furthermore, although the process of getting dressed is a routinized task, the same manual procedures are needed to get dressed and enter the apparatus to leave for a fire related emergency, and have not been altered by any technological advancement.

The gongs and tones have long been a part of the process of receiving an emergency call for firefighters; long before the New Economy came to fruition. While these components still remain, more recently the alerting systems have changed through computerization. However, worth noting is that these changes have left both the WCFD and RCFD with slightly different methods of responding to an emergency call. For the WCFD, this change occurred during the process of receiving calls and was initially altered through use of more multi-sensory alerting systems. For example, these alerting systems had begun to be integrated with the lighting systems at the fire stations throughout the WCFD. Therefore, when firefighters would be sleeping and they received a call, in addition to the gong and tones that would sound off at the station, a portion of the station's lighting system was automatically activated so that the lights would automatically be turned on to help raise the firefighters from their sleep more quickly.

At the same time, these alarms that would occur during the night had also become more selective. In some fire stations in the WCFD, during the night only

certain calls pertaining to a specific fire company in that station were sounded. Calls that did *not* specifically pertain to an individual fire company were not received. This allowed the firefighters to continue sleeping, and minimized the disruption that occurred to their rest. As I had discovered through the course of my interviews, this increased selectiveness was a product of the broader push towards increasing the safety of those firefighters. As discussed by one firefighter at the WCFD:

Firefighter: When that bell goes off and you come out of a dead sleep, you have adrenaline in your body, fat cells, because your body's thinking it's time to fight, or it's time to run. As long as we go on the call, you burn up that stuff. When you don't go on the call, you don't burn that up. So, it's too early to determine this, but in the fire service I think the average age I saw one time, the length that you're supposed to live as a career fireman is 56 years of age.

Interviewer: Phew!

Firefighter: Because of this, heart attacks and things like that, from years and years and years of getting woke up. Now that these calls are less, that age is creeping back up again. Now it's going to take years to find out if it's really making a difference. But now if Engine Four [**the engine on which the firefighter was stationed**] runs a call, they just hit Engine Four's tone. I don't hear Engine One. No there's also a tone in town that they hit that opens everybody up at the same time, even though...but that's for like a big fire or a serious emergency that everybody needs to hear it anyway. (*Author's notation in brackets*)

Here the WCFD firefighter was discussing some recent research reports on firefighters, and how the results had begun to be integrated in an attempt to minimize the physiological effects that can occur to a firefighter's body through the constant adrenaline rush that occurs when receiving a call; effects that may be particularly emphasized when sleeping.

This initial portion of the process of receiving an emergency call was routine. For each individual call, the firefighters had to hear the gong/tones, process the information it provided, and then respond accordingly. With the increased selectivity

reported, these skills were not removed; however, the amount that they were used was minimized as the sheer number of incoming calls requiring response was decreased. Thus, this change in the alerting system at the WCFD did remove some elements of the skill required responding to an emergency call, particularly those autonomy/control-related elements in which a firefighter had to initially decide if s/he was required to respond to an emergency. It should be noted that while the selectivity of incoming calls was more widespread through the WCFD firehouses, the computerized, multi-sensory changes in the alerting systems were not uniform. While this technological change existed in some fire stations, others appeared to have not yet received this technology, and subsequently this change did not affect the skills used by all firefighters in responding to an emergency call.

In the RCFD, over the past 20 years computers and printers had been introduced and connected to the alerting system. In fire stations in River City, the alerting system was connected to printers. When the gong went off and an emergency call was sent to a fire station, printers that were connected to the system would ideally activate and generate two types of documentation. The first was a sheet of paper which contained a map detailing the location of an incident, the roads surrounding it, and the closest fire hydrant locations. This print out had an effect on driving and navigating to the actual fire and will be discussed below. However, the second sheet of paper which was also printed out for an incident contained information regarding the location of the incident (e.g., the number of times the RCFD has been called to this particular building/residence). In regards to these particular sheets of information, no aspects of the skill has been taken away from the firefighters, but rather additional

information can now instantaneously be given to the firefighter for him/her to process. Whether or not this additional information is used specifically to aide in the performance of responding to an emergency call is another story. Therefore, this could arguably be viewed as increasing the complexity involved in the process of receiving a call, while at the same time its affect on skill could also be argued as somewhat negligible.

Navigating and driving to the scene

Immediately following the reception of an emergency call and preparing to leave for the scene of a fire, firefighters are then faced with the task of navigating and driving to the scene of the incident. This task is clearly the responsibility of the drivers of the fire engines and trucks; however, through the course of my interviews and time spent around the fire stations, it became clear that both the officers (battalion chiefs, captains, and lieutenants) and (in some instances) firefighters not certified as drivers are also involved in successfully completing this task.

As part of the preparation for leaving, the driver of the apparatus first needs the information on the location of the incident. This information is provided by the 911 center on an incoming call at both fire departments. However, as noted above the alerting system technologies at the RCFD have changed, and subsequently also altered the method in which the drivers (pump operators [POs] and emergency vehicle drivers [EVDs]) obtain the information used in navigation. When I asked one River City firefighter about how the task of navigating and driving to an emergency has changed, I was given a rather good summary of the impact of computers on this task and how this seemingly routinized process can be somewhat complicated.

Firefighter: It has in the computers and printers. They, um, give us maps, but they're all broken. They run out of money and they didn't get it fixed and we're back to, you know?

Interviewer: The same way you used to do it?

Firefighter: We went for year here, *years here*, without having any printers. And now we got these computers in here. That's phenomenal. I mean, there was appoint where I thought I was...keeping up with technology and now I feel like I'm getting older, it's getting past me. You know?

Interviewer: [Laughs]

Firefighter: But we have this computers (sic) on there now and I think it's great. It's phenomenal. For me, it tells me where we're going and then I can really read about, you know, how many times this person's called and really get into some dirt and stuff like that. And there's maps (sic) there, electronic maps and stuff like that. But yet also in my opinion it's made a lot of us lazy too, where guys used to study maps. Like look [**points to a wall near the alerting system computer**], there's a map of our first alarm district right there. So it's a dual-edged sword where everybody's kind of depending on the printers and maps to tell you where you're going and not remembering, you know?

Interviewer: Yeah.

Firefighter: Especially if like what if you're not in quarters, and you're out on the street and you get a run? Well, you're not here to pick up a printed out map!
(Author's notation in brackets; firefighter's emphasis italicized)

This discussion by the firefighter provides a good description of the effects computers have had on navigating to the scene of an emergency. Following the routinization hypothesis, it would be expected that the routinized aspects of the skill required to navigate a fire apparatus to the scene of a fire are beginning to be removed by the installation of these computers and the accompanying printers. The roads and streets of the City create a fairly standardized grid in which the driver of an apparatus can navigate along to arrive at the fire.¹⁵ Therefore, there is an indication that the

¹⁵ In an interview with one WCFD, there was actually an interesting insight made that was relevant to the notion of roads and thoroughways in Waterville City and River City creating a routinized grid. This firefighter stated that as Waterville City is an historic city, there is relatively little room to expand by

introduction of these computers and printed out maps of the incident location and surrounding fire hydrant locations has begun to remove some skill needed for navigation. In this above example, the RCFD firefighter recognizes this not necessarily as a removal of navigation skills, but rather an increase in “laziness.”

In addition to the effects of these computers in the fire station, just a few months prior to when I began conducting interviews at the RCFD, computers were also placed in the fire engines and trucks to help firefighters with navigation. Prior to conducting any of my interviews, I was aware of the introduction of these computers. This was through a series of television advertisements for a local university which boasted their geography department’s role in the introduction of these computers to the RCFD’s apparatuses, and how it was improving the jobs of the firefighters at the RCFD. With this advertisement in mind, I came in expecting these computers within the apparatus to have a noticeable impact on navigating to the scene. However, I was surprised during the course of my interviews that when these computers were mentioned, it was only in passing. I would be told that they did exist, but generally the firefighters claimed that they were not often used by the drivers. The reason for this non-use was less clear. In a few instances the firefighters at River City who mentioned these vehicle computers stated that they had not yet been trained on these computers, and therefore without this training these devices were not used in a manner that had a real impact on successfully navigating to a fire. Thus, from my

creating new roadways, with the exception of one area in town in which is continuing to be developed). Thus, this minimizes the amount of new roads needed to be learned by drivers, and maintains the routinization that may be available in this aspect of navigating to the scene. As River City is also a very historic city, the same logic could arguably be applied for the RCFD. Although this interviewee’s data provides support for this argument, he was the only one to mention the lack of expansion of roadways within each city.

interviews I was not able to draw any real conclusions on the impact of these computers. However, it could be argued that based on the general pattern found between the fire station alerting system computer and its impact on navigating to the fire scene, there is a *potential* for these computers in the fire engines/trucks to have a similar effect on firefighters' skills. Albeit this effect it had yet to be realized, and subsequently no current impact on the skills used by these firefighters was felt.

An important point that was also raised by the River City firefighters was that although these printout maps existed, their availability also was dependent on whether or not these technologies were functioning properly. There was always a possibility for these computers to malfunction. During these instances, the routinized skills that were beginning to decrease due to the introduction of these computers were again needed. Furthermore, these printout maps were only available to the firefighters if they received the call at the fire station. During instances when they were elsewhere, for example at an elementary school participating in a public education lesson, they are not able to rely on these maps that were available to them at the fire station.¹⁶ In sum, although these computers could be seen as decreasing the amount of skill which was needed to navigate to an emergency, in certain instances (such as during a computer malfunction or when being called for an emergency when not stationed at a company's respective fire station) the same skills that technology had decreased were actually again needed. While the potential for change in skill was present, the drastic impact had truly not yet been realized

¹⁶ Due to the introduction of computers to the apparatuses used by the RCFD, there is a potential for the manners in which the maps are received to change. For example, these maps may eventually be able to be received to firefighters when they are on their apparatus and not at the fire station. However, the interviews did not provide any clear evidence that this type of change has occurred, or that there has been any effect on a firefighter's skill due to these computers contained in the apparatuses.

While the RCFD had some aspects of their skill used in navigating to the scene of a fire altered by the introduction of computers, there were also non-routinized aspects that affected those firefighters responsible for navigation at both departments. As noted by one firefighter from Waterville City:

“So the driver’s responsibility is to know where he’s going, what’s going to be the safest route of travel. Based on the time of day it could vary depending on whether or not it’s rush hour, whether or not there’s, you know, a possible train, things of that nature. The route of travel is the driver’s responsibility. And basically you have to make sure everybody in the apparatus is seated, belted in, ready to move the apparatus safely.”

While the local roads and streets dictated certain pathways which the driver of an engine or truck could navigate to the scene, other factors must be accounted for such as the time of day, potential traffic patterns, railroads, one-way streets, roadwork/construction, road closures, and even the location of fire hydrants.

Therefore, a certain localized knowledge was required here by those firefighters responsible for navigating to the scene of a fire. This knowledge had the potential to change day-to-day, or even hour-to-hour, and included a number of decisions that had to be made by the firefighters with which computers could not assist.

In addition to these non-routinized concerns that required a considerable level of autonomy/control-related skills, the order assigned to an engine or truck also played a role in navigating to the scene:

“As you approach the scene it makes a big difference in what you’re driving and what order you’re arriving in vehicle-wise. Try to think of your approach and what the best way is, whether you’re first-in engine and you’re going to have to pump and supply the attack lines for the engine for the fire, or whether you’re second-in engine and have to find a fire hydrant to pick up or the ladder truck when you’re trying to think about your job as you’re pulling in and trying to figure out if you can use the ladder on top, the aerial ladder, or are you going to have to be throwing ground ladders. Um, so you sort of have to be; as you approach the scene have to figure out the game plan

in your head. And that normally depends on whoever the driver is talking to, whoever (sic) the other person on whatever vehicle it is (sic).” (*WCFD firefighter*)

With multiple vehicles reporting to the scene of a fire, and multiple tasks that need to be completed to successfully and safely suppress the fire, an increased level of substantive complexity and autonomy/control-related skill dimensions are introduced in the final stage of navigating to a scene. These drivers need to know exactly what order his/her apparatus is assigned, and subsequently where his/her vehicle is to be positioned at the scene. Furthermore, the precise structure needs to be considered at this stage. For example, even if the a vehicle is to be positioned in front of the working fire, the positioning of apparatuses around a single family home on a five acre tract of land may be different than that of a middle row home with three other residences connected on each side. Finally, as there are multiple vehicles responding to the same incident, this also creates a need for caution as multiple vehicles are approaching the same incident at high speeds. Thus, even with the precise route dictated by the print out map, the drivers also may have to alter this route to allow for all responding engines and trucks to properly reach the positions they will be taking to help suppress the fire. This not only requires judgment on the individual driver’s part, but also communication with other apparatus drivers of the decisions being made by each one.

In addition to navigation, the task of driving in itself also required additional skills needed by the firefighters. Obviously, this entailed knowing how to drive the vehicle itself. In fact, formal training and certification was required at both fire departments in order for a firefighter to be allowed to drive an apparatus. Thus, this particular task and accompanying skills were not possessed by every firefighter. At

the same time, this also did not imply that other firefighters did not assist the driver while s/he was driving. If a firefighter was riding in the front passenger's seat, they could assist the driver with watching for traffic and communicating with other responding vehicles; basically serving as an extra pair of eyes and ears for the driver.

Upon initial examination, one might often consider the ability to drive a vehicle as a rather standard skill that a large majority of persons in the U.S. possess. However, it was extremely clear that operating a fire engine/truck while speeding to a fire requires a higher level of skill than is generally needed to operate a standard automobile. Many factors play a role in increasing the level of both complexity and autonomy/control-related aspects that are part of driving. While interviewing these firefighters, the most stunning detail about this task was to hear about the discretion that firefighters need when driving to an incident. As many firefighters at both departments discussed, when a structure is on fire, every minute matters. However, safety is also an important issue not only for the firefighter's themselves, but also for the regular citizens. A driver must be able to successfully balance the urgency of the emergency call and the safety of themselves and others. For example, an emergency response call that is due to a smoke alarm sounding and only has the potential of fire may not require the amount of speed that a response call involving flames showing out of a second-story window needs. Again, there is certainly much more skill needed than operating a normal vehicle.

Although technology has not had as major an impact on driving as it has on navigation, it has never-the-less changed the driver's skills. Older fire engines and trucks were operated by manually shifting gears; however, the newer vehicles that

have been purchased by the fire departments now automatically shift gears. While this is not a computerized technology, it still follows the logic stated in the routinization hypothesis. These new automatic engines have been able to remove the routine procedures needed to shift gears. For most firefighters who serve as drivers, this is no longer a skill that is needed. As jokingly stated by one of the captains from the RCFD, the drivers can now “just put it in dumb and go;” a statement is a wordplay on the “D” that automatic vehicles have which signifies “drive,” while also recognizing how technology has removed this skill from the drivers. Lastly, it is important to note that this change did not happen uniformly across all fire companies. Specific companies may have gotten automatic apparatuses before others. For example, in the RCFD it appeared that these new automatic vehicles were given to firefighters in the early 1990s; however, two firefighters in the WCFD serving on one specific fire company stated that it was not until recently that their manually operated fire truck was replaced by an automatic. Furthermore, this manually operated truck was still “on reserve” in the department (i.e., it is not used on a daily basis by the WCFD firefighters, but still present if it is ever needed).

Throughout the interviews, there was quite a high level of substantive complexity and autonomy/control-related aspects of skill involved in the successful completion of navigating to a fire related emergency and driving a fire apparatus. In fact, the levels of involvement of both these skill dimensions are arguably quite surprising compared to what the lay observer might expect. At the same time, the introduction of both computerized (i.e., computers accompanying the alerting systems) and other (i.e., automatically shifting apparatuses) technologies appear

consistent with Autor et al.'s (2002, 2003a, 2003b) routinization hypothesis in that some of the routinized procedures in successfully navigating and driving to a fire are being removed. This decrease in skill particularly affects the complexity of navigation and driving, as much of the discretion and decision-making dimensions of these particular skills are involved in the non-routinized aspects of this skill. At the same time, other factors such as the malfunction of technology also pose the need for these original routinized components of skill to remain, even if they are not used regularly.

Giving a size up

Upon arriving at the scene, as dictated by the standard operating guidelines of both departments, the final task needed to be completed by the firefighters prior to physically fighting the fire is giving a size up. As there are numerous fire companies responding to any one incident, the company that first arrives at the scene is charged with giving a brief description over the radio to the remainder of the incoming fire companies:

“In my opinion, and with most people, the proper size up would consist of three elements. Number one, your occupancy. Number two, your obvious fire conditions. And then number three, what are you going to do? What’s your move? And to just simplify things, what’s the building? Do you have a dwelling? Do you have a commercial structure? Do you have a warehouse? What do you have? As far as obvious fire conditions, there’s only three. You can only have fire, smoke, or nothing. Just make it simple. You don’t have to give it a really heavy description. And then the following, what you’re going to do, you only have three choices. Are you going to investigate because you have nothing going on? Are you going to try and make a really quick interior attack? And that would (sic); that’s being more offensive. Or are you going to roll back and say this is really out of our capabilities and we’re going to back up and pretty much be defensive.” *(RCFD firefighter)*

The task of giving a proper size up is not overly complex, and as the above quotation shows a very increased complexity may not be ideal. In fact, giving a concise size up

is believed by most to be adequate in providing the necessary information that the firefighters need to quickly begin fighting the fire when arriving at the scene.

Although both the WCFD and RCFD may have a departmental mandate stating that a proper size up needs to be given, the interviews revealed that not all firefighters thought as systematically about the “proper” information that should be given. In certain instances, it appeared that firefighters gave rather minimal detail:

“When we get to the scene, if we’re the first on the scene, we will give a status report as we pull up. You know, ‘Utility three is on the scene, side alpha,’ which is the front. ‘I have heavy fire on the second floor,’ things like that. And you might tell a hydro **[hydrant]** location to the first-in engine so they know what to expect.” (*WCFD firefighter; author’s notation in brackets*)

Others gave more description and detail during the size up:

“Once we arrive on the scene, I give a brief initial report. Say...we go for a house fire. If I got fire showing, what floor, what side of the building we’re on, what floor’s the smoke and fire showing from, things of that nature. Uh, just to paint a picture for the oncoming units and the Battalion Commander.” (*WCFD firefighter*)

Thus, although this task may not be extremely complex, the amount of detail that is given in a size up is to some extent dependent on the firefighter’s own discretion.

Thus, the autonomy/control-related aspects of completing this task appear to be more apparent than those related to complexity, even if certain firefighters did not view the task in this manner. Finally, in regards to technology, no true changes occurred to the firefighters’ skills regarding giving a proper size up.

At the Scene of a Fire: Engine Companies

After receiving a call, navigating and driving the apparatus to the fire, and giving a proper size up, firefighters next begin a series of skills specific to their type of apparatus. Many of these skills occur simultaneously at very high-paced speeds. In

fact, one firefighter from River City even stated that an outsider viewing the first ten minutes of the scene would interpret it as complete chaos occurring with firefighters running around in all different directions. However, upon talking with the firefighters about their specific duties, it becomes clear that each firefighter at a scene has specific tasks that need to be completed if the emergency is to be properly handled. These tasks are predetermined not only by the type of apparatus to which a firefighter is assigned, but also to the specific position on that apparatus that the firefighter is serving. Those firefighters serving on fire engine companies have two main tasks that need to be performed: supplying water/operating the engine and suppressing the fire.

Supplying water/operating the engine

The first task that an engine company must perform is to actually supply water that can be used to suppress the fire. While not all engines are the same – there are different makes and models which have slightly different features – they all provide water to a fire in a similar manner. To quickly describe how an engine functions, it should be noted that on each engine there are large (up to five inch) hose lines called supply lines. These supply lines are able to be connected to a fire hydrant and carry water from this hydrant to the fire engine. In addition, each engine also has hoses that are called attack lines. These attack lines are smaller in diameter (e.g., one and a half/two inches) and are used to spray water onto the fire. Unlike the supply line that connects to any one engine, more than one attack line can be simultaneously used by firefighters to suppress fire. Thus, the water enters a fire engine via a supply line, and the engine itself serves as a pump to build and regulate pressure needed to adequately use the attack lines to suppress the fire. Thus, while each engine has a single driver

who operates the engine itself, all firefighters in the engine company work on some extension of the apparatus.

In order to establish a fully operational water supply, the first portion of the task involves finding a working fire hydrant. While each engine itself carries approximately five hundred gallons of water, this amount of water is not enough to successfully suppress a working structure fire. Therefore, this external water supply is needed. Connecting the engine to a hydrant involves a firefighter serving as the lead-off and is charged with manually connecting the supply line to the fire hydrant and turning on the water, as detailed in an interview by a RCFD fire captain:

“And then I have somebody who is supposed to lead off from the hydrant, and that would be getting the water supply. When we pull up to the corner, one of us will yell to ‘em which side it’s on, whether it’s on my side or the driver’s side. And then he would get off. He had to go back and he has to un-strap a connection that goes into a large fitting on the hydrant. Take a quick look inside of it to make sure there’s not any debris or bottles or anything in there that’s going to clog up our hose. Then he takes and there’s a swivel connection on the hydrant valve itself. And there’s little handles that he can grab with his hand and basically screw the thing onto the hydrant. Um, at the same time we are traveling to the fire. So the hose which has been laid onto the back is just flipping off.”

This quote describes the procedures needed to be completed by the lead-off firefighter. The levels of each skill dimension needed are not at an extremely high level regarding the establishment of this water supply. In fact, the completion of this initial task leaves little room for decision-making or other autonomy/control-related aspects – each fire hydrant has a particular manner in which the supply line is to be connected. In regards to complexity, while it appears that only basic physical actions are required, the need to perform this task quickly and correctly does add a subtle level of complexity to connecting the supply line to the hydrant.

Although the use of fire hydrants and supply lines has existed for a long period of time, these tools had been recently changed. The first change was that the diameter of supply lines has increased to five inches which allowed for the flow of more water to the fire engine. However, in regards to any changes to the actual task of supplying water to the engine from the hydrant, there appeared to be little actual change in the amount of skill that was used. However, while the majority of firefighters who operated an engine discussed the lack of change to this portion of water supply, there was one firefighter I interviewed who did discuss the shift to sexless couplings used to attach the fire hose supply lines to the fire hydrant. According to this firefighter they were much easier to establish this connection, and did remove some of the pure physical strength needed to perform this task. Although this one firefighter discussed these sexless couplings, it did not appear that these were prevalent throughout either River or Waterville City based on the remainder of the interviews I conducted.

With the supply line/fire hydrant connection established, the next portion of successfully establishing the water supply is to attach the remaining end of the supply line to the fire engine itself. Each engine has a certain length of supply line; however, the amount of this supply line that is used is dependent upon the distance between the fire hydrant and the fire engine:

“Once we stop in front of the building, we pretty much have two choices. We do have something called a hose clamp. That is on the back step of the engine, and we can clamp off that hose so that nothing can get past the other side of the clamp. Or, if the driver’s pretty quick, he can go ahead and pull the hose off to the next coupling section, undo it, bring it over to the intake of the pumps and hook that up really quick so that we do not put water in all of the hose.” (*RCFD firefighter*)

Thus, it is the driver's responsibility to make this connection. While it requires the same basic procedures used in establishing the hydrant/supply line connection, in this instance the driver needs to exert more discretion as in the supply line/engine connection there is the added factor of water flowing through the supply line; something that is not faced by the firefighter establishing the former connection.

While both fire departments established a water supply in a similar manner, there was one subtle difference between the two. At the WCFD, it was often solely the decision of the driver/pump operator to decide what size supply line was to be used to establish the water supply. This discretion was needed by the driver simply because it was the driver and one additional firefighter that were the only personnel aboard the fire engine. There was no officer (i.e., captain or battalion chief) to provide input as to how one should make this decision. However, at the RCFD there was an officer (i.e., lieutenant or captain) aboard the fire engine that would also provide input in this decision. This did not imply that the decision-making was completely removed from the driver, but rather it was a decision that was made collectively between the commanding officer and the driver.

The final portion of establishing a water supply was actually operating the engine. After analyzing data for the numerous tasks required of the firefighters in the fire related emergency job-context, the task of operating the engine was the one that had changed the most in the New Economy. This change affected both the complexity and autonomy/control-related aspects related to the completion of this task, and was directly the result of the computerization of the fire engine. This recognition was quite apparent only after completing a handful of interviews, and the remaining

interviews only further verified this finding during the course of my data analyses. In the past, fire engines were manually operated and required quite a bit of skill to successfully supply the proper amount of water to the attack lines so that the fire could successfully be attacked. The skill required here was somewhat a more complex process on these manually operated engines:

“The old way, up to not that long ago, maybe five years ago to four years ago, you actually had to physically open each valve. You controlled the engine, controlled the speed, you controlled the friction, you knew what you had to set each valve at, each gauge at.” (*WCFD firefighter*)

As this firefighter describes, the drivers who operated the engines had to manually adjust multiple valves that governed various pressures. However, the simple changing of knobs was not all that was required to operate the engines. As another WCFD firefighter states, firefighters controlling the pump on the engine also had to use his/her eyes and ears in addition to physical adjustment of various valves:

Firefighter: That was pretty much a basic, basic fire engine where you pull a lever and you had to keep an eye on the gauge and it was the old; I call it the old school where you have like your incoming line, your supply line, you like kind of lean against it. Or you put your foot on it. And if you start to feel that thing go limp that means you're dragging. You're trying to pull more water than the supply. So you had to learn to start the gauge and back, throttling back. That kind of thing.

Interviewer: So it's a lot more manual?

Firefighter: Yeah, yeah, manual. You had to keep your eyes and ears open particularly, listen to the pump and listen to the radio.

In addition to feeling and listening to the pumps, there was also a large amount of mental complexity involved. The proper pressures used had to be calculated by the firefighter so that the gauges could be properly set. Variables such as the length of hose, the diameter of the hose, the number of attack lines being used, the size and nature of the fire, and even the particular individual who was operating

the attack line all played a role in calculating the proper pressure to effectively supply water via the fire engine. Thus, these manually operated pumps on the fire engines truly required the integration of mental and manipulative tasks. However, there was also a clear decision-making aspect to this task. In each situation the individual operating the pump on the fire engine was also able to use some discretion as to how much pressure is established:

“You have to calculate, understand where to pump the line, what pressure to put in the line. That’s basically a benchmark, but depending on who’s on the line you can adjust it a little bit. If we, the two guys on the van [**utility vehicle**], the firefighters that will probably be going in the fire, they’re pretty big guys and if the fire’s really rocking pretty good I might give them a little bit more, so they have more water and more punch to get in there a little further. Where if it’s two little guys I might back it off a little bit from the benchmark. Still gives ‘em plenty of water to do their job, but they’re efficient enough that it’s done better because they’re not struggling moving the line, or having too much pressure.” (*WCFD firefighter; author’s notation in brackets*)

These manually operated pumps on the fire engines clearly required a large amount of skill to successfully operate. However, during the New Economy both the WCFD and RCFD began to see a shift from using manually operated pumps to using computer-controlled pumps. While both departments had switched over to computer-governed pumps, the RCFD had these types of pumps for sometime (according to the interviews, my best judgment was for about ten years), while the WCFD was still in the process of completely shifting over to computer-controlled pumps. According to one firefighter from Waterville City, “four out of five” engines were governed by computers – one was still manually governed.

The portion of this task that was computerized was the process of initially and continually adjusting the gauges so that the correct pressures were provided. Thus, with the introduction of these computerized pumps to the engine, the procedures used

in operating the pump on the engine was able to basically be removed from the skills used by the firefighters. Again, this decrease occurred in line with the ALM hypothesis in that the mathematics and physics behind supplying the pressure to the attack lines were standard, and although prior to this the firefighters operating the pump could make some adjustment that was arguably outside of this routinized procedure, the computerized equipment still was able to be used in a manner that could remove this skill from the firefighters. Important to note is that this decrease occurred along the lines of both substantive complexity and autonomy/control-related dimensions. A firefighter from the WCFD details this:

“Now these things do it themselves. Like the engine will increase in RPM [**rotations per minute**], decrease all by itself. You’re standing there listening to it and it’s adjusting and sending water where it needs to go. You still have to activate the valve, but once that’s activated the pressure governor, it’s called, controls the pressure in each line so if we’re flowing two lines at once, and somebody shuts one line down it’ll reduce the pressure in this one over here so that this guy ain’t getting everything.”
(Author’s notation in brackets)

Not only are the computerized pumps able to govern pressure, they can also account for the use of a different number of lines being used. Thus, the introduction of computers to the task of operating an engine to supply water clearly had a decrease in skill for all firefighters certified able to operate the apparatus, noticeable enough that more than one firefighter even made the classic comparison that it was so easy a “monkey could do it.”

Suppressing the fire

With the water supply established and the engine pumping the attack lines with water, additional firefighters at the scene are charged with the task of spraying the water on the fire and suppressing it. Thus, the firefighters actually performing this

duty must first find the fire. While interviewing the respondents, one point that was made explicitly clear by the firefighters was the actual difficulty itself in finding the fire. When they would enter a structure that was on fire, the smoke filled environment prevented them from seeing more than inches in front of their face. Therefore, they also had to depend on their other senses in order to find the fire. This meant that the firefighters had to use their sense of feel to push towards the heat until they could finally see the orange glow created by the fire. When discussing the result of a fire in a structure, the interviewees made clear that it was not simply that you walk right in and can see the fire, but rather it required a use of one's senses to locate it. One firefighter from the RCFD even went so far as to discuss at some length how eerie this process was, and how at a basic human instinct level, it is an extremely unnatural feeling for a human being to push forward blindly in a smoke filled, toxic environment towards an overwhelming sort of heat that one knows has the potential to be a deadly.

Once the fire was located, one firefighter working the attack lines was able to turn on the water and begin to spray the fire. Fundamentally this was a rather physical task. Here a firefighter's adrenaline has been pumping at an extremely high level. While using the hose, it is quite a physical task to establish control of the hose with the amount of pressure that the engine is pumping through the attack line. A firefighter must be able to simultaneously control the hose itself through the use of physical strength while being able to spray the fire in certain patterns. These patterns are important to ensure that the suppression is effective. In addition to the control of the hose and the patterns that is needed for a specific type of fire, the firefighters also

have to balance this attack with consideration of the safety of him/herself and the other firefighters inside the structure:

“It doesn’t seem like a lot. It seems like dumb firemen go in and put water on the fire and it’s game over. It’s much more than that. Um, how we use our water. What type of stream we use on the fire. If we extinguish the wrong part first could determine if we get burned, if somebody else gets burned.” (*RCFD firefighter*)

Thus, the level of complexity involving the performance of interpersonal and manipulation is at a much higher level than the sheer physical strength and control needed to simply hold and turn on a hose.

In regards to the level of autonomy/control-related aspects needed by firefighters to perform this task, seniority played an important role. As most new firefighters came into the department without the formal training to operate a pump, they tended to be the firefighter on the attack line (referred to as the pipe man in the RCFD). However, as these firefighters were still rather inexperienced, they were seen as lacking the knowledge needed to effectively make decisions regarding the proper extinguishment of a fire, and were given direct supervision when suppressing the fire with an attack line. For example, one senior firefighter who sometimes served as an officer discussed a younger firefighter who recently joined his company:

“Firefighting, especially when you’re new like him, his vision is very narrow. All his job is to have the pipe, go through as much shit as he can as quick as he can to find the fire. That’s all he knows. He will learn over time that there’s a lot of things to look for. You know when we pull up we have to figure out what color smoke; what the smoke’s doing. Where the fire is, where the fire could be. If there’s people trapped, where are they, how we (sic) getting there.” (*RCFD firefighter*)

In these instances with a younger firefighter, their officer would be suppressing the fire along side with them as to ensure they are properly working the hose and doing so in a manner that is safe for him/her and the remainder of the firefighters inside the

building. In the case of the RCFD, the officer of a fire engine would physically be going into the building with the firefighter manning the attack line to assist with extinguishing the fire. As each engine always had some firefighter serving as the officer, there was always an individual on the attack line with the rookie firefighter guiding them through the process. In the case of the WCFD, in most real working fires, the individual on the attack line also had their captain stationed on the inside of the building and providing similar guidance. However, since there was only one captain per shift at the WCFD, there was not a one-to-one ratio such as in the RCFD. Because of this it could be argued that there may have been a higher ability for rookies in the WCFD to possess these autonomy/control-related aspects compared to those firefighters in the RCFD.

A reoccurring theme that about two-thirds of my interviewees mentioned was that when fighting fire, you really learn by doing. The more fires a firefighter responds to, the more experience they gain. The more experience they gain, the more they are able to develop the autonomy/control-related skill aspects of fighting fire. Therefore, when more senior firefighters worked using the attack lines, the officers may have still been in this supervisory position. However, the dynamic shifted some and allowed for the firefighter him/herself the ability to use more discretion concerning using the attack lines. This notion was made quite clear during the interviews and reaffirmed in the data analyses. However, during the course of my analyses, another pattern emerged among the senior RCFD firefighters I had interviewed. When discussing this shifting autonomy between the officer and firefighter working the attack line, it also appeared that the history of these

firefighters also played a role in allowing more discretion to the firefighter while performing this task. Firefighters who had served on the same engine company for a number of years appeared to develop a high level of trust among one another. Perhaps this is not surprising given the risk inherently involved in the firefighting occupation; however, it allowed for this relationship to shift from more of a supervisor/supervisee dynamic to a peer/peer dynamic. Therefore, while the amount of experience was a critical factor for both firefighters from Waterville and River City in regards to suppressing fire, those interviews of RCFD firefighters also revealed that the development of this trust and peer/peer relationship also played an important role in the shifting autonomy of suppressing a fire.

A few firefighters stated that over the course of the past twenty years that fighting fire was still “putting the wet stuff on the red stuff.” Throughout the course of my interviews, this appeared to hold true for the majority of cases. However, there were a few instances where firefighters did discuss some change in the task of suppressing the fire with water. One of these changes was spawned by technology,¹⁷ and did not really have a real impact on the skills involved in this task. However, the recent increase in practices to increase the safety of firefighters while in the fire related emergency job-context did have some potential to change these skills, even if

¹⁷ There were actually two technologies that were discussed by a few firefighters during the course of my interviews as having an affect on the suppression of fire; however, the analyses showed that only one of them appeared to have any real impact on the skills used by firefighters. This second technology was the use of foam systems. Basically, foam is a substance which can be added to a water supply to potentially create a liquid material more effective than standard water to help extinguish fire. The use of foam would most likely add skills needed to both supplying water/operating and engine and suppressing the fire. However, the use of foam was only mentioned by approximately one-quarter of the interviews in the WCFD and only one interview in the RCFD. In addition to the low number of firefighters interviewed who discussed foam, those that did discuss this technology also stated that it was rarely (if ever, in the case of the RCFD firefighter) used to suppress fire. Therefore, there was not enough strong evidence that this technology was having a real impact on the firefighter’s skills and it was subsequently not included in the results regarding the fire related emergency job-context.

not yet fully realized. The first technology that came into play over the past twenty years in regards to working the attack lines were different types of nozzles:

“In my career there’s been what’s called automatic nozzles. In other words, these nozzles from the same diameter hose can flow much more gallons per minute, of water, with using the same delivery device; the same hoses. And depending on what the pressure’s set at is how many gallons per minute you get out of the hose. And it put more control of the fireman on the end of the line because if somebody got the pressure jacked way up on the old hoses you could hardly hold onto it. You had to really back it off, and when you backed it off you were losing your gallons per minute which could be dangerous for you. Now you can back it off and still have above what the old lines would be at their maximum... There’s nothing automatic about them as far as electronic or motors moving. It’s still all manual stuff; it’s just that having that valve inside that allows more water to pass through.” (*WCFD firefighter*)

As clearly stated by this firefighter, improved nozzles did not specifically change the method used while actually using a hose. However, what it did do was decrease the pure physical strength required to operate an attack hose through a more efficient design of the nozzle.

In the past ten years, there had also been an increasing push to improve the safety of firefighters while completing their tasks at the fire related emergency job-context. This reoccurring theme arose in different manners throughout the course of my interviews. While this safety push was occurring, it specifically meant two potential changes to the skills used of suppressing a fire. First, in the past ten years national guidelines have begun to set a standard that state for each working fire incident there must be a rapid intervention team (referred to as a RIT team) stationed at the scene. The responsibility of RIT teams is to stand by a fire in the instance that a situation arises where a firefighter inside the burning structure is in need of any form of emergency assistance. These types of instances particularly include getting injured, where a firefighter inside the structure needs to be rescued or assisted rapidly in any

manner. Generally it was cited by firefighters that it is ideal for the RIT team to be on location at a fire related emergency prior to them entering the structure. However, this procedure appeared to not always be followed precisely according to the guidelines as it was also extremely important in the firefighters' eyes to begin fighting the fire as soon as possible.¹⁸ Thus, these RIT teams potentially had the ability to alter the skills used for those firefighters suppressing fire with the attack lines (and other firefighters inside the building performing other tasks); however, at this point in time this impact was not cited by the firefighters as something that had really changed the manners in which they throw water on the fire.

At the Scene of a Fire: Truck Companies

At the scene of a fire, the engine companies are charged with the process of establishing a water supply, preparing to throw water on the fire, and suppressing the fire. While these firefighters on the engine company are performing these tasks, the firefighters on the truck companies are busy performing other tasks vital to the safety of citizens who may be trapped in the burning building and other firefighters, in addition to others that must be completed if the fire is to be completely extinguished. Among other things, this includes forced entry, search and rescue, throwing ladders, and ventilation.

Forced entry

The first task that firefighters in truck companies are charged with was to force entry into the burning structure. Forcing entry into a building was purely a

¹⁸ This is similar to the findings of Weinschenk et al. (2008) who discuss the implementation of formal guidelines versus their acceptance by firefighters while fighting a fire.

physical task where firefighters would use a variety of tools to break open a locked door or other barriers which prevented them from getting inside the structure to rescue any victims and fight the fire. This task was not always needed: some fire emergencies may have not had any obstruction. However, when this forced entry was needed, it tended to be left for the truck companies. While the basics of the task were not overtly complex in regards to the mental capabilities of a firefighter (it drew more on the physical and manipulative abilities of a firefighter), one of the reason that forced entry tended to be left for the truck companies was that it was on the fire trucks where many of the tools needed to force entry were stored. For example, while both types of apparatuses had the basic hand tools (e.g., axes) used for forced entry, at both the WCFD and RCFD it was the truck companies that carried hydraulic rescue tools that may be needed to gain entry.¹⁹

Interesting enough, I was informed during my interviews by firefighters that these hydraulic tools had originally been used during stock car racing, such as NASCAR, when drivers needed to be cut out of one of their race cars in certain emergency situations.²⁰ While these hydraulic rescue tools have been available for quite some time elsewhere, they had only been placed on fire trucks in the past 20 years. This is not to say they were never used by the fire department prior to this instance. For example, in the RCFD there was a special (or heavy) rescue unit (see **Chapter 6**) that had long been in possession of a hydraulic rescue tool. Even when

¹⁹ Hydraulic rescue tools were also referred to as Hurst® tools (after a particular manufacturer that makes these types of tools), and also the Jaws of Life® (a reference to a particular brand/model of these hydraulic rescue tools). These terms will be used interchangeably throughout the present study as well.

²⁰ NASCAR stands for National Association for Stock Car Auto Racing. It is a national business venture in the U.S. that oversees and sanctions various auto racing events, with its most major race series as the Sprint Cup Series (for which one race in the Series is the Daytona 500).

the fire trucks at River City were equipped with these tools, the special rescue unit still carried a larger, more powerful hydraulic rescue tool.

With that extremely brief history of the hydraulic rescue tool, it is also important to quickly explain how it works. The tool's base consists of a hydraulic pump that is connected by a cord to a tool. The types of tools that are connected to the hydraulic pump can be changed depending on what the firefighters' needs are. During the course of my interviews, the firefighters who worked in truck companies who used hydraulic rescue tools discussed two specific parts of the tool that could be used. The first were cutters which were simply a series of blades that were strong enough to cut through the exterior of a car. Obviously, these tools were mainly used in the instances of automobile accidents during non-fire related emergencies (see **Chapter 6**). The second tool that connected to the hydraulic pump and was discussed during my interviews was a piece of equipment called a spreader. This spreader allowed for a firefighter to pry apart two objects, mainly a sealed or locked door of an automobile, or (in this instance) of a house or a building.

Obviously, the hydraulic rescue tools brought with it the need to learn the new skills that were required to use them. It is important here to note that although these tools were mainly used by truck companies, it did not imply that firefighters working on fire engines were not responsible for this skill. In fact, all firefighters were *cross trained*. This implied that although the main tasks performed while at a fire related emergency were specific to the type of apparatus one is riding; all firefighters were responsible to be in possession of the knowledge and skills needed to ride upon the particular type of apparatus which they did not regularly serve on, and be able to

successfully perform the associated fire related tasks for that apparatus. For example, the firefighter on the truck who may primarily be responsible for forced entry and other duties assigned to the fire truck must also know how to use an attack line to throw water on the fire. On the other hand, those firefighters on engine companies must also understand how to throw ladders, for example. It should be noted that this did not apply to the responsibilities possessed by the driver of an engine (i.e., operating the pump to supply water) or a truck (i.e., operating the aerial ladder). The ability to possess all these skills was important at both departments if a situation arose where firefighter from an engine company needed to fill in as a firefighter on a truck company for an entire work shift, or even during a single fire related emergency.

Forcing entry with either basic hand or hydraulic rescue tools appeared to have been a rather straightforward physical task. Furthermore, besides the type of tools used, there was not a large room for any type of discretion. However, the interviews revealed that the characteristics of the areas surrounding a fire station may also play a role in increasing the level of discretion that is needed by the firefighter, as certain firefighters noted that technology external to their apparatuses may also be used to circumvent the damage created when using physical strength to force entry.

The area in which the WCFD was responsible for was one example of this:

“I don’t know if people really call it technology or not. One thing that’s been instrumental, well it’s saved communities a lot of money, is the Knox Box system. It’s a little safe they put on the outside of the buildings, and the building puts their phone numbers, their contact numbers in this little safe, and they put the keys to that building in that little safe. And of course we have a master key. So we can get in that Knox Box, get the keys out, let ourselves in the building...” (*WCFD firefighter*)

This Knox Box system had (approximately in the past 15 years) become widespread used by Waterville City establishments (not so much private residences), and have

prevented the firefighters from needed to damage any property as no forced entry is needed. While this tool can be used in instances of an actual fire, during false alarms (see **Chapter 8**) they can also be used as well.

While this is one example in Waterville City how the local area can influence the performance of forced entry, there was also evidence of this in River City. One particular fire station of the RCFD was located in an area that was very impoverished and had an extensive amount of vacant buildings which in turn was a factor for the task of forced entry. I interviewed a number of firefighters positioned on the truck company at this station who discussed how the area affected their forced entry. For example, when discussing the tools used in these instance:

“For like chainsaws and stuff for cutting. We have a lot of vacants [**houses**] for getting the plywood off and stuff like that. But basic it’s just been a toolbox full of crude tools showing up with a bunch of raging bulls breaking the place open.” (*RCFD firefighter; author’s notation in brackets*)

Due to the large number of vacant houses needing to be responded to by this particular fire company, the manners of how forced entry was completed was different then other companies in River City or even Waterville City. While the use of saws may have not commonly been used to force entry by other fire companies, in this particular area the large number of boarded up vacant houses required saws to be used more often.

Search and rescue

As soon as the forced entry (if needed) was completed, arguably the most important task of the firefighters on the truck was to search for and rescue any persons trapped inside a burning structure. Clearly, the firefighters I interviewed who

discussed this made clear it was not an easy task. As for the first thing to consider, in addition to the danger that the fire itself presented, other factors also hindered the ability for this task to be completed by the person(s) performing it. As mentioned above, the smoke inside a burning building creates an environment where a firefighter has extremely limited vision. As one Waterville City firefighter stated, “it was almost like closing your eyes and trying to walk. You had to feel with your hands.” Thus, this drastically adds to the difficulty of navigating and orienteering oneself through the environment. In addition, the trapped persons themselves can unintentionally add a level of complexity to this task. The situation is not always as we see in the movies where a victim inside a house on fire is hanging out the window and yelling to get the attention of the firefighters. On the contrary to this, people who need to be rescued may attempt to intentionally hide from the fire, and although unintentionally, wind up hiding from the firefighters as well:

“And people do different things. They’ll probably hide under the mattress. They’ll go in the bathroom and get in the shower. So you have to check that area. Put mattresses over ‘em thinking that will protect ‘em, so you got to check on top of the bed, under the mattresses, in between the box spring.” *(RCFD firefighter)*

Therefore, when a firefighter is in a structure that is on fire and s/he is searching for victims, the fire, smoke, and victims themselves can all work to increase the difficulty pertaining to searching for the victim and successfully rescuing him/her. These factors create not only a certain level of complexity for the firefighter, but also a level of heightened autonomy/control-related aspects that need to be possessed by the firefighter. The firefighters not only need the mental and manipulative integration needed to navigate and search a structure that is in flames, but also must be able to make decisions as to what may be the best method of locating a victim depending on

both environmental and factors related to the victim him/herself. Because of this, the commanding officer on a truck in the RCFD was normally the one who (after forcing entry) would also search for any victims inside the structure, as s/he was a firefighter with a greater level of experience and training.

When discussing search and rescue, one tool that was mentioned was the thermal imaging camera (TIC). This camera became widespread in the two departments over the course of the past five to ten years. The TIC allowed a firefighter to locate heat patterns. This in essence allowed a firefighter to see through smoke, or even some types of walls. In the instance of performing a search and rescue, the TIC could allow one to see and locate a person by showing the specific heat patterns of their bodies. As with the introduction of many other devices used in the fire related emergency job-context, in order to use them these cameras required a new skill that was not previously present in the fire departments. This meant that as firefighters in both departments now began to use the TICs, they were also required to train on them so that they can be properly and efficiently used. As with other technologies that entered the fire service, these TICs did have some drawbacks that firefighters needed to be aware of in order to effectively use the camera. One RCD firefighter laid this out quite nicely when recalling some of his experiences when using the TIC:

“You’re looking at the camera but your depth perception is completely off. I’m thinking I still got another foot before I hit the stairs, and I was **[smacks his hands together signaling that he fell down the steps]** at the top of the steps already. So your depth perception’s off. And it’s weird. Like the ice house fire. Took a thermal imager in there, couldn’t see nothing. All I see is bright light which is indicative of fire. If this is all fire, I’m dead. Done! But in hindsight it was the reflection off the ice...So, I mean, the thermal imaging’s come a long way...Thermal imagers (sic) good for an auto accident at night. Go see if there’s woods around, people been

ejected, can't see through trees in the dark. You know, take the thermal imager, scan the tree line, and you'll be able to find somebody [**snaps his fingers**] that quick. Um, they don't work in water. If somebody's submersed under water, it doesn't work. It reflects the top." (*Author's notation in brackets*)

Both fire and non-fire related emergencies were discussed here, but provides a good explanation of the skill required to use a TIC.

Although the TIC was a relatively new technology, the specific models of TICs available at each department were quite different. At the RCFD, the TICs equipped on the fire trucks were older models which many firefighters who worked on the trucks claimed were bulky and difficult to use while fully dressed in your PPE, SCBA, and carrying your hand tool. These TICs had a screen that went over one's face that showed the heat image. This screen was connected by a wire to a large, "bulky" battery pack that the firefighters also had to carry. In contrast, at the WCFD this older style TIC model had been replaced by more modernized versions that were much smaller in size. These newer cameras were handheld models which allowed for an easier use. The same skills were required by the firefighters in the WCFD to read the imager; however, these versions were simply more convenient to use.

Subsequently, the model and style of these TICs appeared to have played a roll in how they were used by firefighters while performing search and rescue. In the RCFD, although a TIC was standard on each fire truck, the firefighters did not normally use them while searching for victims. Instead, they were primarily used during overhaul (see below). However, at the WCFD the firefighters I interviewed stated that they were used not only for overhaul, but also while searching for victims. However, there was one exception, where a firefighter from one truck stated that although they can be used in this manner, "that's not the typical." Instead, the method of searching for

victims most commonly used is still by physically feeling one's way around. As discussed later in detail, clearly the most common use of the TIC in both departments was to assist with the overhaul process (i.e., ensuring the fire is completely extinguished and all hazards are contained; see below).

While searching was one portion of this particular task, the rescue was another. While victims are not always able to come to a window, in some instances they are. Here, ladders can be used to remove the victim from the building. In these instances, the victim him/herself could again increase the difficulty of this task. During ladder rescues, the panic and fear a trapped person is experiencing may set in which may make for a not cooperative situation for a firefighter who is trying to remove them from the building both quickly and safely. A prime example of this was found in a photograph that caught my attention in the WCFD administration building. Here was the picture of an almost completely naked man hanging upside down three-quarters of the way out of a second story window. The building he was in was in flames. A standard ground ladder had been placed up against the building in front of the window, and a firefighter from the WCFD was near the window on the ladder. I did not initially ask about the photograph, but it was explicitly brought up two or three times over the course of my interviews, and as I found out this citizen was trying to jump onto the firefighter on the ladder to exit the burning building. In this instance, it took some effort to calm this individual down to a state where (with the assistance of the firefighter) he could safely get onto the ladder and successfully exit the building without putting himself or the firefighter in danger. While exaggerated,

this instance provides an example of how the individual him/herself can make the process of rescue difficult, regardless if a search was even needed.

As mentioned above, searching and finding a victim is in itself a rather difficult task; however, the rescuing of a victim can require just as much skill. Even when a person is located by a firefighter, the firefighter still has to navigate in the harsh environment created by the fire and smoke. Another point important to note here was that the buildings themselves can create a more deadly environment that works against the firefighter when trying to rescue a victim:

“You know, we’re getting into more hydrocarbon-based products. You know and all the foams in furniture. You know, everything like that burns hotter, faster, gives off more toxic fumes, where 40 or 50 years ago it really wasn’t. You know, the wood-based products for the most part. The fires are burning hotter and faster and the atmospheres are getting to a point where they wouldn’t have.” (*RCFD firefighter*)

Fires are now creating more toxic environments that are not only a concern on the part of the firefighters’ safety, but also for the safety of the individuals needing rescued. This increasingly toxic environment is creating a deadlier environment than was previously present. In turn, this works against the firefighters in that even if the victims have been found, the ability to get them out safely of this environment may require a more accelerated rate. Not only are the flames a danger for the person being rescued, but the smoke and toxic fumes that are released by the burning housing material can be just as dangerous to the victim.

Using ladders

Using ladders was another task performed by firefighters on truck companies. There were two different types of ladders used here, ground ladders and aerial ladders, both which had been used by both fire departments prior to the New

Economy. Ground ladders could be used by all firefighters, and was generally the duty of the firefighters on the truck who were serving as drivers or performing any type of search and rescue. The procedures used from ground ladders have been the same for “maybe a hundred years” (quoting one WCFD firefighter). This basically involved placing (or referred to by the firefighters as “throwing”) a standard ground ladder up against the building to areas that either needed to be opened for ventilation, or that could be used by other firefighters to gain access to the building or rescue victims. Even if the firefighters did not initially need access to a building through a particular area such as a window, for preventative safety reasons it was important that these ladders were placed there anyway. If a firefighter inside the structure was fighting the fire and needed to make a quick exit, these ground ladders allowed them to do so quickly so they would not become trapped and need to be rescued by members of the RIT team or other firefighters. While the process of placing ground ladders itself may have not required a substantial amount of substantive complexity or autonomy/control-related skills, and had not changed in the past 20 years, this task did require a large amount of physical strength to quickly place a ladder in the proper position. It was in this aspect that a change did occur; the ladders themselves were now being made with material that weighed less and would require less physical strength to throw. However, this new material did not affect the actual skill dimensions in any way – the same skill needed when using ground ladders prior to the New Economy was still needed in the present day.

While the ground ladders were common place in many fires, in some occasions the aerial ladders had to be used. The aerial ladder was a large ladder able

to extend anywhere from 75 to 100 feet and was bolted to the fire truck. The aerial was operated in both departments by the tiller, and was used to transport firefighters to and from heights that were not able to be otherwise reached. Generally, the driver of the truck would be the firefighter to go up the ladder to ventilate. As mentioned above, the aerial was not always used. The firefighters I interviewed stated that this was the case for a variety of reasons. The most prevalent reasons that surfaced included: (a) in certain instances the fire being fought simply did not require the firefighters to be able to go to that great a height, or (b) the specific situation did not allow for the firefighters to use the aerial ladder because space limitations (i.e., the aerial was hindered by obstacles such as tree limbs, power lines, or even the narrow size of the alley/street where the burning structure is located).

While the skill required to use ground ladders may have been minimal, there was inevitably much more skill required to properly operate the aerial ladder. What had remained constant was the fact that the tiller manually had to operate the controls of the aerial from the back of the truck. For example, in older models of the fire trucks:

“I mean we were riding in open; the tiller was an open cab and one of them literally you were sitting between the ladder rungs. You had a windshield and a seat that when you got out if you were going to have to use it you threw a switch, or pulled a lever down, let the windshield went (sic) out of the way, hit another lever and the seat would flop out of the way and then you had to take the tiller wheel out between the ladder rungs and you had a place to put it, if you were using the aerial.” (*WCFD firefighter*)

However, with newer models being introduced to the fire departments in the past 20 years, these portions of the preparation for the task of using the aerial had been simplified by these new fire trucks. Firefighters serving as the tiller were no longer

situated between the aerial ladder itself. This removed a number of the steps used as preparation when completing this task. This new style of truck with fully enclosed cabs was now commonplace at both the RCFD and WCFD, and in both departments had removed this longer process required to prepare to use the aerial ladder.

While this portion of the preparation to use the aerial ladder was shortened, there was some evidence provided in two interviews that this new computerization has also added more skill to using the aerial. It should be noted that these three interviews were all from the WCFD and discussing one particular apparatus that the department purchased approximately ten to 12 years ago, and may not be representative of the second fire truck used by the WCFD. This increase in knowledge concerned the process of establishing outriggers from the fire truck when using the aerial ladder.²¹ As explained by one of these WCFD firefighters who served as a tiller on this specific apparatus:

Firefighter: It's just like here in town, there are times we cannot fully extend out outriggers. Uh, well it could just be a matter of inches to do that. Well, there's sensors on there that if you're not fully extended we have to do other, flip other switches and do other things to get it to work, um, which is built into the truck. If you're not thinking about it at the time, it will actually stop you from extending to an area that a short-jack. If you're short-jacked is what they call it. If you're short-jacked you're going to that side it won't let you do it unless you have a couple of switches you have to be pushing and you have to constantly hold to continue to do that. So it kind of makes you think about what you're doing.

Interviewer: It's like extra steps?

Firefighter: Yeah, yeah. And it can throw some guys off because it's not something you do that much, you know? And the first time it happens to most people they go, you know, they're like 'Ok, now what's wrong? Why won't this thing go? Why's there a buzzer going and all like that?' And then they, usually they'll be able to figure it out. It's like 'Oh, okay. This is what I need to do.'

²¹ The outriggers were simply mechanical legs that were extended from the fire truck to prevent it from tipping over while the aerial ladder was in use.

Thus, while properly setting the outriggers on this apparatus was a skill previously needed to complete the task of using the aerial ladder, these newer aerial ladders sometimes created a situation where the outriggers would not be fully extended due to the fact the computerized sensors would not allow it. As described by this firefighter, in these instances the firefighter operating the aerial ladder had to understand why it was not fully extending, if they had additional room to fully extend it, and subsequently the procedures used to manually override the computerized sensors located on the fire truck.

While this above example was related specifically to one apparatus in the WCFD, there was evidence among all firefighters who worked on a fire truck company that fire trucks had become increasingly computerized (as with the fire engines). However, unlike the engines, the process used to control the actual aerial ladder was dependent on the particular structure that was on fire, and not on a standard pressure that was routinized as when using certain attack lines (this was in contrast to the process used to prepare to use the aerial). Therefore, although the preparation to use the aerial ladder was routinized, and these newer models appeared to have removed skill from the substantive complexity dimension in preparing to use the aerial, the use of the aerial ladder itself was non-routinized and subsequently not affected by the computerization. In fact, in this instance discussed by the WCFD firefighters, there may have even been the case where the introduction of computers could have added some skill needed to properly operating the aerial ladder right after other aspects of the skill used to complete this task had been removed from the firefighters.

Ventilation

The fourth task specific to firefighters working on a truck company was to ventilate. The reason this task was performed was to create a safer environment for the firefighters inside fighting the fire and performing search and rescue. Ventilation helped remove both heat and smoke from the structure, and also helped remove from the structure some of the toxic fumes created by the burning materials. Ventilation also helped prevent (quoting a firefighter from the RCFD) two “evils in firefighting.” All fires need a certain combination of fuel, oxygen, and heat to exist. The removal of any of these three items will extinguish the fire; however, in certain instances this can create an extremely deadly situation. The first instance is when a fire burning in an airtight room depletes all the oxygen in that room. The heat and fuel still remain in this room, and the instance that the room’s airtight seal is broken and oxygen is introduced back into that environment, the result is an explosive situation of flame. This is called a backdraft.²² In the second “evil,” a room may have oxygen and may have a smaller fire burning, but it lacks the heat required to reach an ignition temperature. In this instance, heat can continually build from the fire in the room or elsewhere in the house via gases produced by the fire. This process heats the entire room until the room reaches a certain ignition temperature. The result is an instantaneous flame that engulfs the room and its contents. This is called a flashover.

²² This was the same phenomenon featured in *Backdraft*, a 1991 American film of the same name. Interesting enough, references to this movie and others (e.g., *Ladder 49*) did come up throughout the course of my interviews where a handful of the firefighters I interviewed mentioned how these movies did not accurately portray the experiences of firefighters in the fire related emergency job-context, romanticized fighting fire, and did not paint an valid portrait of the process of fighting fire and the skill that was involved during fire related emergencies.

Through the process of ventilation a firefighter may remove heat from a particular room which can help prevent both a backdraft and flashover from occurring.

Ventilation typically occurred from high points in a structure. As the goal of ventilation is to remove heat from a burning building, this logic of ventilating the highest point of the building follows a common knowledge that most of us learned in our primary schooling: heat rises. Thus, in many instances firefighters physically go on the roof of a building to perform this task:

“So I go to the roof, open the roof, open that roof up. Either the skylight or the scuttle, and the scuttle is a lot of work because usually it’s got tar paper over top it and you got to chop all around it, lift that hatch open and usually it’s like a false ceiling, like a drop ceiling, and you drop down and that may open up and let ‘em out. If you don’t have none of those, then you got to chop a hole in the roof which is a hell of a lot. Basically we got axes and we’re just swinging away, you know?” (*RCFD firefighter*)

In this instance, an RCFD firefighter who drove a truck discussed the process he uses to combat fire in the homes around the area for which his truck company was responsible. Furthermore, depending on what due truck the firefighter is on, the task of ventilation can differ. This RCFD continued and described the duties of the second due truck in regards to ventilation and how sometimes he handles this task while he is on the first due truck:

“And then after that’s done, if it’s going to be a while before the second truck company gets there, then you actually go to the rear and you have two tools on the tip of the ladder. You don’t have to carry tools up, you just grab the tip of the ladder and throw them in. Take maybe a long six foot hook, lean over the back of the roof and break out the back windows. The second truck company’s going to come back and open up the back windows too, so it saves a lot of time.”

This is a prime example of how ventilation occurs, but also the nature of how first and second due companies work together to fight fire. While both may be performing the same tasks, these tasks may be performed on different portions of a building to

more quickly account for an entire building. Furthermore, this also shows that although firefighters may have specific tasks assigned to them each time they enter the fire related emergency job-context, there is always additional room to perform needed tasks.²³

As with forced entry, search and rescue, and using ladders, there was also evidence of changes in homes in recent years affecting the completion of this task:

“These lightweight constructions of new things (sic). These homes are very dangerous. If a fire’s going pretty good in them, they’re susceptible to collapse. The trusting systems they use in the roofs are very weak, so you think twice before you send these guys from the ladder truck up on top of the roof to ventilate because the roof could collapse and you’re going to kill two firemen. So a lot of things have changed...” (*WCFD firefighter*)

Thus, again it appears that the buildings themselves can create more dangerous environments for firefighters to perform their tasks. In fact, two firefighters from the WCFD who worked on the same truck discussed how in some instances this has led them to ventilate using the aerial ladder, thus preventing them from even having to set foot on the roof. Thus, it does appear that the procedures used to ventilate have changed. However, this change did not specifically appear to create a shift in the complexity involved in performing this task – firefighters were still using physical force coupled with basic hand tools to tear holes in the ceiling and break out windows. In addition, these firefighters ventilating a building also knew the procedures to ventilate as soon as they arrived on the scene. Thus, it could be argued

²³ Another example of firefighters performing more than their required tasks at any one given fire was evident during the interviews I conducted with firefighters in the WCFD who served as pump operators. As described in the methods section, the number of firefighters during each incident was more limited at the WCFD compared to the RCFD (or even National Fire Protection Agency [NFPA] national standards). Therefore, once these pump operators established the water supply needed and the pump was running properly, they often would throw a ground ladder or two to assist those firefighters on the truck. This task could be completed relatively quickly and done so simultaneously while operating the pump.

that the autonomy/control-related aspects of this task created an increasing concern for the safety of firefighters on the roofs of buildings, subsequently leading to the increase of using discretionary skills. In this instance technology – albeit external from the fire departments themselves – did play a role in the task of ventilation.

One final thing to mention, in three interviews I conducted at the WCFD, the use of fans in the ventilation process was also mentioned. Basically, this simply involved high-powered fans that could be placed by firefighters to help blow non-heated, non-toxic, fresh air into a burning building. However, as these tools were only mentioned by three firefighters, it was unclear the extent that they were used (at either the WCFD or RCFD), and not enough evidence could be drawn from the interviews to discuss how these tools either created or changed the skills used by firefighters. Furthermore, these were never mentioned during any interviews with firefighters from River City, and thus it was unclear if these devices were used at all in this department.

Using Firefighter's Gear

Each firefighter has an assigned task that they need to complete depending on the type of apparatus on which they are working (i.e., engine or truck). In addition, the particular position on that apparatus where the firefighter is sitting also determines what particular task they will be completing. The position a firefighter is sitting is particularly pronounced in the RCFD as they have four firefighters working on a single apparatus during any one shift. However, in the WCFD, only two firefighters are assigned per apparatus during any one shift. Therefore, here there is somewhat more fluidity as to what precise task needs to be completed. Regardless of the type of

apparatus, one's position on that apparatus, or even which fire department the firefighter was working at, there was a likelihood that they had to use their personal gear while performing the various tasks discussed above. This was not identified by these firefighters as a task which had to explicitly be performed; however, throughout the interviews the firefighters at both departments discussed various considerations and knowledge that needed to be possessed in order to properly use their gear to its potential, and even to maintain their own safety. Thus, even if not explicitly seen by these firefighters as a skill per se, there was obviously a certain level of complexity and autonomy/control-related aspects that went into the use of this equipment.

Personal protective equipment

Obviously, firefighters could not perform their tasks in the fire related emergency context without certain clothing. This type of clothing was referred to as personal protective equipment, or PPE for short. This was also referred to as turnout gear. Over the past few decades the PPE has changed drastically. This recent change actually occurred prior to the time period of interest of this study. Before the New Economy, the turnout gear consisted of long, heavy coats. The boots were of three-quarter style and could be pulled up above one's knees and close to his/her thigh and the helmets worn were metallic in nature. To quote one WCFD firefighter, at some point the manufactures of this gear and the fire services started taking the gear and looking at it "a little more scientifically." With this new perspective, the gear "changed from something that kept you dry to something that now actually is protecting you" (quoting the same WCFD firefighter) Thus, in the current day the

main goal of the PPE is the firefighter's safety; perhaps not too surprising given the larger push towards safety of the firefighters while actual fighting fire.

Obviously these safety improvements were only able to be reached through the use of new technologies in the form of fabrics and synthetic composite materials. For example, as the helmets used to contain metallic materials, there was a risk of firefighters being electrocuted during instances where a live wire may be present in the scene. Thus, new materials that contained no metal were now being used. In addition, the design of the helmets was created in such a manner that they allowed for an extra layer of protection. The helmets worn by the firefighters in the WCFD gave a prime example of this:

“Of course helmets have changed now. They have six-point harnesses in for fall protection. They're actually break-away helmets. People don't realize they are break-away helmets. When you put your helmet on and put your chin strap on, the top layer; if something hits it'll actually break away and fall off of your head, but you still have the impact liner just in case something else falls on your head or you fall. People don't realize that, there's actually two helmets there.”

As for the remainder of the PPE, instead of a rubber material, the turnout gear was now made using Nomex/Kevlar-type material which had a much greater heat resistance than the old rubber gear. In addition, this new material used to construct the turnout gear allowed for an increased level of mobility among the firefighters. This PPE also now fully encapsulated the firefighter: in addition to the coat, gloves, and pants, and boots, they also wore hoods which covered their heads (including ears) and part of their face. Furthermore, the design of some of these articles of gear had also changed to create this more encapsulated environment. At the RCFD, a change in the coats created a better seal between the firefighters' gloves and coat. Prior to this new equipment, in some instances the firefighters' wrists would be exposed between the

gloves and coats while the firefighters were moving a certain way (i.e., fully extending his/her arms). Now, this newer PPE had a hole near the end of each coat sleeve which a firefighter could insert his/her thumb. Subsequently, this prevented one's wrist from becoming exposed when his/her arm was fully extended, and potentially burned. This is an example of one particular alteration to the turnout gear that had occurred within the past 20 years, but it is not the only one. Although they may not be as drastic as the transition from the rubber material to the Nomex/Kevlar-type material, these changes were still constantly occurring: firefighters in both departments stated that turnout gear is constantly evolving and being improved upon, with the ultimate goal of these improvements being to maximize their safety.

Due to the new style and technology of the gear, firefighters were better protected from heat and flame. This also had consequences to how they were able to fight fire. Because of these new materials, and the full encapsulation, firefighters could now push further and deeper into a structure to fight a fire as the gear could now withstand environments that would not have physically been able to be withstood by the firefighter prior to this new gear. Firefighters could now physically perform their duties in environments that the human body was physically not supposed to be able to withstand. Thus, while discussing the PPE, there appeared to be a large consensus among the firefighters that this created a double-edged sword. In addition to the benefits of being able to go further into the fire, there were also potentially negative side effects of this:

Firefighter: One thing I've noticed though since we're more encapsulated with all the turnout gear, I'm finding we're going further in the buildings and sometimes getting into spots that we shouldn't be in. Years ago you would use your ears. When

your ears start burning, it was time to back up. But now since your ears are covered I think we're going in a little too far sometimes.

Interviewer: Okay.

Firefighter: So yeah, it's good if somebody's trapped, we need to make a rescue, it's good to have all this on but other times I think we're going in a little too far sometimes. (*RCFD firefighter*)

This quote from the firefighter provides an example of two explicit issues that were negative by-products of the turnout gear. The first was that firefighters could now get into situations that they were only physically able to withstand due to this gear.

Therefore, when in these situations the firefighter was completely dependent upon this gear for survival. To put it bluntly as did a RCFD deputy chief I interviewed, if the gear failed, "you're dead." It created a false sense of security among the firefighters. In addition, a few of the older firefighters serving in officer positions also stated that this was particularly problematic with new recruits. These younger, inexperienced firefighters did not yet have the knowledge to determine of what particular environment may be too dangerous to be in fighting fire, and ability to mentally weigh this with the limitations of the gear and one's own human body.

In addition to the danger these environmental factors posed to the firefighters, certain instances where the room had a high level of heat, there was also the potential of this gear itself to turn from protective to harmful. This new style gear had what was referred to as "moisture barriers" which prevented liquid from penetrating the turnout gear itself. However, to account for perspiration, these barriers also needed the ability to breathe and allow for moisture from the firefighter to escape this encapsulation. This new technology was not completely fine tuned and could potentially create a dangerous situation for the firefighter in which the gear did not

properly allow for the moisture to escape. This was again related to situations where a firefighter enters an extremely heated environment:

Firefighter: And the real aggressive firefighters will just go charging in and most of the burns come from steam 'cause they get inside and you're working and you, you have 100 pounds of equipment on and you got adrenaline going and the heat does permeate through their equipment to the point where naturally you do get warm. And it's very, very easy to start perspiring. And you're perspiring inside your turnout gear and you get too far into a burning building, the heat will go through the equipment and turn that perspiration into steam, and you end up being burned!

Interviewer: Kind of like an oven?

Firefighter: Yeah. So in that instance the equipment is actually working against you. Now the Nomex equipment, it's supposed to release the water vapor inside but it doesn't do it fast enough in certain conditions. So I feel like now I (sic); I feel like I've seen probably more guys get burned on the fire ground because of their turnout gear than I did way back when. When we didn't have gear on, oddly enough. (*RCFD firefighter*)

Another concern to the firefighters about the new PPE that fully encapsulated their bodies was that it actually diminished their sensory skills. Prior to the full encapsulation, the amount of heat felt on one's exposed skin was used as a crude method to determine how heated the environment was in which they were fighting fire. They claimed that your body would not allow you to go into certain areas that had extreme levels of heat. Your body would start to have a burning feeling and would reach a point where the firefighter knew s/he would be burned if they proceeded any further. In addition to exposed skin not allowing you into environments that were too volatile, feeling heat was also important to find fire itself (e.g., see the discussion above regarding using attack hoses and moving towards the heat). Fire was not always burning in the open for all to see. In some instances it may hide within the interior of walls, closets, or even closed rooms. Thus, full encapsulation prevented this technique for finding fire to be used. In fact, one RCFD

firefighter stated that he actually purposely did not wear his gear properly so that the ability to feel for fire was not removed from him:

“It’s, it’s also difficult. You could have a little closet fire on the second floor and the second floor’s completely charged. There’s a lot of heat. Now I do something that will get me a rip in the ass....I take my gloves off. And I don’t raise my hand up, because that’s very foolish. You could lose your finger. But I take my glove off and I’ll start to peel it back to see how hot it really is. And if it isn’t that hot, now I’m doing this. And that’s the only way I can find that small closet fire that’s not a big deal. Even though it may look like it, it’s not a big deal. So now I know there’s not a lot, there’s not that much heat.”

While the gloves were one example of the removal of this sensory ability used by firefighters, it was not the traditional one cited by the firefighters. The one which many firefighters had found issue with was the hoods now required to be worn as part of their turnout gear. It was quickly apparent during the course of my interviews that firefighters were weary of these hoods. In fact, one interviewee even suggested to me that a research study on the affects of the hood in firefighting could be a “thesis all by itself.” This stems from that fact that traditionally firefighters used their ears to tell when an environment was too heated and they had to leave. Basically, if they felt their ears burning, it was time to get out. However, these new hoods again limited their sensory abilities and prevented them from using their ears as heat indicators:

“The turnout gear has improved our protection, but it also gives you a false sense of security because you don’t feel what you used to. And the thing that I’ve done and take a beating over is I won’t wear my hood the whole way. I’ll keep an ear open. And the reason being is because I don’t feel the heat in my gear...I know it’s an old indicator; it’s probably not the best thing.” (*WCFD firefighter*)

Again, this example shows how the newer gear can prevent from sensing the heat. It is important to note that these two preceding quotes which show a firefighter resorting to these older methods of feeling heat did not appear throughout the course of my interviews. In addition, I am not claiming that these methods are

recommended. However, what they did emphasize was an extremely interesting finding. Not in one single interview was I provided an alternative way to “feel” now that the newer PPE was fully encapsulating.

Drawing back to the original conceptualization of this study, skill was defined along the lines of tasks required in one’s position. Therefore, using the PPE was not precisely a skill by this definition. However, due to the constant discussion of the PPE and SCBA (see below), it was clear that this was an important supplemental consideration that went along with the tasks being performed by firefighters to suppress the fire. In addition, this PPE was a new technology that was introduced just prior to the New Economy, and had been continuously modified throughout the following years. Furthermore, this technology did in fact change certain aspects of how other tasks were completed by firefighters, even if there was no ready solution for gaining certain aspects of one’s sensory abilities. In sum, while arguably not a skill in itself, this particular technology did in fact play a role in skills that were completed by firefighters while in the fire related emergency job-context.

The SCBA and PASS

Similar to the PPE, it is arguable that using the self-contained breathing apparatus (SCBA) itself is not a skill per se, but rather contributes to the skills used when fighting fire in the toxic environment the fire itself creates. The SCBA was an air bottle which was attached to a mask the firefighter wore. This system supplied oxygen to the firefighter so that s/he may breathe fresh air in the toxic environment created by the fumes caused by the fire. In addition, the SCBA also created a barrier which prevented these toxic fumes from being inhaled. There were three major

changes that occurred to the SCBA over approximately the past 20 years. First, the materials had changed that were used to construct the bottles themselves. The material went from metallic to composite material. These new materials allowed for air to be compressed tighter, subsequently making the bottle smaller and lighter. This made it easier for the firefighter to physically wear and carry the bottle while using the attack hose, searching for victims, or any other task in which they needed to wear the SCBA. The second and perhaps most interesting shift was the SCBA moving from an “on demand” to a “positive pressure” system. These “on demand” systems would only release air from the bottle when a firefighter inhaled. However, when the seal around a firefighter’s skin and the mask of the SCBA was broken, contaminated, toxic gases could enter through this broken seal into the mask and be inhaled by the firefighter. Now with positive pressure masks, the air is released in a slow, constant stream. In the case of a broken seal between the firefighter’s skin and the mask of the SCBA, the positive pressure helps to prevent any of the contaminated atmospheres from entering into the mask and being inhaled by the firefighter.

A final change to the SCBA was that now a device called the personal alert safety system (PASS) device was now integrated into the SCBA. The PASS device was basically a motion sensor that would emit a loud sound if it remained motionless after a certain short period of time. The PASS device would work automatically once turned on; however, prior to the SCBA/PASS integration, the firefighter had to remember to turn this device on. Firefighters obviously have a number of tasks needed to be completed to fight fire, and have to complete these various tasks at an accelerated pace, thus there was the risk of forgetting to turn on one’s PASS device.

This integration allowed the PASS device to be powered on whenever the firefighter's SCBA was in use, and in essence removed the need for the firefighters to manually turn on the PASS device.

Once the Fire is "Knocked Down"

After the firefighters from the engine and truck companies have successfully extinguished the obvious fire hazards, there still remain tasks that need to be completed in this job-context. At this point, the engine and fire companies come together to perform two final tasks: overhaul and salvage. In addition to these tasks, in some instances there is also a fire investigation that needs to occur. Investigation particularly involves firefighters trained in fire investigation, which only comprise of a handful of firefighters. Therefore, while the task of fire investigation was not commonplace among the average firefighter, there was evidence this task had drastically changed, and there were some instances in which the firefighters not trained as investigators would assist the fire investigator with his task. Finally, after the firefighters have completed the tasks of overhaul/salvage and assisted the fire investigator with whatever is needed, they complete one final task, checking their equipment and apparatus, prior to leaving the fire related emergency job-context.

Overhaul

Once the obvious fire was extinguished, or "knocked down," the firefighters then began to perform a task what is known as overhaul:

"You obviously seek and make sure every ember's gone. You rip walls apart if there's a fire in a room to make sure there's nothing hidden so you don't come back here hours later. Once that's done, and all the overhaul's over, wetting everything down so there's no way it can ignite again..." (*WCFD firefighter*)

As shown here, in its basic form overhaul is simply ensuring not only that the hidden fire has been removed, but that there is no manner in which the environment may allow for the fire to reignite. As another WCFD firefighter stated, overhaul is a physical and “manpower-intensive” task. Traditionally it has involved taking basic hand tools like axes and pike poles (a long pole with a hook on the end) and tearing through walls and ceilings. This ensures that no hidden fires or even embers remain in the wall. This also allows for the walls to be properly cooled with water to remove any dangerous levels of heat, one of the conditions needed for a fire to exist.

Overhaul also involves removing any of the damaged material:

“Uh, that’s where we remove all of the burnt furniture and so on. Remove that from the house. If it’s an occupied house we actually, we clean it up a little bit more.”
(RCFD firefighter)

Thus, the physical components of this task in themselves do not have a high level of complexity. However, the task of identifying where hidden fire or even embers may be located does require a certain level of knowledge. Therefore, the integration of this knowledge of how to find hidden fire with the physical strength needed to perform overhaul does create a substantial dimension of complexity needed to complete this task. Furthermore, as noted by a RCFD firefighter one must be able to maintain a “certain credibility of the scene” so that any fire investigation needed may be able to determine the origin and cause of the fire (see below).

While fighting a fire, each firefighter understands going into the fire what their specific task involves, and in most instances these tasks require a higher level of autonomy/control-related and substantive complexity aspects to be successfully performed. However, in the case of overhaul, the dimension of autonomy/control-

related skill is more limited for these firefighters. The performance of overhaul requires a large amount of persons contributing to be successfully completed. Therefore, the person left overseeing the scene, whether it is the battalion chief, captain, or lieutenant, is charged with orchestrating the firefighters through this task. This may not include a huge oversight on part of the firefighter, but rather simply assigning certain areas or overhaul components to certain firefighter personnel. This does create a lower level of autonomy/control-related skill required by the firefighters when performing overhaul on a broader level. However, for those firefighters charged with finding hidden fire, there remains a certain level of discretion needed to determine whether a particular area of the wall or ceiling should be opened up and searched for hidden fire or embers.

Technology has also played a role in the performance of overhaul, particularly in the form of the TIC. Firefighters can now use the TIC to help locate hidden fires within walls or ceilings as the TIC can pinpoint the temperatures of particular areas such as walls and ceilings without the need for them to be physically torn down with an axe or pike pole:

Firefighter: But those [TICs] come in handy, you know, for finding fires hidden in walls and stuff where before we'd have to go in there and tear your house apart and physically put holes in walls and stuff where now we're able to use that camera and pinpoint. And an example would be if you had electrical wiring in the wall that was faulty. You know, we'd have to, you know, tear. Like I said, tear your wall apart to find it. Well now we can just run that camera along the wall, see where it's at and only, you know, maybe damage a small area.

Interviewer: Okay, so minimizing damage.

Firefighter: So I think that's a major addition to what we; additional tool to what we do. (*RCFD firefighter; author's notation in brackets*)

Thus, the TIC does not necessarily affect the firefighter's broader autonomy/control-related aspects of completing the task of overhaul as the officer overseeing the scene is still orchestrating the overhaul process; however, it does affect the immediate decisions they need to make regarding whether or not to tear down a wall to find a hidden fire. It also affects the complexity involved with this task in two ways. First, using the TIC during overhaul does remove some of the routinized components of the skill needed to find hidden fire (as would be expected by Autor, Levy, and Murnane's [2002, 2003a, 2003b] routinization hypothesis). Firefighters can now rely on the TIC to locate these areas, and in turn know that the wall or ceiling at this area needs to be ripped open and the hidden fire or remaining embers need to be extinguished. Note that although this does minimize the number of times the firefighters have to exert the physical component of this task; it does not alter how the performance of this overhaul is performed in any manner. The second manner in which the TIC alters the complexity dimension involved in performing overhaul is that the use of the TIC itself requires training. Therefore, simply understanding how to use the TIC requires a certain level of complexity in itself.

On a final note regarding using the TIC during overhaul: the differences between departments remained. However, the differences in using the TIC for overhaul were less pronounced than the differences when using the TIC during search and rescue. As mentioned earlier, the RCFD's TICs were somewhat older versions than the WCFD. The TIC used in River City was larger, bulkier, and was not really used for search and rescue. The RCFD firefighters did get into the habit of using it for overhaul; however, this still was not always used:

Interviewer: Do you guys have thermal imagers?

Firefighter: We do but it's a very, very old manner quite a piece of equipment. I think we got it from others. The City has always been lacking in top-of-the-line stuff. Um, we use that thermal imaging camera *mostly* for finding hidden fire in the walls after it's knocked down. It's kind of bulky and clumsy...It would be a good idea to take it but you got a mask on, you got a hook or an axe. *(RCFD firefighter; firefighter's emphasis italicized)*

Although the TIC has been used while performing overhaul, it was not used all the time, with the dominate reason again being cited as it simply was an outdated version of the TIC which was still awkward and difficult to use. Regardless, it still did have an impact on the firefighters who were overhauling. On the other hand, the WCFD did not cite this issue:

Firefighter: Things like heat guns, thermal imaging cameras: non-existent when I got into the fire service. The thermal imaging camera, the main focus is to be able to take into a smoke-filled building and be able to see any hazards and to find people.

Interviewer: Okay.

Firefighter: But more often than not we use it to detect hidden fire, fire behind a wall. Let's say the question of do we open the wall or don't we open a wall.

Interviewer: Okay.

Firefighter: Uh, we can use that and a heat gun. I'm a big fan of the small, handheld heat guns which detect temperature. It gives us a specific Fahrenheit or Celsius. *(WCFD firefighter)*

The WCFD not only had the TIC, but also a corresponding type of technology called a heat gun which could actually pinpoint and provide a specific temperature of a wall or ceiling, or in the case of this WCFD, a light ballast. This heat gun was similar to the TIC in that it affected the skills of these WCFD firefighters in a similar manner as the older TICs in the RCFD. However, the heat gun added a new level of complexity as it also required specific skills to use, while at the same time it could be argued that

it further removed the complexity and autonomy/control-related elements involved in locating hidden fire and determining if a particular wall or ceiling area should be torn down.

Salvage

Salvage was the other main task that was required of the firefighters after the fire had been knocked down and tended to occur alongside the overhaul process. This task was simplistic in regards to both substantive complexity and autonomy/control-related dimensions, and also had not been affected in the past 20 years by any new tools or technologies. Basically, the task of salvaging consisted of trying to prevent damage from occurring to any of the property in the structure, whether it is furniture, carpet, or even certain areas of the structure itself. If this was a private residence, salvage also included making the home as livable as possible to the extent that hopefully individuals could move back into the residence (e.g., taping plastic over broken windows). Thus, in regards to complexity, salvage required basic manual tasks that were not overly complex. As for the autonomy/control-related dimension, it was similar to overhaul in a broader sense where the commanding officer may be instructing firefighters to perform specific salvage procedures in a particular area of the structure; however, it differed from overhaul in that once a firefighter was assigned these particular procedures there was not a large number of discretion and decision-making needing to occur.

It is important to note here that the salvage process itself was not only performed post-extinguishment of the fire. Rather, it ideally should be occurring throughout the process of knocking down the fire:

“And it all depends on, you know, if this house is fully involved, or it’s going to be destroyed anyway, but if we can make a difference and not do more damage that they could possibly fix what’s wrong and move back into their house, you know. So we might even be considering putting salvage covers down, protecting the porches, protecting the carpeting, you know, a whole bunch of different things.” (*WCFD firefighter*)

When a fire may be contained to one section of a building or a structure, there is the ability to place down salvage covers or tarps in an attempt to prevent property damage from occurring. While this damage could be cause by the fire, the procedures used to extinguish a fire also created a need to perform salvage:

“If we have a fire, let’s say on the second floor, and water is running down through we’ll put covers, try to protect anything that has not been damaged yet. So that’s a continual process.” (*WCFD firefighter*)

Unfortunately, this ability to salvage prior to an incident was dependent upon the number of firefighters available. Obviously, the first and second priorities were to rescue any trapped individuals and extinguish the fire, and therefore during instances when manpower was short (this was particularly noted in the WCFD) salvage may not be able to occur simultaneously with these two high-priority tasks. Furthermore, as discussed in a quote above, if the structure was completely engulfed in flames the task of salvage was quite minimal. This was simply because of the destruction created by the fire may have not left any property that could physically be saved, subsequently minimizing the salvage that needed to be performed.

Fire investigation

Fire investigation was a task that in most cases the average firefighter had only minimal involvement. This task was mainly left in the hands of a firefighter who did not actively fight fires, but instead were trained to detect the origin and cause of

the fire through a series of investigative techniques. The reason I was able to gain this insight was that I was fortunate enough to interview an experienced fire investigator at River City regarding the task of investigation.²⁴ This provided insight into how investigation was completed.

Although specific to a select number of firefighters, it was still present in the fire related emergency job-context. Please note that in regards to the WCFD, I was informed that this task was completed by the Fire Marshal's Office. While I did interview one firefighter from this office (the Fire Prevention Officer), the focus of the interview was primarily on public education and not fire investigation (although he did mention that he was involved to some extent in the fire investigation, the information was not enough to provide strong evidence for the WCFD).

In the RCFD, a fire investigation (if conducted) follows immediately after a fire is extinguished, sometimes even prior to the extinguishment (if the fire is well under control/contained). Important to note is that investigation proceeds the overhaul and salvage of the scene. According to the RCFD fire investigator interviewed, the reasoning for this is that an investigator needs the scene to be left "as is" without any additional disturbance other than the disturbance that is created while actually extinguishing a fire. Thus, overhaul can lead to "spoliation of evidence" according to the investigator I interviewed, which in turn can make it not only difficult to make a final judgment on the origin/cause of a fire, but in certain instances can be used

²⁴ I was actually able to interview two fire investigators; however, one only recently began the position as a fire investigator shortly prior to the interview. As this new fire investigator spent the majority of his career on the special rescue unit (discussed in **Chapter 6**), and did not have extensive experience in his new position, his interview mainly focused upon the task of special rescue. Therefore, it was only this one fire investigator who provided me in-depth information regarding the task of fire investigation. This situation was rather beneficial, as it provided more insight into both of these tasks which may have otherwise not been able to be completed.

against the state of Maryland in court if prosecuting an arsonist. According to the investigator, the amount of time spent investigating the scene averages about one and a half to two hours, followed by two to four hours of paperwork. Fire investigation cases can go on “weeks at a time,” and in the instance of an intentional fire (i.e., arson) from the beginning of the case to the end (i.e., fire investigation to court sentencing) cases may be open on average about six months. Throughout the years, fire investigators in River City were always responding to any fires that were suspected of being intentionally set (according to the investigator, River City had a higher number of these than other bordering jurisdictions/counties) and accidental fires that were extremely large. However, within the past two decades, investigators also started responding to fires where any civilian suffered burns, either fatal or non-fatal.

An interesting discovery during this interview was the shift in fire investigation from something which the investigator referred to as “junk science” to a more scientific method-based approach to fire investigation. In these instances, the fire investigators were actually formulating and testing hypotheses:

“So we pretty much what our job is to do then is (sic) we basically have to rule everything else out. Say if um, say if we find an electrical outlet there. And that’s; we’re developing our hypothesis saying ‘Okay, we got electrical, we got electrical cords.’ We got to make sure the extension cord was plugged in. We got to make sure the house actually had electric to it, ‘cause we can’t call something electrical if there’s no electric to the house. So we have to determine that it does have electric if it’s an electrical, for our hypothesis we’re thinking. So then we have to rule out everything else. We have to rule out the possibility of cigarettes. You know, a million candles, a million other things. So once we develop our hypotheses, we rule everything else out and we have to say the only thing we have there, we can determine it’s an electrical fire.”

In addition to this more rigorous and methodological approach, there has also been an increase in the amount of knowledge required to be held by these investigators.

Knowledge has increased in regards to burn and ignition temperatures (i.e., what temperature aluminum is able to ignite), burn patterns (i.e., the pattern of an inverted letter “V” and what this implies), and even signs of criminal activity (i.e., gang symbols). Thus, overall the investigations appear to have gotten more complex as additional knowledge is now needed by the fire investigators in the RCFD. While no real broad conclusions can be drawn from a single interview, it should be noted that the investigator did mention that this knowledge and method of approach to fire investigation followed a publication of standards produced by the NFPA, which is sort of the investigators’ “bible of procedures” (to quote the RCFD fire investigator).

As part of this shift towards a more scientific and methodological approach, the RCFD fire investigator also noted that the emphasis of investigation moved from “cause and origin” to “origin and cause.” Investigators now start by first examining the entire structure to get a feel for the environment. For example, were there candles throughout the building? Did anyone smoke inside the building? Then, the investigators start from the least burnt area of the building and work their way to the most burnt in an attempt to narrow down where the fire may have originated. Once the location of the fire’s origin has been determined through this process, the investigator can then search for what may have caused the fire, begin formulating his/her hypothesis, and then subsequently rule out other causes to provide support for this suspected cause. As noted by the investigator, “you want to know where it started first before you determine.” While conducting this search/investigation, the fire

investigator had an extremely high level of autonomy needed to emphasize the utmost discretion during this situation. Thus, normally all other fire department members (both firefighters and even the commanding officer of the incident) were not able to be within the structure during the investigation. Again, this returns to the point that there is a need to prevent from spoiling the evidence which may be used to convict a felon in the instance a fire was intentionally set. Although this may be the case, there were also instances where the investigator may have requested assistance from a firefighter, and in this case the firefighter would fulfill the request. For example, the investigator may have requested that a firefighter station him/herself at the front and rear entrance of a building and not allow anyone to enter until after the investigation of the scene had concluded, or if otherwise allowed by the investigator. While the knowledge behind this method had increased, and the autonomy/control-related skills used by the firefighter was at a rather high level, the investigator stated that the task of fire investigation had not really been changed by any new technologies. In fact, the only technology that had come into play was different types of gas meters which were able to detect different gases and fumes in the case a liquid was expected to play a role in the fire and needed to be tested.

One final (and interesting) point the investigator made was that in cases where the fire was intentionally set, the fire investigators of River City had to be able to collaborate with various other state and city government agencies throughout the full investigation process. For example, the River City Police Department (RCPD)²⁵ would work to a certain extent with the RCFD investigator during the course of the fire investigation. The RCPD also had some resources that the RCFD did not have

²⁵ See footnote 10.

(such as a laboratory to test evidence for possible indications of the cause of the fire; e.g., carpet samples). In the case of arson, the RCPD was also the agency responsible for obtaining a warrant to arrest the suspect. Following this, both the RCFD and RCPD would also work together during a court case with the State's Attorney's Office²⁶ who was the government agency that would prosecute the suspected arsonist(s). This may have included not only providing the proper evidence to the State Attorney's Office, but also testifying during a court case as an expert witness. Therefore, not only were the actual skills of fire investigation needed by the RCFD fire investigator, but both a healthy knowledge of the criminal and legal systems and working professional relationships with various state and city government agencies were needed to be developed over time.

Equipment and apparatus check

The final task completed during the course of a fire in the fire related emergency job-context is to check one's equipment and apparatus. During the course of a fire, the apparatus and the equipment it contains is inevitably thoroughly (or perhaps completely) stripped down of many of the tools and components it contains in order to fight the fire. Before the firefighters leave the scene and return to the fire station, they must check to ensure all equipment has been returned to the apparatus, and is in working order (which may involve cleaning off any of the equipment). This prevents the firefighters from arriving at their next emergency situation and realizing there is equipment missing that is vital to handling the emergency. Equipment and apparatus checking after a fire is similar to those conducted while in the fire station

²⁶ See footnote 10.

job-context, and although not as extensive, they will not be discussed here to prevent redundancy. Please refer to **Chapter 7** for details.

Summary

Among the firefighters I interviewed, successfully completing the tasks required in the fire related emergency job-context was viewed as the bread and butter of a fire department. Not surprisingly, it was the skills in this particular context that the firefighters themselves truly prided themselves upon and identified with in a manner that gave them their identity as “firefighter.” The skills used in this particular job-context were uniquely situated in that not only did they require a certain level of substantive complexity and autonomy/control-related aspects, but they also required a certain level of physical strength to be able physically to perform these skills. Furthermore, a certain level of urgency was also required for many of these skills as every minute equated to a further loss of property, or even human life. Thus, even with evidence of skill change occurring, and new technologies being introduced, there was a certain fundamental level of skill that in its very nature was at a rather high level. While certain specific skills may have required a lower level of skill across both skill dimensions (i.e., salvage), the majority of tasks completed in a fire related emergency context did require high level skills. Even with the relative level of skill shifting over the past 20 years, it did so in a manner such that the absolute levels remained at levels where firefighters had to be able to rapidly integrate both mental and physical actions to successfully combat the fire, and have a heightened level of when to execute these specific actions. Furthermore, as a number of the skills did require a certain level of non-routinization, the introduction of new technologies was

limited to the level of skill that they could substitute (per the ALM routinization hypothesis). Therefore, there would always be a specific fundamental portion of the skills required for firefighters to complete the tasks of their occupations that could not have been impacted by technology.

With numerous tasks needing to be performed through the course of a fire related emergency, and an increasing number of new technologies being introduced, it was not surprising that the skills had changed. As for preparing for a fire related emergency, there was evidence that less substantive complexity was involved, mainly due to the introduction of new technologies. In particular, the introduction of newer alerting systems (which in the case of the RCFD included printers) and automatic transmissions in the fire engines/trucks did remove a certain level of complexity to the skills needed in preparing for a fire. In addition, the electronic maps produced by the printers in the RCFD also appeared to remove some of autonomy/control-related skill dimension involved in navigating to the scene of a fire related emergency.

At the scene of a fire, both engine and truck companies completed a series of tasks that paralleled one another and required a higher level of absolute substantive complexity and autonomy/control-related skill than many of the other tasks in this particular job-context. While they shared these similarities, interesting enough they did not parallel one another when it came to their changing nature over the past 20 years. In regards to duties assigned to the engine companies, one of the most evident changes in both skill dimensions was with the introduction of computerized pumps. These pumps decreased both the complexity and discretionary aspects of this skill (to the dismay of all but one engine operator I interviewed). This was a prime example of

Autor and colleagues hypothesis (2002) where a routinized task was able to be supplemented by a computerized device. It is also indicative of the diminishing effect that Braverman (198/1974) believed would occur with the widespread introduction of technologies. However, the engine pumper remained the only technology that followed this pattern. The process of attacking and suppressing a fire remained rather unchanged in the RCFD; however, with the introduction of the TIC in the WCFD, this did appear to increase the skill required to attack the fire. On the other hand, while the new engine pumpers themselves clearly had a decreasing effect on these particular skills used by firefighters, the skills of the truck companies (i.e., forced entry, search and rescue, using ladders, and ventilation) appeared to remain at a level consistent with the skill needed prior to the New Economy. Furthermore, there was evidence that when these skills did change (which was at the hand of technology), it appeared to occur due to the need for the new skills required to use the technology itself. For example, forced entry now required firefighters to possess the knowledge of how to use hydraulic rescue tools, and (in the case of the WCFD), the Knox Box. Newer style building construction created potentially more dangerous situations for firefighters performing ventilation and subsequently increased the autonomy/control-related skill involved when completing this task. Finally, the use of the aerial ladder did remove some complexity involved in setting up the mechanism for use; however, newer computerized sensors also created the need to understand how these sensors work in regards to the outriggers on the apparatus, and how to override them (if needed). It could also be noted here that while I argued that the use of a firefighter's

PPE and SCBA/PASS device was not particularly a skill per se, it also had been altered by technology.

Finally, after a fire had been knocked down, there were three skills that were discussed in which the firefighters were directly responsible: overhaul, salvage, and equipment/apparatus checks (fire investigation was a task not routinely performed by the average firefighter). Overall, the complexity and autonomy/control-related skill dimensions remained relatively similar to those 20 years ago, and at lower absolute level than many of the other tasks required at the scene of a fire. However, the biggest change occurred with the introduction of the TICs. With this new technology, firefighters now needed to be trained on how to use this new technology to find hidden fire, which increased the amount of complexity involved in completing this task. However, this simultaneously removed some of the discretion required by the firefighter when performing this task. Although overhaul had changed, and new skills were required to use the TIC, the skills required to complete salvage and equipment/apparatus checks (see **Chapter 7**) remained somewhat similar to those in the past.

Examining the fire related emergency job-context, there is an extremely high level of skill required to successfully complete the tasks needed to extinguish a fire. This high level of skill is evident not only while at the scene of a fire, but even during the tasks required while preparing for a fire and (although at an arguably lower level than other tasks in this particular job-context) after a fire has been knocked down. There is also evidence this level of skill has changed in the New Economy, and in almost all instances this is due to the introduction of technology to this fire related

emergency job-context. The effects of technology have been two sided, both removing certain aspects of skill, but yet at the same time creating new aspects. First, these new technologies have caused the removal of certain aspects of the skills used by firefighters to fight fire. This removal was evidenced through applying the conceptual model of my study to systematically analyze the data resulting from my interviews. In these instances the removal of these skills was rather clear and even acknowledged by the firefighters themselves. As mentioned above, a prime example of this was the introduction of new computerized pumps in the fire engines themselves. However, this diminishing of skill was not commonplace across the entire fire related emergency job-context. Many new technologies did increase certain levels of the skill dimension for the firefighters by actually requiring increased levels of complexity and/or autonomy to use these new technologies themselves. For example, the introduction of TICs and hydraulic rescue tools now required that the firefighters understand how to use these technologies that had only limited (if any) use in the fire departments prior to the past 20 years. Because the real changes in skill can be contributed to these new technologies, many of the aspects of the skills required by firefighters to fight fire could not be shifted by these technologies. There was a certain level of non-routinization present in the tasks completed by firefighters in this job-context, and according to the theoretical model, as would be expected these new technologies could not replace these particular aspects. Therefore, while technology had a clear impact on the firefighters' skills in the fire related emergency job-context, there still remained a certain high level of skill that appeared rather

constant. Thus, even with new technology, it was (to re-quote a firefighter) still “putting the wet stuff on the red stuff.”

Chapter 6: “They Call for Everything” – Non-fire Related Emergencies

The skills and knowledge needed in addressing fire related emergencies consisted of numerous tasks occurring simultaneously with a variety of firefighters completing these various individual tasks according to what precise position they were serving during that particular shift, and the environmental factors involved in the structure where the fire was occurring. It was obvious that these procedures required an absolute high level of complexity and autonomy/control-related aspects. However, in regards to the volume of these types of emergency calls, they were not the most dominant. Throughout the course of my interviews I quickly realized that the majority of calls to which the firefighters responded did not actually involve fire. In fact, the proportion of fire versus non-fire related emergency calls had shifted over the course of the past 20 years where the number of non-fire related emergencies is much higher than the fire related emergencies. Although the premier mission of the Waterville City Fire Department (WCFD) and River City Fire Department (RCFD) involved rescuing victims safely from fire and extinguishing the fire, there were many other emergencies that firefighters faced at all times during their shift.

It should be noted here that the term “non-fire related emergency” is used to distinguish these types of call responses from an actual call involving a structure fire. In the eyes of the firefighters, not all of the tasks that need to be completed that I refer to here are actual emergencies, but simply calls that needed to be responded to in some timely fashion. In other words, while these calls did not require a response at

the same high speed and urgency that a fully involved house fire required, they still needed to be responded to by the firefighters in a timely fashion. For example, dealing with flooding conditions may have not always been a real “emergency.” However, other calls such as multiple vehicle automobile accidents were in fact treated as such. Regardless of whether or not these particular calls were considered a real “emergency” by the firefighters, in this present research these calls will be referred to as non-fire related emergencies, simply to distinguish them from other non-emergencies (e.g., public education programs at schools). Of the non-fire related emergency calls, there were a number of them that will be discussed here, including automobile accidents, first aid and medical emergencies, conducting CPR and using automatic external defibrillators (AEDs), responding to false fire alarms, mechanical/maintenance tasks, and finally specialty rescues.

Receiving an Emergency Call/Navigating and Driving to the Scene

Obviously, the reception and processing of a call and navigating/driving to the scene of an emergency were involved in any of the following tasks in the non-fire related emergency job-context. Both the reception of a call and navigating/driving to the scene involved very similar procedures as were needed when the call was for a fire related emergency. However, one brief difference should be noted. As the personal protective equipment (PPE) were specific to handling fire related emergencies, they did not always have to be donned by the firefighters when responding to all of these types of non-fire related emergency calls, as they simply

were not needed.²⁷ Therefore, based on the definition of skill used in this research, these preparation-oriented tasks preceding any emergency may have a lower level of substantive complexity involved when responding to non-fire related emergencies than compared to fire related emergencies. Regardless, as the tasks of receiving an emergency call and navigating/driving to the scene were discussed in detail in the previous chapter (**Chapter 5**), as to not be redundant they will not be repeated in this current chapter.

Automobile Accidents

The task of dealing with automobile accidents was a task needed to be completed by firefighters on a somewhat regular basis. Not only did these type of non-fire emergencies involve the firefighters needing to deal with the actual automobile itself, but at least one individual (i.e., the vehicle's driver), if not more, was inherently involved in the accident. Thus, not only did this task require skills involved with successfully creating a safe scene and successfully removing the victim from the crashed automobile, but it may often times also involve first aid/medical care that needed to be administered (described below in the following sub-section).

The first portion of the task of addressing an automobile accident did not involve the vehicle, or any potential victims, but rather ensuring the scene of the accident was safe so that the firefighters could begin to handle the aforementioned components. This portion of the task could involve a few items. First was to ensure

²⁷ It should be noted that when responding to false alarms – listed here as a task in the non-fire related emergency job-context – there may be still be a need to don the PPE as this task may initially be handled by firefighters as a fire related emergency.

that the physical location of the incident was secure. This began with positioning the fire apparatus to block off traffic:

“You know, they teach drivers to position the fire engine to block traffic, to protect us from traffic. They [**fire engines**] can take a hit, not me. That big wagon can take a car or two, I can’t.” (*RCFD firefighter; author’s notation in brackets*)

Second, while not necessarily the norm, there were instances in which the vehicle may have caught fire, and thus the flames had to be extinguished.²⁸ While fire itself may have not needed to be addressed in all automobile accidents, the *possibility* of fire did need to be considered. Here, one concern was that any fluids that had leaked or spilled from the vehicle could potentially ignite and quickly create a fire putting either any victim(s) or firefighters in danger. Another concern was that the automobile’s battery itself could also send electrical currents through the vehicle and shock any individuals in the scene, again whether it was the victim(s) or firefighters.

In order to prevent this, firefighters often discussed needing to disconnect the vehicle’s battery so that electricity was not actively running through the vehicle. This would help diminish both of these potential hazards. However, while this task has remained constant over the course of the New Economy, technology itself has created a more complex situation than in the past, and subsequently a need for more knowledge than may have once been possessed by firefighters. Interestingly, this shift was not initially caused by any technology introduced by the WCFD or RCFD

²⁸ Although extinguishing fire was sometimes involved with an automobile accident, I have still considered it here as a component of this particular task of addressing automobile accidents in the non-fire related emergency job-context. This was for two specific reasons. First, the processes and steps involved in fighting a fire to a residence or business structure were unique and different than dealing with a car fire. This occurs not only through how the fire itself is suppressed, but (in the instances of automobile accidents) the primary task involves rescuing any potential victims and removing all hazards from the scene. Second, throughout my interviews, it was clear that the firefighters viewed fires involving a structure and fires involving a car to be drastically different.

themselves, but rather due to the technological changes in newer model cars, particularly hybrid vehicles:

“Well, the way cars are built now. We got to have better ways to deal with them. Like, you got these hybrid cars now. A lot of people don’t know it but they get into an accident it’s the same amount of voltage as if you touch the **[hybrid]** car as sticking your finger in a light socket. They tell you when you buy ‘em **[hybrid vehicles]** that you don’t touch the orange wires. That’s because there is so much voltage in there it’s enough to kill you. So, we can’t go up and just touch the car to see if someone’s okay.” *(WCFD firefighter; author’s notation in brackets)*

As the WCFD firefighter discussed here, hybrid vehicles now have a much greater amount of electrical current present to allow the hybrid battery to run. In turn, instances where these vehicles are involved in accidents creates a much more dangerous (and deadly) environment for all the individuals involved. The firefighters now need to be familiar with this newer type of vehicle in order to safely handle the situation and prevent injury or death of themselves or the victims. As an example of the increasing danger of the situation, a firefighter from the RCFD noted that being shocked by a regular car’s battery would “tickle,” where a hybrid vehicle’s shock is deadly. Thus, these newer types of vehicles have clearly increased the knowledge and complexity needed to secure the scene of an automobile accident. This gain in skill was particularly important as not possessing this knowledge could in turn be a fatal mistake.

Once any immediate dangers have been established, the next portions of properly handling automobile accidents are to stabilize the vehicle and any victims. As mentioned previously, there has been a major concern over the safety of the firefighters and others involved in the incident. This concern is seen here with the increasing standards that need to be followed when handling an accident. Firefighters

are required to use car cribbing in certain situations in an effort to stabilize the wrecked vehicle prior to extracting any victims. This car cribbing equipment consisted of various types of wedges and other materials that could be inserted around the car to prevent it from rolling and potentially injuring a firefighter or (further) injuring any of the victim(s). This was a skill that has long been in place; however, we again see a change here occurring by the invasion of technology. The materials used to stabilize vehicles has now become lighter and easier for firefighters to use. It does not necessarily change the amount of skill involved in the integration of manipulative and mental components, but rather it simply lessens the amount of physical force required to insert and adjust the cribbing to a position where the vehicle would be stabilized. Thus, in this instance while the technology used had changed, the process and skill of stabilizing a vehicle with automobile cribbing has not changed.

After a vehicle is stabilized, another component of addressing automobile accidents is to stabilize the victim. This involves both extracting the victim from the automobile, but also providing them with any immediate first aid or medical care (see below). Depending on the specific accident, this may not be extremely involved. It could simply consist of assisting the victim in exiting the vehicle without the firefighter truly having to do much. However, although not commonplace in most automobile accidents, extraction can also be quite involved. Car-related technology itself has again played a role in this instance; however, the hydraulic tools have also been used here to assist with extraction of individuals from the vehicle (not

surprising, as they were originally used in stock car [i.e., NASCAR] racing). In addition, other “gadgets” are also used:

“We got a lot of newer gadgets to break in places. Rabbit tools, things like that where you have a door that won’t open so you get this tool and you get between the door and the jam and you got a hydraulic pump... **[To]** open the door before that, you John Wayne’d it with your foot or an ax or a sledgehammer. The tools they’ve come out with to get in cars, they’re amazing to me. Um, you get the cars with the window glass that goes up to the seal so you got a plastic thing you wedge down and then you got a little airbag you put in there, that opens it up and holds it, and you get this rod down – ‘click’ **[sound of an automobile’s lock popping]**. You don’t have to shim down in the doors with Slim Jims and all that stuff anymore. They’ve come up with new tools for that.” (*WCFD firefighter; author’s notation in brackets*)

The above quote provides a clear example of how the use of technology by the fire departments has changed the manner of extracting victims out of an automobile accident. As the WCFD firefighter stated, before the introduction of new tools used in car extraction, it was basic hand tools and brute strength used to bust open a vehicle to remove someone – you “John Wayne’d it.” Now, the introduction of tools allows for less physical strength to be required while at the same time you can still have the same effect. Simultaneously, each one of these new technologies did require that a firefighter understand how to use them. This was particularly evident for the hydraulic tools. As mentioned in the prior chapter, the introduction of these tools themselves required an increase in complexity to the task of forcible entry as firefighters now needed the knowledge of how to properly and effectively use the devices. In regards to automobile accidents, this complexity was also present. The basic skill of using these tools was required; however, they also needed to be used in a certain manner to gain access to a wrecked vehicle. Thus, the use of hydraulic tools affected the substantive complexity not only in the fire related emergency job-context (i.e., forcible entry), but also in the non-fire related emergency job-context (i.e.,

automobile accidents). While these hydraulic tools were discussed by almost every single firefighter that mentioned vehicle crashes, the above quote also shows that these were not the only technologies introduced to this task, but that in some instances other tools were also used, and as with any other tools introduced to the fire departments added a further level of complexity (even if small) to the task at hand.

While the fire department's tools themselves increased the level of skill – particularly substantive complexity – that was involved with removing victim(s) from a wrecked vehicle, the technology involved in newer automobiles also has played a role. Obviously, the electrical lines and wiring discussed above was one thing, but there are also others:

“Another technology that's just come out, that (sic) just been real big lately is the side-turned airbags. And one of the cuts that you can make with a tool to say like take the roof off, uh and the pillars. And there's, um, compressed...cylinder that holds the compressed gas to inflate that airbag is located within those pillars. In different vehicles it's in different places. It may not be there in one vehicle, it may be in another. Um, but if you were to cut through that with a tool, it's bad. It's very bad...It's almost like a gunshot. Um, but that's something you got to kind of keep educated with, with (sic) auto industry changing the way they manufacture certain vehicles, have fluid lines. Um, there are fuel lines running on the inside of the vehicle actually through the passenger compartment is something to be aware of. Um, different relief cuts to roll the dash are made where that fuel line may very well be...you have to look behind the plastic to see what's actually behind there before you make the cut, but you do have to be more aware of there could be a canister; there could be a canister of compressed gas anywhere within the vehicle for an airbag. (*WCFD firefighter*)

Features that may originally increase the safety of a driver/passenger of a vehicle during an automobile crash may actually have an adverse impact while an individual is being extracted from an automobile. For example, airbags that did not activate during a vehicle accident could potentially become hazards to a firefighter in this task. Not only could the airbag itself strike and harm a victim or the firefighter, but it

could also have an impact on the tool being used to cut or pry open a vehicle, causing the tool itself to harm someone. While these technologies themselves have changed over the past 20 years and increased the knowledge needed by firefighters, the constant evolution of personal vehicles appears to continually have been perpetuating this increase in knowledge. Not only are these new features such as side airbags, gas line placement, and electric wiring needed to be considered, but the firefighter also needs to have some knowledge about the make and model of cars to determine where these items may be located. As discussed above, one manner to handle this situation is to pull away the outer plastic shell covering areas where these features might be, where before this level of complexity was not involved and firefighters may have been able to simply saw, cut, or pry apart a vehicle without even considering the possibility that a compressed canister of air may be hiding in the column next to a car door.

Thus, with the victim removed from the vehicle, the next step involves medical assistance/first aid being given to the victims, and then (if needed) taking them to the hospital for further medical treatment. Following this, the final portion of this task is for firefighters to secure the scene itself. One item this involves is containing and removing any fluid spills. Gasoline, oil, anti-freeze, and brake fluid are all liquids that can easily have leaked out of the vehicles and been left at the scene. This involves throwing down absorbent material, which one RCFD firefighter noted is similar to “shredded paper.” This paper is then cleaned up and removed from the scene. This manner of handling fluid spills is another aspect of automobile accidents that has changed – as a few firefighters mentioned, they are no longer able

to simply use their fire hoses to push these hazardous materials down a storm drain. While the use of absorbent may not be overly complex in itself its introduction has never-the-less increased the complexity to this task. Another aspect of stabilizing the scene is simply to clean up any debris that has resulted from the crash, and gaining assistance in having the wrecked vehicle itself removed (a portion of this task that has been around for quite some time).

While above I have detailed the impact of technology in dealing with automobile accidents, and have discussed the increase in substantive complexity in this task (almost totally related to these new technologies), discussing the autonomy/control-related dimension of automobile accidents is somewhat difficult. Throughout the course of my interviews at both WCFD and RCFD, no clear picture emerged of exactly how the autonomy/control-related skill dimension exists in the case of automobile accidents, or how it has possibly changed. However, there were a few indications as why this might have been the case. During the course of one interview, the firefighter interviewee noted that when responding to an automobile accident, it is a very “situational” task, and the firefighters are getting pushed in “20 different directions.” The number of vehicles involved, the number of victims involved, whether or not there’s a fire, how badly the victims are injured, etc., all make these types of emergencies extremely unique. Thus, although there is a general sense of what needs to be done, the situational aspect of the accident truly plays a large hand at exactly how this task is completed. In addition, there is obviously a commanding officer at the scene who does oversee how the task is completed. However, in these situations it may be that the officer does depend more on the

individual firefighters to make decisions on what precisely needs to be done, which vehicle or victim should a firefighter be addressing, etc. Thus, internal to the department, it does appear that there is in fact more room for a higher level of autonomy/control-related aspects to occur here in this skill.

At the same time, automobile accidents also involve other parties besides the firefighters themselves. For example, the local police agency will inevitably be there to assist with legal aspects of the situation. Furthermore, in the case of the WCFD, the local rescue/ambulance service will also be there assisting with the victims.

Therefore, in these situations, the firefighters must be able to work along side these other parties involved with the incident to ensure that all legal (and in the case of the WCFD, medical) procedures are successfully completed. Thus, in these instances it appears that some of the autonomy/control-related skills are shared between these parties. In this case, while handling the immediate danger of the scene, and stabilizing the vehicle and the victim, it may be that the firefighters exert more autonomy/control-related aspects than these other parties. However, once the danger has passed, police officers and other professionals may have a higher level of autonomy. Thus, while no concrete evidence surfaced of the autonomy/control-related skill dimension, it could be *assumed* that to successfully complete the task of addressing an automobile accident, there is arguably a high level of autonomy/control-related aspects involved. At the same time, it is not clear as what level these aspects are exerted by firefighters, and how they may have changed over the course of the past 20 years.

First Aid/Medical Care

Over the course of my interviews at both the WCFD and RCFD, the data collected clearly showed that the most drastic change that occurred to firefighters' skills over the past 20 years was in regards to the first aid and medical care incidents to which they responded. Perhaps this is not a drastic surprise, as beginning in the 1970s, and particularly into the 1980s, there was a steady integration of emergency medical services (EMS) into fire departments in the U.S. Although the volume of fire related emergency calls has been decreasing in recent years, the volume of EMS related calls (an increase noticed even in the early 1980s; see St. John and Sheppard, Jr. 1983) has actually increased the overall number of emergency responses that firefighters must address (a pattern noticed even in the early 1980s; see St. John and Sheppard, Jr. 1983). Traditionally, the medical care involved at the fire service has existed at a very basic level where only limited EMS training may be needed (i.e., first responder certification) (see Smith 2001). However, in more recent years there has been an increase in the level of medical training required by firefighters, and not surprising this has had a major impact on the skills of firefighters. At the same time, the data collected in the present study show that this change is not uniform, and has been experienced quite differently by both the Waterville City and River City Fire Departments.

First aid/medical care by the WCFD

In lieu of the large integration of the EMS into fire departments across the U.S., the WCFD remains somewhat unique compared to this national trend. Waterville City had its own ambulance rescue service that ran independently from the

WCFD. During my initial visit and observation at the WCFD, I was able to discuss this matter a bit with some of the commanding officers in the department, and the basic impression I received was that that the collaboration of the WCFD with this ambulance rescue service was an extremely positive experience, and since it has worked well in the past, there was no real desire to change this system. Obviously, there are mostly likely a variety of logistics behind this longstanding partnership; however, there did not appear any sign that this collaboration would be changing in the near future. What is quite important here is that this working arrangement did impact the EMS knowledge and training required by the firefighters in the department. As advanced medical services were not directly incorporated into the WCFD, the firefighters did not need to be certified at an advanced level. Therefore, the firefighters in the WCFD only had basic emergency medical technician (EMT-B) training, or for those who were senior firefighters in the WCFD, first responder training.

With this specific departmental structure (i.e., no internal EMS vehicles), the effects felt by the firefighters were clearly different than those in the RCFD. In particular, the types of medical calls that the firefighters at the WCFD responded to were only instances that were life-threatening medical emergencies: heart attacks, stroke, respiratory distress, excessive bleeding, etc. As one WCFD firefighter noted:

“You got to know your basic EMT skills: first aid, you know, how to control bleeding, things like that. How to splint fractures. The good thing about us is we may be the first one on the scene, but five minutes later there’s an ambulance crew there, a medic, and they pretty much take over, and then really all we’re used for if we are not doing CPR is lift.”

Thus, the firefighters know exactly how to handle these clearly life-threatening emergencies. In addition, geographically the fire stations themselves are in an ideal location to address these calls. The WCFD firefighters are stationed in locations throughout the City that allows them to respond to an emergency call in a matter of minutes, and in many instances this response occurs prior to the ambulance. In these life-threatening situations, seconds can make a difference to the life or death of a civilian, and therefore the ability for firefighters to potentially arrive at the scene prior to the ambulance service places them in a position where they can make an initial intervention into the medical issues being faced by an individual, and hopefully this may be the difference in increasing the chances of a person's survival.

Interestingly, while all firefighters were trained and had the ability to perform these basic first aid/medical care tasks, they were more often used by firefighters on the engines as opposed to those on fire trucks. The reason was quite simple. As there was a larger number of engines present in the WCFD, each was responsible for a smaller geographical area of Waterville City, and they could more rapidly arrive at the location of the incident. In the case of the fire trucks in the WCFD, they were responsible for much geographically larger response areas in the City compared to the WCFD engines, and they simply may not be able to arrive at a scene as quickly as an engine. Therefore, not only would it take longer for a truck to arrive at a medical scene, but there was a greater likelihood that a truck would not be able available (i.e., in service) to respond to the emergency call.

When discussing the two skill dimensions outlined in the conceptual model, the presence of this ambulance service again has an effect. For example, when WCFD

firefighters initially arrive at the scene of a medical emergency, they need to perform basic life support services to a patient. Controlling bleeding, performing rescue breathing, and splinting a fracture all have a specific level of substantive complexity.

Yet, when the ambulance service arrives, these dynamic shifts:

“If it’s kind of what we would consider a routine emergency, we’ll get in, we’ll respond accordingly of course. When we get there we’ll just do an assessment of the patient, take vital signs. If there’s some kind of care we can give them, if they’re having respiratory stress, watch over them until the ambulance gets there and help them get loaded up and sent to the hospital. We’re the muscle, basically.” (*WCFD firefighter*)

The task of administering proper first aid/medical care shifts at the point when the ambulance service arrives. The firefighters are no longer responsible for these basic life support medical services, as the ambulance service workers now begin to perform this task. At this point, the firefighters may then stop performing the lead role, and enter a more supporting role. They are now charged with lifting and moving the injured person, providing any tools the ambulance service may need (i.e., rope, ladders, etc.), and even in some instances driving the ambulance itself to a hospital.²⁹

It should be noted that in some instances the firefighters may continue to administer this initial basic medical care (one example discussed in the interviews was providing CPR); however, as noted above in most instances they become the “muscle.” Thus,

²⁹ While a number of firefighters in the WCFD discussed the potential for a firefighter to drive an ambulance to the hospital, one interviewee provided more insight than others. During his interview he discussed that in some instances it may be best for a worker from the ambulance rescue service to remain by the patient’s side to continue administering any needed care. In these instances, the ambulance service may be short staffed, and therefore a WCFD firefighter may drive the ambulance so that the ambulance service worker could continue to administer care to the patient on the drive to the hospital. Due to the increase in personnel at the WCFD (i.e., now two firefighters are assigned each shift to a fire apparatus), this was not a problem as one firefighter could drive the ambulance while one could drive the fire apparatus. One thing to note here is that I am not certain if being able to drive an ambulance is dependent on the certification of the firefighters. For example, it was unclear from these interviews if only those WCFD firefighters who were fire apparatus operators (FAOs) trained to drive a fire engine or truck could also drive an ambulance, or if any firefighter from the WCFD could drive an ambulance regardless whether or not they were trained and certified to drive a fire engine/truck.

performing these actions with the task of administering first aid/medical care to a patient contain a lower level of complexity than the initial actions needed to be performed. Thus, the complexity involved in the task of responding to medical calls shifts over the duration of the task, moving from an initially higher level, to a lower level when the ambulance arrives. Although the higher level of complexity decreases over the time period of this task, this does not imply that it is completely removed from the task. Instead it is only needed until the ambulance arrives at the scene, and not for the entire duration of the task.

The autonomy/control-related skill dimension was affected in a manner somewhat similar to the substantive complexity dimension throughout the course of a first aid/medical care emergency incident. Upon the initial arrival at the scene, the responding firefighters were unassisted and therefore had complete discretion over the situation: how to proceed, what care to administer, when to administer the care, when to start/stop specific types of care, etc. However, when the ambulance service arrived, the firefighters from the WCFD at the scene would then experience a shift in their autonomy/control-related skills. They would no longer have the foremost discretion over the task, but rather the ambulance workers themselves who had a higher and more comprehensive EMS training background were the ones who would make these decisions. Thus, similar to the complexity involved, the initial level of autonomy/control-related skill was very high, yet when the ambulance service arrived it drastically decreased. Again, this did not imply that this skill dimension had been completely removed from the task. Instead this autonomy/control is only needed until the ambulance arrives at the scene, and not for the entire duration of the task.

A final note about these shifting levels of skill dimensions involved with medical emergencies – it was not always the case that firefighters would arrive at a medical incident prior to the ambulance rescue service. This could potentially be due to the geographic location and/or traffic patterns at any specific point in time (i.e., an ambulance may be only one minute away from an incident while a fire engine may be located three minutes away and located off a road with heavy traffic), or simply the nature of the call. For example, perhaps the initial first aid/medical care needed was able to be provided by the ambulance service without the assistance of the WCFD. However, the WCFD may still eventually be needed to assist in lifting and transporting the patient into the ambulance so they can be transported to the hospital. Therefore, there are also certain instances where the specific medical care tasks needed to be performed by a firefighter may not need a high level of skill. However, this is not imply that acting in a supporting role is unimportant – it is a vital component in removing a victim from the scene to a location where the appropriate care can be received.

Thus, although the collaborative relationship between the WCFD and the ambulance service was rather interesting, it did not overall change the basic medical life support skills that were needed by the WCFD firefighters; however, it did have an effect on the duration of the higher levels of complexity and autonomy/control-related dimensions involved in the task of medical emergencies. While these changes are important to recognize, it was actually a number of new technologies that had the biggest impact on these skill dimensions:

“You know, we didn’t have the capabilities that we have now... We do blood screenings now though, we check blood sugars, we check through glucometers which

we didn't have when I first started. They were carried by the medic unit but we can actually use that in situations where you have medic emergencies where you know, you think it might be a stroke or something, you can rule that out by doing a quick finger stick to see if a person might just have low blood sugar, it might be a diabetic and we can give them sugar which with our glucose which we now carry that would enable them basically possibly not even need transported (sic) to the hospital if it's caught early enough, so. And then also we carry drugs now that we didn't carry before, primarily epinephrine which is called 'epi' by, you know, like the slang name. But, you know, someone is bit by a bee and goes into anaphylactic reaction, prior to a couple years ago that was a drug that was only enabled to be given by a paramedic with an intravenous [IV] drug or a line that had to be started and it was a lot of time involved. Now they have auto-injector pens and they basically auto-inject the epinephrine into a person's system without having that set up that enables us to be able to provide that and basically save someone's life if they're having severe reaction where they can't breathe. So some of those things...we didn't have those capabilities because of the technology a couple years ago that now the technology's affordable and it's available and we now all carry those devices on our apparatus." *(WCFD firefighter; author's notation in brackets)*

The quote above by a WCFD firefighter discusses two specific technologies that were consistently found throughout the interviews at both the RCFD and WCFD: the glucometer and the epinephrine auto-injector (commonly referred to as an EpiPen® after a particular company brand name). Both the glucometer and EpiPen® had only been introduced within the past few years (less than five years was the time estimate I received), and while both were used to address a specific medical condition, they did have some similarities. As the WCFD firefighter mentioned above, the glucometer was used to test specific blood sugar levels of a patient to prevent them from entering shock. This device consisted of a needle that was able to puncture an individual's skin and draw an extremely small amount of blood. This blood was then collected on a strip of paper that was inserted into the glucometer. The meter would then automatically diagnose the blood sugar level based upon the sample provided and provide an electronic reading to the firefighter could then use this information to determine how to best proceed with medical care. In regards to the

EpiPen®, its use was somewhat more simplified. The EpiPen® was simply a device shaped roughly like a pen (writing instrument). It could be placed against a patient's skin. A button on the EpiPen® could then be pressed which automatically injects a needle containing the drug (epinephrine) into a patient.

Both of these technologies have inevitably added further skills that firefighters at the WCFD can now utilize when responding to medical emergencies. The skills provided by this technology were not previously available to the firefighters, and in essence has increased the abilities of firefighters when completing first aid/medical emergency tasks. Therefore, it is rather clear that these technologies have played a large role in the increase of the skill of firefighters regarding medical emergencies. Not only do the firefighters now need to possess the mental and manipulative integration needed to use these technologies, they also need the discretionary aspects as to when these tools are to be implemented. According to the argument posed by Autor and colleagues (2002, 2003a, 2003b), it would appear that it was an organizational decision which allowed these technologies to be introduced to the fire department and allowed the firefighters to increase the skill involved in responding to and successfully addressing these types of emergencies. In the case of the WCFD firefighters, this is not an instance in which there was a previously routinized task form which skill was able to be removed.

Interestingly, taking a broader picture it becomes clear that while these technologies have allowed the firefighters to gain additional skill when addressing medical emergencies, it never-the-less has done so via a decrease in skills used elsewhere. For example, as discussed above, an intravenous (IV) line was formerly

needed to be used in order to administer epinephrine. This skill is not possessed by a firefighter in the WCFD who is trained at an EMT-B or first responder level, but rather is a skill possessed by individuals trained as full-fledged paramedics. However, with the introduction of the EpiPen®, the skill involved with administering an IV is no longer needed. Thus, applying the conceptual model in a broader sense, routinization is able to remove skill involved in administering these medical treatments; however, it is not removed from the firefighters, but rather EMS personnel who have been trained as full-fledged paramedics. In the instances of firefighters, this routinization has decreased the skill involved to a level where it can be managed by the firefighters who are only trained at a basic level. Further drawing from the conceptual model, bringing the conceptualization of skill dimension into the conversation, it could be argued that these new technologies have also alternatively affected these two dimensions differently. In regards to substantive complexity, the mental and manipulative integration involved in the task prior to the new technology (e.g., establishing a working IV line) was at a higher level than is required by these devices. Therefore, the technology itself has clearly decreased the amount of complexity involved. However, as for the autonomy/control-related dimension, this decrease is less clear. With the technological innovation, there is still a need to make decisions as to (a) whether or not to administer these treatments, and (b) when to administer these treatments using the new technology. Thus, regardless of whether an IV or EpiPen® is used to treat anaphylactic shock, an individual still must possess the discretion involved in making the decision. Therefore, it appears that while both

dimensions have been affected by these new technologies, they have not been affected uniformly.

First aid/medical care by the RCFD

It was rather clear that the first aid/medical care skills used by the firefighters in the WCFD had drastically increased in the New Economy. As mentioned earlier, this was not unique to this particular fire department, but rather part of the general trend at the national level. Therefore, it is not surprising that the RCFD firefighters also had their first aid/medical skills increase over the past few decades as well.

However, while the overall pattern here may have been similar, there were a few stark differences within this pattern when comparing the RCFD to the WCFD. Due to these differences, the skills of firefighters in River City were at a higher level than those firefighters at the WCFD, and have subsequently created both new skills and allowed new tools/technologies to enter the picture. The most noticeable difference was that there was now a fully integrated EMS system within the RCFD, including a fleet of ambulances:

When I came in there was no such thing...When I came in it was 13 ambulances and a million people in the City. The busiest ambulance was probably about 1,500 runs when you only had 13 ambulances. Now you got 22 first line ambulances plus a bunch of reserve ambulances. Six hundred and fifty thousand people living in the City and the slowest ambulances probably gets about 6,000 runs a year. So it's protocol if any difficulty breathing, chest pain, seizures, uh anything of that nature, or if the first due ambulance is not available and another one's coming from a distance they'll send a suppression company [**fire engine company**]." (*RCFD firefighter; author's notation in brackets*)

The firefighters at the RCFD that I interviewed clearly recognized this dynamic shift in the services provided by the RCFD. As one RCFD firefighter bluntly stated it, the EMS aspects of the job were the "biggest change I've seen in our Department since

I've been here." Thus, even in the eyes of these firefighters, it was clear that this aspect had brought many new skills. In addition, these skills were no longer a secondary set of skills. Simply from the call volume and increase in ambulances (which was continuing to occur as I interviewed) discussed by the RCFD firefighters, it was clear that these skills were used very frequently by the RCFD.

As with the WCFD, the RCFD did see an increase in skill over the past 20 years in that their firefighters had begun to possess at least a basic EMT-B training, which brought with it an increased set of medical and first aid skills that could be used by the firefighters. However, organizational decisions made by the RCFD administrative officials in the early 1990s also further increased these skills. With the introduction of the EMS service and ambulances to the RCFD, the EMS paramedics and firefighters worked as separate entities. The EMS would be charged with the medical emergencies, and the firefighters remained responsible for the task of fighting fire. However, in this time period (early 1990s), a decision was made to begin training persons as both firefighters *and* paramedics through a program referred to by the firefighters I interviewed as a firefighter-paramedic apprentice program. Therefore, when an individual is now hired by the RCFD, they first must spend a number of hours riding and serving as a paramedic on the ambulance. After this individual serves on the ambulance for the required amount of time, they are then assigned with a fire company (it appeared as though most often an engine company) where they can begin to gain experience fighting fire. The firefighters from the RCFD I interviewed were almost all senior firefighters, and definitely had mixed views on this firefighter-paramedic program. Among a handful of firefighters I interviewed,

there was clearly a rather negative opinion of this current program. The rationale here was that these new firefighters were not getting as much experience as they should in the fire related emergency job-context as they may often be moving back to ambulances when needed. As a result, they were not getting the proper experience and training they needed to fight fire which subsequently could create less-than-ideal situations at the scene of a fire. A particular issue was raised that these situations may potentially place these new firefighter-paramedic “hybrids” in danger due to lack of training, or even potentially place their fellow firefighters in danger.

It is important to note that the firefighters who discussed this situation did not direct these comments at the firefighter-paramedic him/herself. In other words, it was not seen as a personal issue, but rather an organizational issue that could affect not only the safety of the firefighters at the RCFD, but also of civilians at the scene of a fire. Furthermore, the EMS skills themselves possessed by the paramedics were not being attacked. In regards to the medical skills, it was clearly recognized by the firefighters that there had been a drastic increase in the skills and procedures able to be conducted by these dual-trained firefighters compared to the more senior firefighters who were trained at an EMT-B or first responder level. Medical procedures that were once unable to be performed at the scene and needed to be performed at a hospital could now be performed upon the fire apparatus’s arrival. And there was clearly a respect present for this increasing ability to perform EMS tasks using these more complex skills. As shown by a lieutenant in the RCFD:

“I’m looking at the new guys now where five years ago in the Fire Department and I see ‘em out on the street in any kind of medical situation and I watch ‘em operate and basically all I do is I assist them. They have the training, I don’t. And I’m trying to assist them. I’m trying to foresee what they may need and have it right there so all

they have to do is reach behind ‘em and get what they need. You know, I can help ‘em lift, I can help ‘em get equipment. I can help ‘em establish communications and maintain the communications. I’m just; I’m amazed. I observe ‘em and in some cases wonder in some cases ‘Why are you fighting fires for a living? You could be so much more.’ But if one of those individuals left, then we’d be less of a department. So God bless ‘em. It’s an amazing thing to see.”

A captain in the RCFD who I interviewed perhaps put it in even simpler terms by stating that because he had a firefighter on his fire company that was trained as a paramedic, he has been to incidents where a civilian would have died if it was not for this paramedic training.

Through this organizational change implemented by the RCFD during the New Economy, it was rather clear that new skills had been introduced to the firefighters who have begun working for the RCFD within the past two decades. While it had not affected the training of those senior firefighters (which consisted of most of those persons in the RCFD who I interviewed), there was still the overall affect that these skills were increasingly present within the department and a requirement of all new personnel. Drawing from the conceptual model and the skill dimensions that stem from Braverman’s work (1998/1974), the increasing of skill is not as simple as may initially appear. In regards to the substantive complexity involved in the first aid/medical calls, this organizational change implemented in the RCFD has inevitably brought about a greater level of mental and manipulative integration needed by the firefighters. Thus, the substantive complexity involved in these types of non-fire emergencies has drastically increased among these firefighters trained as paramedics. In addition, it has also increased the autonomy/control-related aspects involved during these types of emergencies in a particularly interesting fashion. Prior to the paramedic level training of firefighters, the RCFD firefighters

had similar levels of training. Thus, during instances where firefighters were at a medical emergency, there was no marked difference in training, and the autonomy/control-related skills fell more evenly throughout the firefighters at the scene. Furthermore, during instances when a paramedic was at the scene, the firefighters would assist the paramedic with what was needed and the firefighters exerted less decision-making aspects than would be needed if only the firefighters themselves were at the scene. However, the change in departmental protocols now has integrated these two sets of skills to a point where the firefighters are also being trained with paramedic skills. Therefore, these autonomy/control-related skills are remaining within the firefighters; in the large majority of instances there are no longer non-firefighters in the department who are also responding to the scene. This autonomy/control-related aspect of medical emergencies now remains almost solely with the RCFD firefighters. Furthermore, as more complex procedures (and the sheer volume of procedures) are now able to be performed by RCFD firefighters, there is a more involved decision-making and discretionary ability that is needed by the firefighters.

It is also interesting to acknowledge that among the firefighters themselves in the department there is also a difference in the autonomy/control-related skill aspects during medical an emergency that is somewhat unique. It is now the younger firefighters who have more advanced EMS training and can successfully perform more complex tasks at a medical emergency when compared to the more senior firefighters. Therefore, this increasing level of autonomy/control-related skills has not been uniformly distributed within the RCFD. It is actually at a greater and more

involved level among the junior firefighters as they are in possession of a higher level of EMS training than the more senior firefighters. This is different from many other tasks (e.g., fire suppression using an attack line) where the commanding officer has a greater level of autonomy/control-related skill during certain situations. The preceding quote by a RCFD lieutenant provides a great example of this. This lieutenant had a very basic level of medical training and during situations where there was a medical emergency, a secondary role was assumed by this lieutenant to younger firefighter-paramedics. Thus, the firefighter-paramedic had the main responsibility of the patient, and with that all the autonomy/control-related skills that were needed. However, at the same time this does not imply that a firefighter trained as a paramedic had full discretionary abilities over the entire scene. While the patient was the responsibility of the firefighter with paramedic training, talking with family members, arranging placement of the vehicles, and deciding which tasks other fire companies should perform fell back onto the plate of a officer. The decision-making and discretion involved with this more overall supervisory aspect of a medical emergency fell under the more senior firefighters. In sum, the organizational change that occurred in the RCFD regarding first aid/medical care tasks increased skill along the lines of both substantive complexity and autonomy/control-related skill dimensions. While the increase in complexity during medical emergencies clearly fell on the shoulders of the firefighters trained as paramedics, the increase in the autonomy/control-related dimension was less uniform. Regarding the patient an increase was experienced by the firefighter-paramedics, yet the overall scene fell under the discretion of a commanding officer. Skill involved in medical emergencies

increased in the RCFD along both of these lines, yet through examining different dimensions it appeared that (a) it did not do so uniformly among all the firefighters within the department, and (b) the change in both dimensions occurred differently.

Although the reception of paramedic training by RCFD firefighters as directly affected the skills used by firefighters during first aid/medical emergency calls, it has also had an indirect effect on the skills of firefighters. Paramedic training has also introduced new tools to the firefighter-paramedics which can be used during medical calls. These new tools follow the same pattern as most of the medical technologies that have been introduced to both fire departments: their existence adds a new series of skills that was not before needed. One example that was consistently discussed by firefighters I interviewed in the RCFD was the introduction of drugs and medications that were now carried on a number of the apparatuses throughout the department. Of the paramedics in the RCFD I interviewed, they discussed that there was currently between 20-25 drugs carried by certain apparatuses. Some of these “drugs” can be administered by all firefighters trained as EMT-Bs (e.g., oxygen), yet many of them were used only by firefighters trained as paramedics. Administering these drugs may be somewhat complicated, and for some this even involved the use of an IV. Thus, there was an initial complexity involved in this specific procedure. However, this increase in complexity did not remain consistent over the years: technology in the medical field occurs quite rapidly and because of these tasks such as administering medication through an IV have themselves changed over the past few decades:

“To give an IV is to give an IV, but the needles have changed probably 20 times since 1980. They’ve gotten not necessarily easier to use because the needles I used in 1980 to give an IV was (sic) much more simpler and easier for me to use than the IV needle that is now used today, see, because the IV needle I used back then you had to take

the cap off. The catheter needle and then insert. Well, again because of injury. Paramedics were putting the cap back on and getting stuck, or taking the needle and laying it down and sitting on it, whatever. Take a needle, sticking it into the seat of the medic unit until you got done, you know?" (RCFD firefighter)

The needle now was not just a straight needle, but rather a more involved device that had a protective sheath which acted as a safety measure for those firefighters administering the needle. At the same time, this safety feature also made administering an IV a more involved task than it had been previously. Furthermore, as mentioned by the firefighter above, there were constant changes over the previous few decades. Thus, with all new technology has come more training and a need for the knowledge of how to use it. While this may not be a drastic shift in the complexity involved in the administration of IVs, it never-the-less has created a need to learn new skills corresponding to this technology, and the ability to perhaps disregard some of the complexity involved with administering an older type of needle.

The autonomy/control-related skill dimension involved with administering drugs has been affected in a less consistent manner:

“But before you do that [**administer drugs/medications**] then you have to have some; the doctor’s authority and that’s done via consult with the doctor, okay? There’s (sic) some jurisdictions that have a standard protocol. A paramedic can give one dosage at 0.4mg one time, but to go beyond that, okay, protocol says I can give you four dosages but I can only give you one prior to consult. If I deem, if five minutes later you’re still...maybe entrapped and I know five minutes later you are going to need, or ten minutes later you’re going to need another dosage of morphine, okay? But before I can give that, I have to have a consultation to the hospital with the doctor to have this authority to give that.” (RCFD firefighter; author’s notation in brackets)

Thus, only certain medications and certain dosages can be given by the firefighters with paramedic training. Other combinations of medications/dosages need the

discretion of a doctor. The firefighter must call a physician and receive verbal permission to administer a specific medication/dosage combination. Thus, the autonomy/control-related components of this skill are rather situational, and not always at a high level for a firefighter.

Interestingly, one of the RCFD firefighters that I interviewed who was also trained as a paramedic had an interesting take on this physician/firefighter interaction and discussed how this phone consultation itself also could add another level of complexity to the task at hand:

Firefighter (FF): For some drugs we have to call before we can give, because it needs a doctor's on-site approval. We have our protocols which says if you have this, this, and this you can give this, this, and this. If you have this, this, and this, if you *consult* you can give this, this, and this. That's just when we, as being a paramedic, whether I'm on the engine, whether I'm on the medic, when you consult you have to, you pretty much; they're [**doctors/physicians**] in a controlled environment with security, bright lights. You know, their friends around all the time laughing and joking and treating people. You know when we pull to a scene I got life-threatening emergencies, I need a physician on the line, there's still guns (sic) on-site. It's a big difference!

Interviewer (I): Oh yeah! I could imagine!

FF: So as a paramedic you have to paint a picture in the shortest, fewest amounts of words as possible to that doctor who's sitting behind a nice kosher desk so he can say 'Okay, he does need to give this patient these drugs. He does need to perform this procedure. Go ahead and do it.' That's the hard part. Because you can be a complete idiot and if you talk good over the radio, they'll give you whatever you want. You paint the picture to the doctor, now you can be the best paramedic in the world and can't talk and you are not going to get anything from the doctor.

Thus, in this conversation by the firefighter, he makes clear that the communication between the firefighter and the physician is a component to the administration of medication with its own level of complexity, aside from the substantive complexity involved in administering the medication itself, and the initial discretion needed to

diagnose the patient and determine what medication may be precisely needed at the beginning.

Clearly, the reception of paramedic training by all newly recruited firefighters in the RCFD was a major factor in the change of first aid/medical emergency skills that were possessed by the firefighters. It was also the dominant difference between the WCFD and RCFD in regards to the skills used for this task in the non-fire emergency job-context. However, within the interviews I conducted with the RCFD, another aspect of the task of handling first aid/medical emergency calls was also discovered throughout the course of my interviews, and one with which almost all RCFD firefighters that I interviewed took issue. This was the difference between “true” medical emergencies and other types of medical emergencies that were not really emergencies at all. As one firefighter noted about the local residents, “they call for everything.” Throughout the course of my interviews I received a number of stories that discussed instances where the firefighters would respond to a location for a medical emergency, and once they arrived at the scene, the situation for which they were called was not a true emergency:

“It’s every shift, throughout the whole City. The murder, the assaults, and the violence, and stabbings. Overdoses have tripled then they were 20 years ago. Go on a lot of overdoses, ODs. You know, so yeah. And then we get a lot of wasted calls. We go to the same house time after time and it’s the same thing. They use it as an ambulance to go get their medications at the hospital, or they use the ambulance as a bus or something. And soon as the address comes out you know where you’re going, you know what you’re going for. It’s the same people over and over but the City’s got to send for ‘em because of liability.” (*RCFD firefighter*)

Thus, the firefighters of the RCFD often do get “true” medical emergencies with a life-threatening situation that needs to be addressed and their medical skills utilized. However, those interviewed also stated that they often are being placed in

situations where the emergency they were called for was not an emergency at all.³⁰ Throughout the interviews I heard stories about a number of situations that firefighters responded to that were not even close to emergencies, everything from headaches to jammed fingers, from regular colds to constipation. As one could imagine, these instances were viewed in a very negative light by the firefighters. Due to the nature of their occupation alone, it was apparent that the firefighters would put themselves in harm's way to help someone in a real emergency situation. Thus, those I interviewed were not at all happy to rush to the scene of an incident only to have the caller state that they needed medication for their headache. Furthermore, the increase in these types of emergency calls was also problematic (in the eyes of a number of the firefighters I interviewed), as these sorts of calls were taking their apparatus temporarily out of service. If a true emergency was in need of a response in the immediate area surrounding their fire station, they would be unable to respond as they were tied up dealing with these other type of "medical" situations. As the firefighters deal with situations that need immediate response, and a matter of minutes can determine the outcome of a life-and-death situation, this is very problematic when a fire company is tied up dealing with a bogus medical call and must rely on another company to arrive from another area further away to handle a situation.

As firefighters are required to respond to these truly non-emergency medical calls due to liability issues, the task is created for firefighters of distinguishing true medical emergencies from bogus ones. It is quite difficult to discern the amount of

³⁰ This notion of "true" medical emergency calls versus medical calls that were not emergencies also was discussed in some of the interviews I conducted with firefighters in the WCFD, but not enough to make any true generalizations about the findings for this fire department. It was only in the interviews with firefighters in the RCFD that these non-emergencies disguised as medical emergencies were consistently discussed.

complexity and discretionary and related skill aspects involved when responding to these calls; however, by definition there is a certain level of these dimensions present. The firefighters in essence need to be able to distinguish between these types of emergency medical calls, and being able to interact with callers themselves, requiring a certain level of autonomy/control-related aspects. At the same time, these non-emergency medical do have a certain level of complexity to them (albeit not extremely high).

Conducting CPR and Using AEDs

Modern versions of CPR (known by its full name of cardiopulmonary resuscitation) can be dated to the 1950s/1960s (Paraskos 1993). Very quickly after modern versions of CPR began to be implemented, this technique also began to be integrated into the fire service (Jude 2003). While it is a skill that may often be used in medical emergencies faced by firefighters, because of its unique role as a method of treatment for cardiac arrest that can be used by all firefighters (CPR requires its own medical training certification), it was a specific medical procedure that almost every single individual firefighter mentioned during their interviews. Thus, as this task was one that was so clearly identified by firefighters as an important and distinct medical procedure, I have decided to discuss it separately from the other types of first aid/medical care.

As it is often glorified in popular movies and television programs, the average person in the U.S. understands that CPR involves a series of chest compressions and breaths administered to an unconscious victim. The breaths are performed in a standard manner for all persons, while the compressions are performed differently

depending on if the distressed person is an adult (performed using two hands), child (performed using one hand), or infant (performed using two fingers). There is also an alternating pattern that occurs repeatedly. Thus, once the initial diagnosis is performed by a firefighter, the type of person is identified (i.e., adult, child, or infant), and the decision is made that CPR is needed to be administered, the actual complexity is not at an extremely high level as it follows a basic and routine pattern. While this breathing/compression pattern has existed for sometime, it has changed repeatedly over the past 20 years based on recommendations made by national and international bodies of medical professionals. Over this time period the recommendations have many times affected the ratio of breaths to compressions given by the individual administering CPR. This ratio has repeatedly been changed, as was noted by a number of WCFD firefighters who constantly joked about this during the interviews stating that CPR changes “every year,” “every six months,” or even “every other week.”

However, while the breath/compression ratio has been changed, it has not changed the substantive complexity and autonomy/control-related skill dimensions:

Firefighter (FF): Yeah, CPR’s used...the American Medical Association, the American heart Association, for years they’ve; they’ve gone back and forth. They’ve bounced it, the procedure. Um, meaning that two breathes/15 ventilations, one breath/15 [ventilations], two breaths/30 [ventilations], you know. And it’s right now at two breaths and compressions initially. Um, that’s changed a little bit. The procedure has changed. Well, the procedure has not changed, but its requirements have changed, you know?

Interviewer: Okay. Yeah, I got...

FF: So doing two and 15, now you’re doing two and 30. But how you *do* that two and 30 is all pretty much the same. (*RCFD firefighter; firefighter’s emphasis in italics*)

Thus, the manipulation involved with chest compressions and breathing remains unchanged, rather just performed at a different ratio. In addition, the initial diagnosis of whether or not CPR should be administered still remains; however, once this diagnosis is completed by the firefighter, there is no discretion as to how many breaths/compressions to provide – the number performed is simply the current ratio (i.e., 2 breaths to 30 compressions) stated by those national organizations.

Using the conceptual model outlined here in this research, the skill dimensions remain unchanged throughout the changes in the breaths/compression ratio. However, over the past twenty years there have been two technologies that have altered the performance of CPR when handling cardiac arrest patients. One of these technologies that began to be used in the 1990s in the two fire departments where I interviewed was a protective face mask. These masks were part of a larger acknowledgement of the importance of safety throughout the medical profession in the increasing concern over transmission of infections such as human immunodeficiency virus (HIV) among persons. Other items such as face protection, gloves, and gowns were also starting to be worn to protect the firefighters and injured civilians from passing any type of infections/diseases. In regards to CPR, a special face mask was used to help with the assisted breathing aspect of the procedure. Instead of breathing directly into the person suffering from cardiac arrest via mouth-to-mouth, a face mask was used so that mouth-to-mouth contact did not have to be made. It could be argued whether or not this face mask affected the skill of firefighters in the WCFD and RCFD. As far as determining whether or not to administer CPR to a victim (i.e., autonomy/control-related skill dimension), the face mask did not have any impact. However, as far as

the integration of mental and manipulative tasks (i.e., substantive complexity) are concerned, one could argue that having to learn how to use this mask did increase the complexity involved in performing the breathing component of CPR (not the compression component). However, if any shift in the complexity of performing CPR did occur, it was very slight.

The second technology that was discussed by the firefighters throughout the course of my interviews was in regards to the automated external defibrillator, or AED. AEDs have the ability to analyze cardiac rhythms and (if appropriate) administer an electronic shock to the patient in an effort to revive them from their current condition (Kerber et al. 1997). While AEDs have been around since 1979 (Kerber et al. 1997), through my interviews I discovered it was not until sometime within the past ten years that they were introduced in a widespread fashion and placed on a variety of apparatuses within the WCFD and RCFD. It was not that they were necessarily absent from the fire department at this time, as specific vehicles in a department may have had AEDs in their possession. However, cost prevented them from being placed on the apparatuses throughout the departments until recently:

“I mean some of the first automatic external defibrillators, which is what the AED stands for, were very large and very expensive and not all units carried ‘em ‘cause of that cost. Now the cost is about \$2,000 a piece. There’s grants available and they’re encouraging more people to have them so they’ve become much more affordable and cost-effective and they don’t require as much maintenance before with the lithium batteries. You could have an AED where you don’t have to charge the battery for maybe two years, or maybe a year and a half depending on the usage where before you had to swap batteries out almost every shift, put them on a charger. They didn’t last and you would always have to carry extra batteries in case of, you know. So I mean the technology from that point has really improved and making us more efficient.” (WCFD firefighter)

As mentioned in the above quote, cost was no longer prohibitive for the use of AEDs. In addition, this particular firefighter noted that the technology itself had become more reliable and user-friendly. With this new technology, even firefighters trained at the most basic level of EMS could use this mechanism to administer an electronic shock to a person experiencing cardiac arrest, a task that was not able to be completed by firefighters throughout the department prior to the introduction of the AED. From the interviews I conducted, it was quite apparent that the firefighters clearly acknowledged and appreciated this particular technology. It was spoken as a definite asset to their EMS skills, and a handful of firefighters discussed situations in which they have seen a victim revived through the use of this technology.

While the firefighters I interviewed were now responsible for being able to use the AED, the actual use of the equipment itself did not appear that difficult. In fact, one firefighter even stated he could train a monkey to use it. The AED itself consists of a couple of pads which are placed on the victim's chest and a computerized monitor that reads cardiac rhythms to determine if a shock should be administered, and if so, how large of a shock. The computerized monitor that was connected to the pads actually verbally instructs the firefighter how to use the device during the course of its use

“You know, you find a patient down, you go in and assess. Yep, they're coded. You start compressions, start oxygen, someone hook up the AED, put the pad, put pad, hook up, turn it on, it tells you what to do.” (*WCFD firefighter*)

Thus, in regards to the substantive complexity involved with using the AED and administering the electronic shock, it is rather simple. It only involves physically placing two pads on a victim, turning on the machine, and following step-by-step

voice directions that may inform you to press a button (to administer the shock) or begin performing CPR (a skill already in possession of the firefighters). Thus, the amount of complexity involved with using this technology is not extreme. In addition, as the AED is now used in conjunction with CPR, it requires the same initial diagnosis of whether or not a victim is in cardiac distress and if this type of treatment is needed. However, the machine is programmed to dictate to the user the decision of whether or not to proceed with using the AED or to revert to performing CPR. Thus, although this has been an invaluable technology to the interviewees, and was perhaps the one technology introduced in the past 20 that was recognized by the firefighters as the most valuable, it did not drastically change the skill used by the firefighters. However, this is not to say that it had no effect on their skill – when accounting for both the complexity and autonomy/control-related dimensions involved, the AED did create a higher level of skill needed by all firefighters in both departments.

Referring back to the conceptual model, the routinization hypothesis (Autor et al. 2002, 2003a, 2003b) does apply to the procedures here. Previously, the administration of shock to an individual experiencing cardiac distress, and the diagnosis as to whether or not it should be administered, was completed by paramedics. However, as one's cardiac rhythms follows a routinized pattern, the AED was able to be programmed to read and identify certain patterns and administer the shock. Thus, the elements of this task follow a routinized pattern and in essence were able to be captured by computerized technology. At this point, this device was able to be implemented widely and used by persons with a lower level of EMS training. Therefore, while the device was able to routinize a specific task of the paramedics

and subsequently capture a certain element of skill,³¹ the same device was able to perform the routinized components of this skill. Furthermore, with a modest increase in training the AED could allow persons not certified as a paramedic the ability to perform the task of administering a shock to a victim. While the skill of administering shock was new to the WCFD and RCFD firefighters, and subsequently increased the skills needed in their job, it did so by removing a large component of skill once possessed by paramedics.

Responding to False Alarms

Both firefighters at the WCFD and RCFD discussed having to deal with bogus medical calls. However, throughout the course of my interviews, another type of “false alarm” was discussed by firefighters: those involving suspected fire.

Interestingly, these were only mentioned by one firefighter from the RCFD, but in the WCFD roughly half of the firefighters explicitly discussed these alarms, while a number of others mentioned them in passing. Through these interviews, the firefighters discussed two different manners to which they responded to such alarms.

In the first instance, the firefighters were aware that the alarm was activated not due to a fire, but for some other reason:

Firefighter (FF): Uh, responsible for any situation; let’s say we receive from communications. Already this morning we had a situation where people were fogging in a building and they set off the smoke detectors. Fogging for bugs.

Interviewer: Oh.

³¹ It should be noted that AEDs are not the only devices used to administer a shock to persons suffering from cardiac distress. As noted by a RCFD trained as a paramedic, the paramedics themselves have other equipment that is used to administer shock to a patient. Therefore, while the AED was able to capture this skill, it was done so at a very basic level and does not imply that paramedics no longer are required to have this ability.

FF: They set off the smoke detectors. Didn't require an engine response but they wanted our response to help 'em reset the alarm. Typically we don't reset the alarm, but we can give them advice as to what they need to do to correct their problem.
(WCFD firefighter)

In this first instance, the firefighters were aware that the instance was not a true life or death emergency, and did not view these situations as an emergency, yet they still needed to respond in a timely manner to the location and handle the situation. Here the cause of the false alarm was known, and thus the task was more a public relations issue (see **Chapter 8**). The firefighters needed to discuss with the civilians responsible for the alarms how to reset/adjust the alarm back to proper working order. In this situation, there was a fair level of autonomy/control-related skill exerted in dealing with the public, as the firefighters simply needed to on their own discuss with the civilians how to adjust the alarm. At the same time, there was also a fair level of complexity involved. The firefighters needed to not only understand how to place the responsible party in contact with someone who can adjust the alarm system, potentially even adjust the alarm system themselves, and finally how to effectively communicate these instructions to the civilian.

In the second situation, the root of the false fire alarm was unknown. In these instances, the firefighters would treat the response as a true fire related emergency response as if they did not necessarily know what the cause of the alarm was:

Firefighter (FF): And the thing is that they're [smoke alarms] sensitive, you know, a spider could get into it and set 'em off, you know. And you know, that happens in businesses if there's a lot of dust, they'll set 'em off.

Interviewee (I): Okay.

FF: But, I mean that happens a lot more, but we've also had calls where we've had fires where the alarm systems went off and that was, that was it. We had one about, uh...I guess it was last, no this past summer, but the summer before. The...our

Eastern engine ran an automatic alarm by themselves during a storm. And what it was it was a building across the street.

I: Wow.

FF: That there was a fire. The smoke was setting off the alarm where they were going. They pulled up and they had a fire. That's what caused it! [**FF chuckles**]

I: There's like no alarm or anything in that building on fire?

FF: There were people working in it that didn't even know it was on fire. The attic was on fire. There was a lightning strike, caught the attic on fire, people were still working, they didn't know. So the smoke set off the alarm from across the street. That's how we found it. (*WCFD firefighter; author's notation in brackets*)

Thus, this quote is a prime example of how a “false alarm” could potentially be a true emergency, and why they must be treated by the firefighters as a real emergency. In these instances, the responding WCFD firefighters are treating the situation as a fire, and thus the same levels of complexity and autonomy/control-related dimensions are present as in the task needed to be performed when preparing for a fire related emergency. However, during the instances where the issue is simply a false alarm, the firefighters may assist in resetting the alarm. However, in other instances (although not commonplace) these alarms may develop into a full working fire. At this point, the task of false fire alarm turns into an actual fire related emergency, and we see a shift in the job-contexts (i.e., from non-fire to fire related emergency). Thus, the firefighters responding to these alarms do have to initiate a certain level of autonomy/control-related skill in determining whether the alarm is in fact a false alarm, or if instead it is a fire that needs to be handled.

Technology also played an important role in the task of firefighters responding to the calls, and definitely was particularly a situational factor in Waterville City. As will be discussed in a following chapter (**Chapter 8**), over the

past 20 years there had been a drastic push in the WCFD to emphasize fire prevention among the residents in the City. A major part of this was the increasing presence of a smoke detector program where residents were provided free smoke detectors.

Therefore, this had both positive and negative effects on the WCFD:

“It’s [**smoke alarms**] a good and adverse effect of technology I think with us. I think it’s increased the amount of places that have automatic fire alarm systems. You know, it’s definitely I think a bonus to the occupancier (sic) to wherever the structure is that if we can get notified of something in its incipient phase and we can get there and do something about it...But at the same time the number of calls I think that we handle every year where it’s an actual something compared to number of false alarms is you know, there’s a big difference. You know, that; and with the false alarms comes (sic) wear and tear on the machinery, alarm machinery. And you know, and the possibility that our guys are handling a false alarm when they could be on another call. Closer or back in their first due area.” (*WCFD firefighter; author’s notation in brackets*)

Thus, in regards to the responsibilities of a firefighter, alarms can provide earlier warning of a fire allowing the firefighters to respond quicker, and subsequently suppress it quicker minimizing any injury to civilians or property damage. At the same time, any instance that a fire company in the WCFD responds to an alarm and is no longer in service (i.e., readily available to respond to an emergency call), they are not available if a true fire or non-fire related emergency occurs in their first due area. Instead, they are handling a false fire alarm that poses no real harm. As noted by another firefighter, this by-product of the smoke alarm/detector technology is really a *catch 22*.

Finally, it is also important to note how exactly this technology has had an effect on the skills of the WCFD firefighters. It is obvious that their tasks are altered by the increased presence of these alarms; however, it is not in a manner that truly affects the skills needed to perform their tasks. In regards to the substantive complexity and autonomy/control-related skill dimensions, the larger number of

smoke alarms in both residential and business structures has not had any large alteration in the manner these firefighters respond and complete the task. Potentially newer smoke alarms and fire detection systems installed in newer model businesses may have an ability to increase the knowledge needed by firefighters for resetting them. However, this is not typically part of the task for firefighters: in most instances the firefighters simply inform the responsible parties which company/organization to contact to reset the alarms, and not reset the alarm devices themselves. Therefore, it does not appear that these new alarm systems have altered either skill dimension involved in addressing the task of false fire alarms. Furthermore, the increase in the number of these false fire alarms that the WCFD responds to also does not appear to have affected the skill used to complete this task. Although the volume increase is interesting to note, even with a greater number of calls being responded to, the firefighters still complete this task in a similar fashion. Now it is simply completed more often per shift.

Mechanical/Maintenance Tasks

A series of non-fire emergency calls that firefighters both departments must address on a fairly regular basis fall under the category of what I would call mechanical/maintenance tasks. Except in certain instances, the majority of the firefighters I interviewed appeared not to view these types of tasks as “emergencies,” yet when a call was received they had to respond. Therefore, based on the categorization of emergency versus non-emergency used in the present research, these mechanical/maintenance tasks fall within the non-fire related emergency job-context. While these tasks may have themselves been independent calls that

firefighters needed to respond to, they also may have occurred simultaneously with some other type of non-fire related (or even fire related) emergency. Throughout the interviews I conducted at both the WCFD and RCFD, four types of mechanical/maintenance tasks were discussed to at least some extent by the firefighters I interviewed.

Flooding

The first task, and the one discussed most at length, was flooding. The majority of these calls occurred when the water pipe of a residence burst and was overflowing into a residence or building.³² These instances occurred throughout the year and in different types of structures, but the firefighters I interviewed claimed that certain conditions could perpetuate these types of incidents:

“Most of the time, uh, again it’s a lack of maintenance in the house. Most people don’t really pay attention what’s going on in their homes. A lot of times it’s the pipes just because it’s frozen or something and they have no idea how to turn the water off...A lot of it’s maintenance on it, on these problems. Again, in the City a lot of people are renting, the landlords don’t do a whole lot and the renters itself don’t pay attention ‘till they have a problem.” (*RCFD firefighter*)

Thus, many of the firefighters saw flooding in residences as simply non-emergencies, but rather as a product of the lack of everyday knowledge by civilians. In addition, a change in method of response to flooding had also occurred throughout both the WCFD and RCFD within the past ten to 15 years which helped reify this view:

³² Busted water pipes overflowing into the house were not the only cause of flooding incidents. For example, one WCFD firefighter discussed a incident in which he was involved where a sprinkler system in a building had malfunctioned and had to be “plugged” so that was would stop from entering the building. Furthermore, during the course of conducting my interviews at the RCFD, there was a major water main that broke in the downtown area of River City which created massive flooding and forced a series of road closures. While the firefighters played a role in this particular emergency call, other City government departments were also involved in maintaining and ameliorating the incident. However, while these two examples are interesting, it was the instances in which pipes busted that were routinely addressed throughout my interviews at both the WCFD and RCFD, and therefore it was these calls that could be discussed here at length in this section of the chapter.

“We used to go in there, turn the water off, get our vacuum cleaners, and suck the water down until you couldn’t get another drop out of the carpet. Now, over the past ten years we’ve realized these people are calling [**a professional clean-up service**], so we are eliminating the hazard and we are leaving. Because that’s our job... We know there are companies coming in that specialize in that and that’s okay for us to leave now which puts us back in service quicker to help someone else. I think that’s a good thing.” (*WCFD firefighter; author’s notation in brackets*)

The procedures of the departments themselves had changed so that firefighters were no longer cleaning up all the water created by flooding. Rather, they were simply turning off the water and making sure that hazards such as the water reaching electrical outlets, or (cited only by RCFD firefighters) the water rising to a level that extinguishes the pilot light on a hot water heater (this would allow for a continuous flow of gas to enter the building). The ability to spend less time on a routine call for flooding may have perhaps been needed due to the increase in the volume of calls being received by the firefighters during each shift.

In regards to the skill involved when responding to a flooding call, it appeared to not be at an overly high level of complexity, particularly for a handful of firefighters I interviewed that had received some form of vocational training in areas such as plumbing or electricity while in school or prior to joining the fire department. Furthermore, even with a rather low level of complexity involved, the shift in departmental procedures over the past ten to 15 years removed the portion of this task where a vacuum/pump (or even basic hand tools such as mops and squeegees) was being used. The removal of this component of the task further simplified the manipulation involved in the task. In regards to the autonomy/control-related skill dimension, these sorts of calls did not generally require a large number of companies (if even more than one), and therefore the firefighters were in a position to operate

with a large amount of autonomy. However, as far as the autonomy/control-related elements are concerned, there was not a large amount of discretion involved during routine flooding calls. The firefighters knew when they arrived that they had to turn off the water and contain any potential hazards. As in most instances this involved a similar and fairly standard series of manual procedures, autonomy/control-related aspects were also not an extremely high level.

Fluid spills

The second form of mechanical/maintenance task that was performed by firefighters at both the WCFD and RCFD was fluid spills. These types of tasks simply entail the firefighters safely clearing away any potentially harmful fluids or liquids. These fluids can range from a variety of substances: oil, anti-freeze, automobile brake fluid, blood, or any type of identified or unidentified liquid that may jeopardize the safety of civilians, the firefighters themselves, or even the environment. In certain instances, fluid spills may actually coincide with another type of non-fire related emergency. For example, during incidents where an automobile accident has occurred, the result may often not only include a wrecked vehicle and injured civilians, but also fluids that need to be addressed. However, there are some instances where a fluid spill may not need to be handled by the firefighters on the engine/truck companies as a large amount of liquid may result in the need to call a specialized hazmat unit to handle the situation.

Similar to handling incidents where flooding has occurred, the absolute complexity and autonomy/control-related dimensional aspects of skills are not at an extremely high level. However, unlike the decrease in substantive complexity found

when addressing a call for a flood, there has been a change in properly addressing fluid spills which has slightly increased the complexity involved:

“You know, fluid spills. Back then you could actually just take the fire hose and wash it down the street. That’s a big ‘no-no’ now. You can’t do that! You got to have absorbent down, you got to sweep it all up, you got to collect it. So now it takes more time for that. Even if somebody’s hurt, has blood on the sidewalk. We used to be able just to wash it off with a fire hose. Now we got to pour bleach on it before we wash it down. So yeah, you know a lot more safety factors go into it now.” (*WCFD firefighter*)

Although this change has occurred within the past two decades, and it does involve a few more manipulative tasks, it does not drastically change the complexity involved but rather it perhaps only creates a slight increasing effect. Even with adding a new tool (absorbent, a substance similar to shredded paper), and the need to successfully clean up fluids to maintain the safety of others, there is still not an extremely high level of mental and manipulative integration or decision-making and discretion being implemented.

Electrical problems

Incidents involving power lines or electrical problems were the third type of mechanical/maintenance task that firefighters at the WCFD and RCFD would address. As with the above mentioned mechanical/maintenance issues, the level of skill involved during most electrical problems was again not at an extremely high absolute level:

“You turn on a light and all of sudden you see a puff of smoke come out of the ceiling, from the wall. Many people have no idea what to do about that, and in most cases we’ll investigate and make sure its contained and the metal safety box in the wall and turn off the circuit breaker and just to call a professional to come out. And it’s a simple fix, but it’s an emergency to them. It’s pretty routine to us.” (*RCFD firefighter*)

Thus, at its basic level the procedures involved with this task are simply identifying where the problem is, cutting the power (which as stated above may simply involve flipping a circuit breaker switch), and calling an electrician. As evidenced by the RCFD firefighter quoted above, it is a “simple fix,” is “pretty routine,” and does not require an extraordinary amount of complexity and discretion. While this may in fact be the case, it is still an issue civilians are faced with and do not understand how to handle.

Although this low level of skill is present, both fire departments had gained a new tool called a hot stick over the course of the past five to ten years. This tool could now be used in this situation to more accurately pinpoint where exactly the electrical problem was occurring. This tool could sense the amount of electricity passing through a wire, light ballast, etc. and caused the firefighters at both departments to possess the amount of manipulation and mental integration required to use this tool. However, the discretion involved with the task of handling electrical problems was also increased. Firefighters needed to make decisions when it was safe to use this technology. As one WCFD firefighter stated, it was not always readily apparent:

“You know, if it is out here where the main power lines that carry thousands of voltage, you know, if it’s dangling, am I going to walk up with a hot stick? No, I’m not going to be nowhere near it. So yeah, you got to know when to use them, the limitations of them. If not, that’s when you’re going to get into trouble.”

It is important to note that while the decision needed to be made during all incidents where firefighters addressed an electrical problem, this was potentially more dangerous during instances where power lines had fallen. These specific type of electrical problems (i.e., power lines fallen down) were only discussed by the firefighters at the WCFD. However, during the discussion of these specific types of

power outages, a procedure similar to dealing with a residential electrical problem appeared to be used (minus turning off the circuit breaker). In these instances, the WCFD firefighters would arrive at the scene to prevent persons from going near the fallen (and potentially deadly) power line, and ensure that the electric/power company was alerted so that the incident could be addressed. Again, the level of skill did not appear to be extremely involved (even though the danger of this situation versus a residential electric problem was much greater).

Testing gases or odors

The fourth and final mechanical/maintenance issue that was frequently discussed throughout the course of my interviews by firefighters at the WCFD and RCFD was testing gases or odors. This type of issues was one that was directly impacted by new technologies that have entered the fire department over the previous few years. Initially, very rudimentary procedures were used by firefighters when they were called for a suspicious gas/odor, simply because they did not have the ability to always detect if a harmful or potentially dangerous gas was present. As one firefighter mentioned, they would simply smell with their nose to determine if a suspicious odor was present and then call the gas and/or power company to come and further investigate this smell. Furthermore, even if a gas/odor was able to be identified, this did not necessarily imply that the firefighters could determine what *type* of gas/odor was being detected. Thus, it appeared that although the firefighters were called to respond to these incidents, it was not apparent that much skill was involved simply due to the fact that the firefighters needed to rely on basic sensory skills that were not able to properly identify and diagnose the gas/odor. As put by a WCFD firefighter,

they would simply respond to the scene and “just babysit it ‘till the gas company gets there.”

More rudimentary meters first began to be carried by certain apparatuses (e.g., in the WCFD these meters were carried by the utility and battalion chiefs; in the RCFD they were carried by the fire truck companies). These could only detect a very limited number of gases (such as carbon monoxide). However, over the past few years the firefighters in both departments have had available to them gas meters that could detect and identify a much larger number of gases (four or five) than before. Thus, instead of just carbon monoxide, other types of gases could be detected by the firefighters themselves without needing to initially call for a power company or hazmat unit to respond to the scene.³³ In regards to skill levels, these new meters have clearly increased the complexity involved during the response to a gas meter as the firefighters now must train and familiarize themselves with how to properly use this tool.

Interviewer (I): What did you use before it, before this meter?

Firefighter (FF): Actually, we didn’t hardly didn’t go out much on ‘em ‘cause a lot of people didn’t have a carbon monoxide [**detector**]. And it really wasn’t that common and when we did have one, we really had a bad situation so you would call a hazmat. Because they were the only ones that had it!

I: So it sort of like added these...?

FF: Right. A lot of training, equipment, things like that. (*RCFD firefighter; author’s notation in brackets*)

³³ During the course of my interviews, while the use of four-gas and five-gas meters was frequently discussed, the specific types of additional gases that could be measured were not clear. Upon reviewing the literature, it appeared that these four/five gas meters may detect such gases/odors as carbon, nitrogen, or sulfate based gases (Bolstad-Johnson, Burgess, Crutchfield, Stormont, Gerkin, and Wilson 2000).

Training with these new meters was now required for all firefighters. With each new meter purchased by the department, the knowledge needed to operate it also increased. Thus, the substantive complexity used to perform this task subsequently increased. On a side note, also discussed here by this RCFD firefighter was that as residences were also installing carbon monoxide meters into their home, this also increased the number of calls. This occurred through two instances – legitimate calls, but also through false alarms. As with other instances, it appears that although the frequency of these calls had increased due to the introduction of technology, the actual skill involved when completing this task was not affected.

Specialty Rescues

It is worth noting that over the course of my interviews a few firefighters did discuss how on certain occasions, and during certain incidents, they or other firefighters may have been involved in specialty rescues. These types of rescues had a wide range, and included everything from swift water rescue (e.g., fast moving water/rapids), deep water rescue, high angle rescue (e.g., involving tall buildings/skyscrapers), confined space rescues (e.g., trapped in a ditch or collapsed building), entrapment (e.g., stuck in an elevator), hazardous materials (i.e., hazmat) incidents, and even severe medical emergencies (e.g., instances where a victim may be mangled with industrial machinery or is in a situation where s/he is not able to be transported to a hospital). These situations were quite rare relative to the fire and non-fire related emergencies that the firefighters faced on a regular basis; however, they still occurred and would need to be addressed by the WCFD and RCFD from time to time.

Only a handful of firefighters from both departments discussed these types of rescues, and it was difficult to make broad sweeping generalizations from these interview data about these types of tasks to the either the WCFD or RCFD. However, it was apparent that the level of mental and manipulative complexity involved in these instances was rather high. For example, when discussing an incident where an individual is trapped in an elevator:

Interviewer: What are you actually doing when you go on these calls?

Firefighter: Well, just like any of it, it all depends on the situation, but mainly we try to; we locate where the car is. Uh, try to make contact with the people. And then we open the doors. We have keys that we can open the doors to the elevator shaft and then that way, then once we can get in its either the people are right there, or like I said they could be halfway between where then we're going to have to get a ladder and there's safety things that are supposed to take place as far as killing the power of the elevator, blocking it off, especially if its not, you know. You get it where right here [**uses hands to signify an elevator not being flush with the floor**] and then all of a sudden you're bringing the people out and the thing decides to move and the thing comes down. (*WCFD firefighter; author's notation in brackets*)

Thus, there are a number of procedures that need to be followed to successfully rescue a person from a trapped elevator, even when the individual is inches away from the firefighter. Other types of specialty rescues may not be as life-threatening, but still require a certain level of skill to meet the complexity of the task, and certain types of tools that are only carried by individuals with this type of specialty rescue training:

“For instance, like women just used to walk in off the street, or the medics would call us. We had like a little Dremel® tool, you know, a little hobby tool. And like we carried them... And like somebody would have a ring and she was pregnant. And her wedding ring, you know, would be imbedded in her skin. Her finger's this big. And there wasn't no way. We used to have to cut the ring off. And what you used to do is of course metal heats up as you're cutting it. So we would take a nail file. You slide the nail file under the ring and hen you had to take the Dremel® tool, and then you would cut the ring with it. Razor blade, you know, with a cutting blade. And then as

you're doing it you had the syringe filled with water and you had to keep water on it, you know." (*RCFD firefighter*)

Thus, even in situations that were not life-threatening, a rather high level of complexity remained.

While the above examples clearly show a high level of substantive complexity is involved, the prevalence of the autonomy/control-related skill dimension is less apparent. One factor here was that not all firefighters had experienced training in these types of rescues. One firefighter in the WCFD stated that while all WCFD firefighters were trained to handle confined space rescues, only a few were trained in dealing with a large number of hazardous materials. Among the RCFD, one firefighter I interviewed had long served as a captain on the RCFD's specialty rescue apparatus. Here, the individuals riding on this apparatus may have themselves gained the knowledge and required training to handle a number of these specialty rescues compared to other firefighters, but this did not mean that they could handle all specialty rescues, or were effective during each of these particular instances. This also should not be taken to imply that other firefighters who did not serve on the rescue apparatus were not trained for these types of tasks. For example, not all firefighters who worked on the rescue were trained as scuba divers for deep water rescue, yet while I was conducting my interviews in River City I also met a firefighter who did not serve on the rescue unit yet was trained as a scuba diver and could assist with these deep water rescues if the situation arose. Thus, as far as the autonomy/control-related dimension of specialty rescues was concerned, it did appear rather situational. The discretion during these special incidents was dependent upon the certain

situation, the particular firefighters involved, and the precise specialty rescue training they possessed. As one RCFD firefighter discussed regarding a trench collapse:

Firefighter (FF): With that, the rescue is like the main focus, okay? The SRO [**Special Rescue Operations**] teams are like the main focus but everybody around 'em, all the engine and truck companies, they're the grunts. And you got to have the grunts because it's carrying a lot of lumber, heavy lumber, you use to shore the streets up and all. It's not two-by-fours, it's big lumber.

Interviewer (I): Yeah.

FF: And so, you have to set up cutting stations when you call back measurements and everything.

I: Yeah.

FF: And so it takes all these people just to assist and help you get the job done. So it's not rescue's so great, or the dive team's so great. They get a lot of support from the whole Department. They get all the credit, but the whole Department, you can't do it without everybody, you know? So 'Joe Blow' from the engine that carried ten pieces of cribbing, he was just as much help as the guy in the hole [**trench**]. (*RCFD firefighter; author's notation in brackets*)

While most firefighters I spoke to were able to be involved in these specialty rescue incidents, and had gained at least some basic specialty rescue training (i.e., increased the substantive complexity involved in this skill dimension), this did not exactly equate to an increase in autonomy/control-related aspects of these tasks as not all individuals possessed the knowledge and training for particular skills that was needed to establish a higher level of this skill dimension.

Specialty rescue tools also played a large hand in increasing the skill possessed by firefighters, particularly affecting the complexity. Different sets of tools were available in each department for certain rescues. A number of tools were discussed and included everything from elevator keys to specialized hydraulic rescue tools, to scuba diving equipment to specialized ropes and harnesses. The use of these tools required training and the firefighters must have increased their skill to be able to

properly use these tools. Furthermore, these tools had constantly been modified throughout the duration of the New Economy, and therefore required firefighters to increase their skills in order to use them. However, there were also instances where firefighters may have taken existing tools/technologies and created new uses:

“People will come up with ideas to use like a simple fire hose. Instead of filling it with water you fill it with air, and now you got if someone’s stuck in the ice, you shove the hose out to ‘em and they can grab onto the hose and pull ‘em in. Uh, you can use it for hazardous materials. Set up a dike, or if depending on the kind of material that might be in the water, the stream, it may be, it might be the kind that floats on water. You stick a fire hose out there and that prevents it from flowing downstream, and you angle it and it’ll pull right where you want it. And it’s just simple stuff that we already had on there that guys will come up with.” (*WCFD firefighter*)

Even existing tools had the potential to be used in a different manner during specialty rescues, subsequently increasing the complexity involved while performing the task.

Summary

After seeing the numerous and varied tasks that need to be performed by firefighters in the non-fire related emergency job-context, it is not surprising to hear a firefighter state that residents in the area “call for everything.” From life-threatening situations such as major automobile accidents to administering CPR and using an AED, to other matters that are arguably not true” emergencies such as responding to an alarm that has malfunctioned, or turning water off to prevent flooding, the firefighters at the WCFD and RCFD faced a plethora of widely assorted tasks within this particular job-context. The dominant general pattern regarding skill that was found within this context was that with one small exception (handling flooded residences), there was no evidence that the skills used by firefighters in the non-fire related emergency job-context had diminished. In fact, even when accounting for

both skill dimensions, and the impact of technology, it appears that in most tasks the level of skill required had actually been raised. The skill requirements to successfully complete all the required tasks within this job-context is clearly at a relatively high level and shows no real sign of being removed or even diminished.

Providing first aid/medical care, handling automobile accidents, and performing specialty rescues clearly involved a rather high level of substantive complexity, and this particular dimension among all three of these skills appeared to show signs of increasing. Even when performing first aid/medical care to a victim where both the WCFD and RCFD differed in absolute level of skill, there was clearly still evidence that showed that more complexity was needed by the firefighters to successfully perform their tasks. As for other tasks such as conducting CPR and using an AED and performing mechanical/maintenance tasks, the absolute levels of substantive complexity involved may have not been as high, and in almost all of these instances (with the exception of responding to floods) there was evidence that the amount of complexity involved was continuing to climb. In fact, it was only one task – responding to false fire alarms – that the complexity involved appeared somewhat stagnant throughout the New Economy.

While the complexity had clearly increased among these various tasks in the non-fire emergency related job-context, the shift in the autonomy/control-related skill dimension was less pronounced. For certain tasks it was difficult to determine the precise autonomy/control-related skill that was involved. This appeared due to one of two reasons. First, it could be that a specific situation of a particular task facilitated the amount of autonomy/control-related skill that was involved. This occurred

specifically during the task of addressing automobile accidents or a specific type of specialty rescue. Second, the actual training possessed by a firefighter also had a hand in determining the autonomy/control-related skill that was involved. This was extremely evident in first aid/medical emergencies. For example, this dimension was much more prevalent in the RCFD where certain firefighters had paramedic training, where as in the WCFD the firefighters had only EMT-B training and work in cooperation with a rescue/ambulance service to provide the needed care. Furthermore, even within the RCFD there were differences in the level of autonomy/control-related skill available to the firefighter during medical emergencies, again depending on whether or not the firefighter was trained as an EMT-B or paramedic. As for responding to false fire alarms, and the level of discretion had remained relatively stable throughout the course of the New Economy, yet during other tasks the levels appeared to have increased (even if this increase was only slight). This does not imply that there was an abundance of decision-making that needed to occur within these certain situations, yet there was a need for a larger amount of discretion than 20 or more years ago.

Clearly the picture of the non-fire related emergency job-context does involve more skill than was needed 20 years ago prior to the shift to the New Economy. What is also relatively easy to see is that new technologies have played a major role in this shift. A number of these technologies have been introduced by the fire departments themselves. Items such as the AED, Hurst® tool, car cribbing, hot sticks, four/five-gas meters, and a variety of medical equipment have all been added to the firefighters' toolbox and are now standard instruments that firefighters must be

trained on and understand how to use to perform the tasks required in this job-context. Furthermore, new tasks such as administering an electric shock via AED and determining precisely what gas is causing a certain odor are also now available to firefighters where they have previously not been able to perform such tasks without the assistance and knowledge of how to use these technologies. Furthermore, technologies external to the WCFD and RCFD themselves have also played a role. For example, newer types and models of cars and increased use of smoke or carbon monoxide detectors also have played a unique role in the shift of the skills of firefighters. Thus, even with instances where the skill used by firefighters in the non-fire related emergency context is increasing on both the substantive complexity and autonomy/control-related dimensions, new tools and technologies are still playing a role in further facilitating the change of skill among firefighters. In fact, it can be argued that these tools and technologies have played a larger role in this change for the non-fire related emergency job-context than in the fire station, fire related emergency, or non-fire non-emergency job-contexts.

Chapter 7: “My Other House” – The Fire Station

In this chapter, the tasks and skills required at the fire station job-context will be detailed. It is clear the skills used by firefighters to complete tasks during fire related and non-fire related emergencies happen in a fluid manner, and often require a higher absolute level of complexity and autonomy. However, at the fire station this is not the case. Here, the various skills need to be completed are performed somewhat independently from one another, and have the potential to be frequently interrupted due a need to respond to a fire or non-fire emergency. Thus, unlike both emergency job-contexts where the skills needed may sometimes overlap or occur simultaneously, the skills used at a fire station are compartmentalized, and rarely a performed in a situation where they overlap with one another. In addition, there is also a sense of predictability to these skills, as during each shift a firefighter knows what skills s/he will have to use at the fire station. This aspect of the fire station job-context is quite different from that of the fire emergency and non-fire emergency context where the number and types of calls, and the skills needed to be used during these calls, can be unpredictable from shift to shift. Each firefighter knows that their shift begins at the fire station and will inevitably end at the fire station.

The fire station is also the job-context at which firefighters at both Waterville City and River City spent most of their time (those at the Waterville City Fire Department [WCFD] spent more time at this station simply due to the shear volume of emergency calls was less than at the River City Fire Department [RCFD]). Firefighters viewed this as their “other home,” home away from home, or their “home

for 24 hours,” and often took pride in the history and appearance of their fire station. This was also the job-context in which firefighters often had downtime from constant (sometimes seemingly endless) work. It is where they sleep, where they eat, and where socialization with other firefighters takes place. Ideally it was a context where they could recharge after physically and mentally exerting themselves at an extreme level while handling an emergency. As was stated in numerous RCFD interviews, the amount of energy exerted by a firefighter during a standard room-and-contents fire was more than the average person exerts at an entire 40 hour work week. Thus, this downtime would initially appear as an important component to produce optimal results when navigating emergencies that occur within the fire related and non-fire related emergency job-contexts.

During a number of my interviews, however, when discussing the fire station firefighters at both departments quickly became defensive over what goes on at the station. While the station did involve time for them to relax, there were also a number of tasks that need to be completed on a regular basis at the fire station. Through my preparation for interviews and pre-testing, I did expect somewhat of a defensive reaction when discussing daily activities around the fire station as I knew that certain tasks needed to be completed. However, after only interviewing a few of the firefighters from the WCFD, I was amazed at the sheer number of tasks that needed to be completed at the fire station, and how time intensive these tasks could be. By listening to the firefighters’ discussions of daily life at the fire station, and discovering the amount of time they spent performing tasks at the fire station, I

quickly came to understand why the firefighters were so defensive about the public's misperception of what actions truly occur behind closed doors at the fire station.

There were four main tasks that needed to be completed at the fire station. While these tasks did not need to be completed with the urgency of those tasks in the fire and non-fire emergency job-contexts, or arguably carried the complexity and autonomy/control-related aspects as the two emergency job-contexts discussed in earlier chapters, they still remained a mandatory component to the firefighters' occupation. The tasks that firefighters performed on a regular basis in the fire station job-context included having to check/assess their personal equipment and respective apparatus, complete daily housecleaning and general maintenance, fulfill incident and activity reports, and participate in various types of training. In the following pages, each of these tasks will be discussed at length in greater detail.

Checking/Assessing Personal Equipment and the Apparatus

The first task that firefighters are responsible for at the fire station is checking and assessing the equipment used when responding to emergency calls. This included all tools and equipment (including the apparatus, or the fire engine/fire truck) that were used by firefighters while responding to fire or non-fire related emergencies. At both WCFD and RCFD, their respective department's formal operating guidelines stated that these equipment checks should be completed at the beginning of every shift. Thus, upon the surface this was not an issue in which potential existed for firefighters to make decisions and insert their agency. In fact, it was looked at by many as quite simple – when you begin your shift, the first thing you do is check all equipment and the apparatuses.

However, as with all other tasks that fall into the fire station and non-fire non-emergency contexts, some flexibility needs to exist when completing these particular tasks. As firefighters noted, fire and non-fire emergencies obviously take priority over all other non-emergency tasks (such as checking equipment), and therefore this task may not be accomplished immediately upon the start of one's shift. As one RCFD firefighter stated about the equipment check/assessment process:

“They give us according to the rules and regs [**regulations**], there's a three hour window that you know you have. It doesn't take anywhere near three hours, but you know we could get interrupted at any time so that's why I think they have that time limit; that time frame set up.” (*Author's notation in brackets*)

Thus, there was the possibility for the firefighter to complete the actions involved in this task, control the manner and speed in which this task was completed, and not identically follow the respective fire department's formal operating guidelines.

However, this possibility was not a decision made by the firefighter him/herself, but rather dictated by tasks outside the fire station job-context. Thus, this control present in the actions was not indicative of specific decision-making and problem-solving actions on the firefighters' part. Rather the control set over this task by the official guidelines was able to be substituted with another: an emergency call response.

Therefore, a low level of autonomy/control-related skill dimension remains over this task, regardless of which source – the operating guidelines or an emergency call – is establishing autonomy/control.

This instance provides a good example of the difference between Braverman's autonomy/control skill dimension (Braverman 1998/1974; Spenner 1985), and the autonomy/control-related skill dimension used in this present research. As mentioned previously, in taking skill to be defined by the tasks needed to be completed in a

particular occupation, and (per Marx) the effects that they have on human nature, the autonomy/control dimension at face value is not indicative of skill, but rather related to skill. Discretion does not equate to a set of tasks which need to be completed, and having a certain level of discretion present does not translate to having more/less tasks, but rather the influence of other circumstances outside of skill. However, having more or less discretion does affect a worker's decision making, problem-solving, self-control, and other discretion-related action needed to perform a particular task. Therefore, these are the particular autonomy/control-related skills which are present in this dimension.

To the large majority of firefighters, the view was shared that the process of checking equipment and the apparatus was a fairly simple and routine process, yet a vital component to their jobs. Firefighters at both Waterville City and River City realized that if their equipment was not working properly, they would not be able to respond to emergency calls. The process began by simply showing up to the station. Each firefighter would come to the station to relieve another firefighter from the proceeding shift. Thus, the first and last few minutes of a firefighter's shift involved a conversation and exchange of information with the individual from the previous shift for whom they were relieving (or replacing). While this might entail friendly conversation, each firefighter would get a "run down" from the previous shift: if any equipment was missing, if any part of the apparatus or piece of equipment was damaged or not working, and if there was any piece of equipment that the incoming firefighter might need to be concerned with during their shift for any other reason.

After the information exchange, one's own personal protective equipment (PPE) equipment would be checked, including the self-contained breathing apparatus (SCBA), to ensure that all is working properly and ready to go. In addition, all equipment located on the apparatus (i.e., basic hand tools, AED, hydraulic rescue tools, etc.) is checked to ensure it is in proper working order. Each driver is also responsible for ensuring their respective fire engine or truck is up and running and in working order. While firefighters not certified as drivers may assist in the process, it was the sole responsibility of the drivers to ensure their apparatus and the equipment it contained was in working order. All equipment and apparatus assessment involved the firefighters manually ensuring that all equipment was working, and could be used at a moment's notice if one needed to respond to an emergency. A firefighter from the WCFD summed this up nicely:

“We pretty much have a routine. We come in [**during**] the mornings. We do our daily check-off to our apparatus that we're assigned to, where here's Engine Two. And that's pretty much; we go over the equipment top to bottom, making sure everything is in working functional (sic), nothing missing, nothing broken. That usually takes about an hour, an hour and a half with two of us working on it. And that's everything. We check all, make sure all the lights are working. It's all inclusive, literally put your hands on everything.” (*Author's notation in brackets*)

Both the WCFD and RCFD had checklists that could be used in completing this equipment check-off/assessment. However, as the WCFD firefighter discussed above, the task itself involved manual labor, but became quite routine, and this checklist was not relied upon to guide the firefighters throughout the task's completion. This was mainly the case for older and experienced firefighters – not those who were newly recruited to the department.

Over the course of the past 20 years, the task itself that needed to be completed remained the same, and therefore the same process was used by firefighters to check their equipment. However, the introduction of new tools and technologies did somewhat increase the complexity of the task:

“Even if you go back a century ago, they did the exact same stuff that we’re doing nowadays, but instead of taking care of the engines, they took care of horses, or they took care of the steamer...Um, I may have higher priced toys to take care of, or maintenance. They didn’t have battery operated stuff. I’ve got a whole host of batteries to check everyday, between the thermal imager, the PASS alarms, the flashlights. They didn’t have any of that kind of stuff. So, you know, nothing’s really changes, just a little bit of the technology’s changed.” (*WCFD firefighter*)

Tools such as the thermal imager and personal alert safety system (PASS) device that have been introduced to firefighting during the New Economy simply increased the types and amount of items needed to be accounted during this task. In addition, as existing technology becomes more advanced, there are more pieces to check. For example, the SCBA not only needed to be checked that their air bottles are full and they are properly flowing air from the bottle to the mask, but newer models now have electronic gauges in the visors that have to be checked, in addition to the PASS device that is now integrated into the SCBA. In addition to this increase in the amount of equipment needed to be checked, the amount of time required to complete this task subsequently increased. As noted by one firefighter, this task used to take about only 15 to 20 minutes to complete, but now consumes approximately an hour of his shift.

Housecleaning

Basic housecleaning

Although the checking and assessment of equipment and apparatuses may be the first task a firefighter completes at the fire station, the housecleaning and general

maintenance tend to be the next task for firefighters. As would be expected, this task generally involved basic, everyday cleaning duties that contributed to the maintenance and upkeep of the fire station. On a daily basis, firefighters were expected to clean the toilets and bathrooms, sweep, vacuum, and mop the floors of the fire station, cook meals, wash and put away dishes, and make their beds. This form of housecleaning involved the use of very basic housecleaning tools (i.e., brooms, mops, buckets, vacuum cleaners, and cleaning chemicals) which had remained consistent over the past 20 years and longer. Many of these basic housecleaning tasks were expected to be completed throughout one's shift on an "as needed" basis. However, the abilities to make decisions regarding when to clean and how to proceed were left up to the firefighters. Thus, these daily cleaning tasks did not necessarily involve large amounts of complexity, but a firefighter's autonomy and control over them was rather high.

In addition to this daily cleaning, both the WCFD and RCFD operating guidelines had established a weekly schedule for individual housecleaning duties that needed to be completed during each shift depending on the day of the week.³⁴ This weekly schedule was not a newly created portion of the housecleaning task – it had been in existence as long as most firefighters could remember. For example, the shift that worked on Tuesdays at the WCFD had the assigned duty of cleaning the kitchen; those Waterville City firefighters who worked on Wednesday were responsible for doing laundry (and so on). This continued throughout the week and included duties

³⁴ As the RCFD had both day and night shifts, it is important to distinguish when the weekly scheduled housecleaning duties had to be completed. These weekly housecleaning duties scheduled at the RCFD were scheduled for their day shift, and not the evening shift. For example, if the RCFD's B shift worked during the day on Monday, and the C shift worked during the night, the weekly housecleaning duty scheduled for Monday would be the responsibility of the B shift.

such as cleaning equipment used to fight fire and handle other non-fire emergencies and the apparatus itself (done within the fire station as part of basic housecleaning duties), washing windows, and polishing the brass within the station (including the poles used by firefighters when responding to a fire).

As with the daily housecleaning duties, these weekly scheduled duties did not involve complex actions, but were viewed by the firefighters, their commanding officers, and the department itself as essential for the fire station and apparatuses to maintain proper working order. Although each respective firefighter department's guidelines set precedent as to what days these tasks needed to be completed, there still existed the discretion for the firefighters to decide when they were to complete them. In addition, the firefighters also had some discretion to adjust this weekly rotating schedule if there was a need to do so. If something was recognized as needing to be cleaned, or even if there was a "slow" day (i.e., not a large number of emergencies to which the firefighters were responding), additional housecleaning may be completed just to help maintain the fire station. For example, one RCFD I had interviewed discussed how the day prior to his interview they were all "bored" and decided to empty and clean out a storage closet, and strip and wax its floor.

Throughout the discussions of housecleaning at the RCFD, the reoccurring theme of romanticizing the past again surfaced. A number of the senior firefighters discussed that a number of the newly recruited firefighters had tendencies to use this autonomy to simply not complete the tasks required. While this was supposedly not the norm around the fire station, in some instances these experiences led to a removal of autonomy from these firefighters. They were instructed by their commanding

officers when to clean, and subsequently their decision-making abilities were removed. This was not necessarily an absolute decrease in autonomy, but only a short-term, temporary instance that this autonomy/control-related dimension skill dimension was revoked. Unlike the RCFD, the firefighters at Waterville City's department gave no indication of this being the case. In fact, a reoccurring theme during interviews with these Waterville City firefighters was the statement that because their battalion chief and captain worked at the main headquarters and did not physically work in the fire station(s) (unlike the captains and lieutenants at the RCFD), there was no constant direct supervision over these firefighters aside from a daily visit to the station by the battalion chief and/or captain. Thus, the opportunity for this removal of the autonomy-related skill dimension was not readily available for these firefighters.

Station maintenance

In addition to the basic housecleaning, firefighters were many times charged with the task of needing to complete building and equipment maintenance at the fire station:

“Well you know; that’s funny too because I talk to pedestrians or the ordinary citizen and they find it hard to believe all the things we have to do in the firehouse. And basically we’re maintaining the firehouse. The City provides us with a building and basically that’s it. Everything else we’re responsible for from the cleaning to the, you know, upkeep; the maintenance, you know. I’ve been here a long time. I’ve actually helped construct quite a few things, actually had to fix quite a few things, so you know, it’s an ongoing thing. When we’re not out fighting fire, there’s always something to do even in here at the firehouse. We’re always, you know, updating and always cleaning and maintaining. And this firehouse is a hundred years old, so it needs some work, some upkeep.” (*RCFD firefighter*)

General maintenance duties such as replacing doors and windows, painting, completing basic plumbing and electrical work, automotive maintenance, and even helping to maintain the emergency power generator were all tasks that were completed by those firefighters at their respective stations. However, unlike basic housecleaning duties which remained relatively stagnant and arguably were not impacted by technology, there were two important variables that influenced this general maintenance.

The first variable that played a direct impact in this task fell along the lines of shifting social class backgrounds of firefighters. Many firefighters whom I interviewed had 15 to 20 years of experience working in their respective departments. Many came from working class backgrounds, and had learned various trade skills, from either their fathers or public vocational training in high school. In addition, prior to becoming a firefighter, a number of those interviewed served a handful of years in traditional blue-collar occupations as plumbers, electricians, or factory workers. Two interviewees even mentioned serving in the military. This may not be very surprising. These blue-collar jobs were part of the nature of the economy at the time when many of the older firefighters I interviewed were in childhood and adolescence, when their fathers were working, and characteristic of both Waterville City and River City during that time period. Therefore, a healthy knowledge of various trade labor skills existed among many of the senior firefighters, and it was these skills that were drawn from when performing general maintenance around the fire station and on the fire apparatus.

However, there was also evidence that this knowledge used to maintain the fire station and apparatus was beginning to decrease. As many of the newer (and younger) firefighters were raised in the New Economy, less emphasis appeared to be placed on this type of trade labor in lieu of more “professional” skills, such as knowledge of computers, that were more readily used in many of the service-type occupations available in the New Economy. Therefore, with less of this (trade labor) knowledge in existence, the level of general maintenance that was needed could no longer be completed in-house by these firefighters. Rather, outside contractors or other persons were hired by the fire departments to complete the required maintenance, and less of this general maintenance may have been completed by the firefighters themselves. With both the WCFD and RCFD experiencing (or recently experienced) a number of new firefighters entering their departments, this was characteristic of both fire departments.

The second variable impacting the general maintenance firefighters perform in the fire station job-context are the station and apparatus themselves. As both fire departments were stationed in historic cities, the WCFD and RCFD both had fire stations that were quite dated. The fire service is steeped with tradition, and many firefighters stationed in these historic buildings were enamored with the long history many of these stations contained. In fact, while walking to various fire stations the thought often crossed my mind of how these buildings were reminiscent of many black-and-white photographs I had seen of the fire service. The interior was just the same. Tin ceilings, linoleum floors, and flimsy wood paneling were standard fare in the construction of many of these stations. Spiral stair cases also remained in the

older stations, as this was an important feature in previous decades of the fire service as it prevented the horses from entering the firefighter's quarters. Old black-and-white photographs hung throughout these stations – mostly in the kitchen and common areas – which stood as a testament to the physical consistency these stations had maintained over the years.

As these structures continually wear down over time, this tended to increase the amount of maintenance that was required. In some instances, it appeared that completing this general maintenance was quite frequent. As stated by one RCFD firefighter:

“You know this [**fire station**] was built in 1888... Rebuilt in 1902. Last major renovation was in the '50s, interior. Last major exterior renovation was in 1902. I think it's pretty good. And we don't have people come in and do most of our stuff. You know if we have a major electrical issue, yes, we have to get an electrician out here. If we have a major water issue we have to go get a company in. But other than that, you maintain it. We paint walls, we fix holes in stuff, we replace doors, we make it work!” (*Author's notation in brackets.*)

Therefore, the particular fire station at which a firefighter was assigned played a role in determining how prevalent this task was for a firefighter while in the fire station job-context. For some assigned to newer stations, the station itself required less maintenance on a consistent basis.

In addition to the fire station itself, the fire apparatus also required general maintenance. General maintenance on the vehicle was performed in-house by the drivers of the apparatus. Drivers at both the WCFD and RCFD were formally trained to perform standard vehicle maintenance on the apparatus, and it was their responsibility. Here, a similar pattern to the station was also followed, and as the apparatus aged, more maintenance was required. However, the amount of use also

played a role, and the more a fire engine or truck was used the more it may require general maintenance.

While the first variable influencing the task of general maintenance was due primarily to a broad shift in the firefighters' social class backgrounds, this second variable was a factor due to technology. As new technology was introduced to the station and apparatus, it was not able to remove completely these routine maintenance tasks of firefighters, but did slightly decrease some of them. For example, one of these new technologies was the ventilation system. These systems were an important component of the fire station as they minimized the amount of hazardous exhaust fumes that were produced by a fire apparatus running inside the fire station. As the national initiative of the fire service over the past 10 to 15 years was to increase the occupational safety among firefighters, these types of technologies appeared to be updated and discussed more frequently. A few months prior to the interviews I conducted at the WCFD, all of their fire stations recently had new ventilation systems installed. This new system replaced an older system that had to be more frequently cleaned by the firefighters. These systems were constructed in a manner such that less routine maintenance of these systems was needed.

Technology introduced to fire engines and trucks functioned in a similar manner. It was clear that the firefighters who drove these engines still needed to perform general maintenance on them, but some components of the apparatuses were now self-maintained. For example, one firefighter spoke of the previous engine that he drove. It had various cup valves that needed to constantly be oiled so that they operated properly and smoothly. However, with the newer engine that replaced this

vehicle he no longer had to perform this maintenance task. This newer fire engine now had a system built into it that self-oiled these cup valves, and there was no need for this task to be performed. Thus, in this example the Autor, Levy, and Murnane (ALM) hypothesis (Autor et al. 2002; 2003a; 2003b) explains how new technology has replaced a routinized task that was once needed to be completed by the driver of a fire engine.

Giving consideration to both trade labor skills and backgrounds of firefighters, the fire stations, apparatuses, and related technologies, distinctions exist along both the lines of substantive complexity and autonomy/control-related dimensions. The general maintenance performed at a fire station may contain slightly less complexity due to both the decrease in the informal knowledge possessed by firefighters to perform these tasks, and at the same time the introduction of new fire stations, apparatuses, and related technologies. However, even with some of these routine maintenance tasks able to be replaced, there are still many that are performed by firefighters at both Waterville City and River City. On the other hand, it appears the autonomy/control-related dimension of general maintenance tasks remains quite strong. It is expected that the firefighters maintain these stations, but rather the amount of maintenance they are able to complete is discretionary. Each individual has their own level of knowledge of various skills required to perform general maintenance tasks, it is left up to them and their company officer as to whether or not these tasks can be completed in-house or externally.

A final issue that affects both basic housecleaning and routine maintenance and should be mentioned is similar to checking/assessing equipment: these tasks

ultimately are stopped for any incoming emergency response, as these responses take priority. Thus, during shifts which these responses are more numerous, these tasks are often not completed until later in the day (the majority of firefighters stated that while not written in stone, they attempt to complete these tasks by mid-morning/early afternoon), or even occasionally not at all.

Incident and Activity Reporting

At both the WCFD and RCFD there were mandated reporting procedures that needed to be completed after every fire related or non-fire related emergency to which a company responded. Often firefighters at both stations attempted to complete this task as soon as they returned from a call,³⁵ but as with other tasks firefighters completed in the fire station job-context, the completion of this task revolved around the need to respond to other emergency calls. While this task was mandated at both departments, there were clear differences as to the process needed to complete them. At the WCFD, the task of incident reporting required that standardize reporting forms be manually completed (in duplicate) by the responding firefighter. One copy was then filed away for that firefighter's respective station, while the other copy was received by the main administration office at the WCFD. While on the surface this appears as a rather rudimentary process, the steps it took to complete and submit each incident form was surprisingly involved, and as jokingly stated by one WCFD firefighter, "Sometimes the paperwork takes longer than the call itself."

³⁵ It is important to note that incident reporting was not always a task that WCFD firefighters who responded to an incident were required to complete. For certain incidents to which a battalion chief or captain responded, it was one of these commanding officers that would complete the incident report. In these cases, this task was not the responsibility of the responding firefighters.

Each incident was reported using a standardized form to which the firefighters had access. These incident report forms were similar to that of the RCFD in that it asked for similar information such as various times that events occurred surrounding the incident (i.e., time the emergency call was received, time the fire company responded to the scene, etc.), what personnel were involved with the scene, information about injuries/fatalities, and also a narrative of the incident. The first step in completing these forms was that the firefighters often had to phone the 911 call center to receive their times. However, on a few occasions this was not the case and this information would be faxed over to the fire station. Once this information was received, the firefighters could continue to fill in the remaining incident information. After the forms were completed, one copy was filed internally at the station, while the other copy was placed in an outgoing mailbox and physically retrieved by a WCFD battalion chief or captain during their daily “rounds” (or visits) to each individual fire station in Waterville City. The final step in the process was that the commanding officer then delivered the hard copy of these reports to an administrative assistant at the main WCFD headquarters. This assistant would then enter the information from these incident reports into the computer using a type of software called *Firehouse*. This software is designed for the emergency incident reporting by fire departments, and is readily advertised in widely circulated firefighter trade journals.

According to the ALM hypothesis (Autor et al. 2002; 2003a; 2003b), the process of incident reporting is a routinized task that uses a standardized report for each incident. Alone this logic would argue that the introduction of computers would allow this skill and the corresponding actions to be removed from the WCFD

firefighters' daily routines. However, as also noted by Author and colleagues, the manner in which computers are introduced and implemented plays a vital role in the ability for computers and computerized technologies to remove skill from one's job. In other words, in the case of these firefighters not only is the issue *whether or not computers were introduced* to the task of incident reporting, but also *how they were introduced* to be used with this task.

At the WCFD, most fire stations did have a desktop computer, printer, and access to a wireless Internet connection. In addition, a digital template of the report was also made available to the firefighters that could be accessed using a computer, and completed on the computer. However, this electronic form then had to be printed out in duplicate from this computer and physically placed in the station's records and the outgoing mailbox to be retrieved by the commanding officer. As detailed by one WCFD firefighter:

"There is (sic) a couple of stations, the one I'm at today, we can do reports on the computer, which may seem archaic. We can type it up on the computer and print it out. Which, that to us is high-tech. Everybody else [**referring to other fire departments**] gets online and types it up and emails it, or whatever. So the thing that has changed is reports have gone from handwritten – some stations still have it – carbon copies to putting them on the computer and doing them that way." (*Author's notation in bold brackets*)

Thus, although computers were readily available at each fire station, and incident reporting was mainly a routine task, there was no removal of this skill from the firefighters' jobs. In fact, this was readily recognized by some firefighters. Comments were even made that although computers had been introduced, incident reporting was still completed via "snail mail." A handful of WCFD firefighters I interviewed even discussed that they continued to manually use pencil and paper methods of

completing the forms. This was completed by using a blank incident reporting form on top, a sheet of carbon paper (kept under “lock and key” as it was a dated technology that was difficult to obtain) underneath, and finally another hardcopy of the incident reporting form on the bottom underneath the carbon paper.

While reporting was routinized and recently computerized, and *Firehouse* incident reporting software was being used, the lack of impact of computers on Waterville City firefighter’s skills was referenced by the firefighters themselves as stemming from a lack of IT support provided by the local Waterville City government. There was a disjuncture between the firefighters initially entering this information at their respective fire stations, and the administrative assistants entering this information into the computerized reporting system. A lack of email use and a functioning intranet had not been made available which may have allowed for this task of reporting to be eliminated or drastically reduced as a responsibility falling upon the firefighters. Although the firefighters at Waterville City had been informed that improved computer support that would decrease the amount of time and effort in completing this task was being implemented in the near future, it had not yet occurred. Thus, drawing back from the ALM hypothesis, although the task is routinized, and the computerized technology had been implemented, the method of its implementation was an overriding factor that did not lead to any dramatic skill change in incident reporting among WCFD firefighters. However, the introduction of computers did show some increase in skill among the firefighters. In addition, it should also be noted that although computers had not drastically changed the skills

used during incident reporting, it did create the potential of a greater change in skill (specifically decreasing the routinized aspects of this task) in the future.

In the case of the RCFD, this task was performed a bit differently. First, as each engine and truck company had a commanding officer assigned, it was the responsibility of the commanding officer to complete the incident reporting for each shift. The firefighters and even the drivers did not have to perform this task with the exception of more sporadic occasions that a captain or lieutenant was not working a specific shift. It then became the job of the firefighter filling in this position (referred to as the “first acting man”). Another difference between the completion of this task at the RCFD and WCFD was that as the RCFD responded to many more calls than the WCFD, they ultimately had to complete more incident reports. While this did not directly affect the substantive complexity or autonomy/control-related dimensions of this particular skill for firefighters, it did increase the sheer prevalence of this task within the fire station job-context.

Unlike the WCFD, the use of computers was an essential component to the successful completion of reporting at the RCFD and affected the manner in which this task was complete. With the introduction of computers to the fire station in 2002, all incident reports were completed on the computer. Now, instead of completing the incident reports in hard copy, these could be completed directly on the computer via software similar to *Firehouse*. A personal login was required by all individuals completing incidents on this software, and allowed anyone with access to the system to login and view the various incident reports from around the department. This software was linked to a city-wide network that allowed the procedures to complete

this task at River City to differ from Waterville City in two distinct manners. First, because these incident reports were connected via a secure city-wide network, it removed the need for a firefighter to drive around the city to each individual fire station and physically retrieve these reports. Subsequently, this also prevented the need for an administrative assist or other support staff to transfer the information contained in these incident reports to some electronic record keeping system. Thus, while this manner did prevent some routinized aspects of this task from being completed, the removal of these steps in the task had relatively minimal impact on the skills of firefighters in the job-context of the fire station.

Secondly, some portion of this routinized task was able to be removed from firefighters. With this electronic incident reporting system, and the ability for others to access these incident reports, firefighters in River City could now be provided certain information fields contained in these reports via this network or other computerized communication systems. Thus, the need to call the 911 call center was now removed from the task of reporting. For incidents to which a fire company responded, they now would receive some information regarding the incident (i.e. location and times) through this electronic equipment. In most cases this information could be retrieved directly from the sheet of paper that was printed as an incoming emergency call was received at the fire station.

Thus, on the surface it appears that routinization had simplified the task of incident reporting for firefighters in the RCFD, but these computers and electronic reporting also had a variety of issues that countered this decrease in skill involved in the task of reporting by further adding a number of components that were now needed

to be completed. The first issue was that during the same time computers were placed in the fire stations, the then-mayor of River City established a city-wide program to electronically report all activities performed by city government employees. This was an effort to establish greater accountability and (ideally) increase productivity.³⁶

Thus, while reporting had always been completed by the RCFD, with the establishment of this electronic reporting system the firefighters stated a number of additional reports were now required to be completed. These reports did not focus on emergency incidents per se, but rather involved more detailed record keeping of fire company activities such as smoke detector installation and training activities. As one captain in the RCFD stated:

“To be honest with you, since we’ve received computers I’m finding myself spending more time in the office than I should. It’s become a job where I became a data entry operator, with so many different programs. Before I would; (sic) an officer or a lieutenant or a captain would go upstairs and an hour he would be done. Now I’m spending two, three, three hours a day up there. So it really to me, the ‘upgrade,’ so-called, computers have not helped my job.”

Thus, while computers were able to change some of the skills needed to complete incident reports, at the same time these computers allowed for the new city-wide reporting system to be implemented and subsequently create additional procedures involved with reporting. In addition, many firefighters at the RCFD who performed this task on a regular basis did not view the implementation of these computers and software in a very positive light.

³⁶ Although national incident fire incident reporting systems exist, this city-wide reporting system was independent of any national system. In addition, while the state of Maryland is a participant in this National Fire Incident Reporting System (NFIRS) (USFA 1997), it was not mentioned by any firefighter interviewed. Therefore, it is unknown if this information contained in these incident reports was eventually included in the NFIRS. However, the issue may also exist that as the firefighters themselves do not directly use the NFIRS data as part of their daily activities, and (if these incident reports are eventually included in this national system) therefore do not relate this inclusion of their incident reports within the NFIRS.

The second aspect of how these computers were implemented involved an inadequate amount of training. As discussed above when detailing the task of checking/assessing equipment and apparatuses, many of the experienced firefighters (such as those commanding officers involved with completing the task of reporting) were products of working class families and collectively have a rather extensive knowledge of trade skills. However, their ability to use computers is rather limited. Thus, while some basic training is available to many of these firefighters, a number of firefighters I interviewed expressed the views that this training was inadequate. This was due not only to the limited training they received on this computer software, but also the fact that the training did not account for the fact that many of these individuals had minimal experience with computers. Thus, in these particular instances firefighters would often view the computers as extending the amount of time required to complete this task and also creating a general frustration with completing reports.

Another issue that arose with the implementation of these computers and reporting software was that since their installation in the early 2000's, they have not been updated. During my first visit to a RCFD fire station, I was able to see firsthand how frustrating using this system can be. I was able to sit down with a captain of that station's fire engine and was shown the outdated version of Microsoft Windows[®] operating platform and simply how long it took to save reports, switch between various reports within the system, and even log onto the reporting software itself. Relative to recent computer systems and network configurations, the wait was quite excruciating.

A final note here regarding the reporting procedures at the RCFD was that even though each station electronically reported incidents using computer software, paper incident reports were also kept in-house by the commanding officers of each apparatus. These incidents/activities were reported in hardcover, bound journals. These paper journals were similar to the computers in that there were specific locations on each page that specified information regarding the incident was recorded. While these journals were not mirror images of the electronic computer software, they did allow for the same information to be reported. These paper journals had been historically completed at each fire station (dating back numbers of decades), and although the information was sent electronically to the central RCFD offices, the same task was duplicated in hardcopy form within these journals. Therefore, each incident was reported twice: once on the computer and once in these journals.

In sum, the implementation of computers in the past ten years did affect the mostly routinized task of incident and activity reporting, and there appears to have been an overall increase in the substantive complexity involved with the skills used to complete this task. The RCFD firefighters who completed the task of incident reporting had now developed a new set of (computer) skills that were needed to properly complete this incident reporting. In both the WCFD, the same actions needed to complete incident reports remains. As for the RCFD, while some aspects have been simplified, the introduction of a new electronic record keeping system has added an assortment of additional activity reports needed to be completed which could arguably be viewed as further increasing the skills of these firefighters.

Ironically, although the addition of computers created a new set of skills that the firefighters gained, when interviewing the firefighters themselves saw this introduction of computers in a rather negative light and creating additional and unneeded tasks. Perhaps this is not surprising: as shown in a study by Moon (2002) many of the expected so-called benefits (in the eyes of government workers such as the firefighters) such as cost savings have not (yet) been obtained by these types of e-government implementations (Moon 2002).

In addition to the substantive complexity dimension, there also appeared to be little impact of computers among the autonomy/control-related dimension involved with reporting. While the firefighters at both departments were free to complete these reports at their own leisure, they had relatively little ability to decide what information was contained in these reports. All incident and activity reports were completed via standardized forms that dictated the information needed to be entered. Thus, the dimension of autonomy/control-related remained relatively minimal to each of these firefighters even though there was some freedom to decide when they could be completed, how they were actually completed was dictated to them.

There was one aspect of these reports that was not completely close-ended and where the firefighters did have some ability to decide what exact details from the incident should be placed in the report. For each incident, there existed a “narrative” data field where the reporting individual was required to enter a description of the events that transpired during the incident. While this was required, firefighters appeared to be rather flexible in deciding how to complete this portion of the report:

“Some guys will still do that. They’ll go and you know: ‘car fire.’ Period. And I’ll put down what I saw, what kinds of vehicle, the tag number, what we did, what we used, everything. ‘Cause later on, who knows.” (*WCFD firefighter*)

Thus, although relatively minimal in this situation, the autonomy/control-related aspects of this task were not completely constrained – there was some small space for firefighters who were writing a report to exert some decision-making and discretion during this portion of completing incident reports. However, this ability to exert these skills was still rather minimal in the larger task of reporting, and had changed little over the past 20 years.

Within-Station Training

Compared to the three skills noted above that were regularly completed in the fire station job-context, training had a greater amount of flexibility not just in regards to the firefighters’ autonomy/related aspects of the skill, but also in regards to the complexity of the situation. At both the WCFD and RCFD, training tended to occur during the day. While training was common at both departments, at the RCFD it was completed on a daily basis. At both River City and Waterville City, the training was led by a commanding officer. While the firefighters themselves did not explicitly define different types of training, the interviews revealed that four different methods existed in which a firefighter’s training occurred: (1) recertification, (2) “as needed,” (3) new recruit, and (4) evolution. However, not all of these training procedures were done “within-station.” Evolution was a training that was completed in the non-fire non-emergency context, while new recruit training tended to fall across both the fire station and non-fire non-emergency job-context. Thus, as this chapter focuses on the fire station job-context, only recertification, “as needed,” and new recruit training will

be discussed. Evolution and (again) new recruit training will be discussed in the next chapter focusing upon the non-fire non-emergency job-context.

Recertification

The first type of training that was completed within the fire station involved mandatory recertification. In order to continually serve as a firefighter, there was formal required training that firefighters needed in order to maintain specific professional certifications. The most commonly discussed example that surfaced during the interviews with firefighters at both departments was CPR recertification. Regardless of an individual's rank, all firefighters had to be recertified in CPR on a bi-annual basis. This recertification was needed regardless of one's official title or level of certification (i.e. whether a firefighter was an emergency medical technician-basic [EMT-B] or a full fledged paramedic):

“I mean there's certain training we have to do every year to recertification. Your CPR needs recertify every two years. Those kinds of things that it's our department's responsibility to see that we get them done. The EMT, they have to re-cert that every three years, and there's several classes you have to do yearly.” (*WCFD firefighter*)

Although recertification-type training may simply serve as a refresher for many of the skills firefighters needed when responding to emergencies, the recertifications themselves were not stagnant. In some instances the recertification involved changes in the manner that a certain skill was performed. For example, the method of performing CPR over the past 20 years has always involved alternating chest compressions and administering breaths in some routine fashion. However, over the years the routine of alternating breaths and compressions has changed; to a frequent enough extent that a number of firefighters cracked jokes about this. One

WCFD firefighter even commenting that it appears CPR changes “every six weeks.” In other instances, recertifications may become more involved. Furthermore, the introduction of new tools and technologies has impacted these certifications: in the past firefighters did not have to be trained on these new tools and technologies. For example, the introduction of the AED has spawned a new skill, and subsequently added another certification to firefighters’ continual recertifications. As can be gathered by the evidence, this device was not widely used until roughly the past ten years, and subsequently before its availability, training was not required.

In regards to recertification training, the firefighters themselves did not exert any type of decision-making ability regarding what recertifications had to be met, and by when they were to be completed. Therefore, this autonomy/control-related skill dimension remained relatively unchanged for firefighters throughout the past few decades. However, with the introduction of new tools and technologies, the substantive complexity aspect of recertification training has increased. This change is particularly being driven by the new technologies used during medical emergencies such as AEDs, glucometers, epinephrine auto-injectors (or epi pens), and other tools that firefighters now must be trained upon. As the number of these tools and procedures increases, so does the complexity of the training that is required to maintain the various certifications firefighters are required to hold.

“As needed”

The second manner of training appeared to be the most common type of training that occurred within the fire station. This type of training was spawned in a variety of different manners as hinted at by a RCFD firefighter:

“Nowadays they give us time to do it [**training**], but we train every day. And it could just be little things. Pull out a piece of equipment, go over it, or do something big out front, throw ladders. We do company training which is done every day. We do battalion training which is done one day out of your two days with other companies in the battalion. And a lot of times that is subject to Chief will call up and say ‘Hey, I want you guys to go over this.’” (*Author’s notation in bold brackets*)

As detailed by this firefighter, the “as needed” training can be rather simple. For example, pulling out a tool like the thermal imaging camera and reviewing how it is used. Perhaps a more involved skill needed when addressing an emergency call is reviewed; here throwing ladders was discussed. In some instances, this “as needed” training may include watching videos or even discussing organizational issues such as payroll. In fact, during one visit to Waterville City I was able to sit in on a training that involved watching a video regarding how to assist in an emergency medical airlift by a helicopter.

This form of training was also influenced by the occurrence of certain fire related emergencies. As a portion of their training, firefighters may come together as a company (or a battalion) and discuss certain fire incidents that had occurred, and the manner in which the responding firefighters handled the situation. This review-style of training may have occurred simply due to the sheer size and involvement of a fire, the particular difficulty of an incident, the involvement of fire-related fatalities, or it even could be spawned due to some portion of the firefighters’ response not being performed to the best of their ability.

Similar to recertification training, this “as needed” training was again influenced by new tools and technologies that were introduced to the firefighters’ repertoire. Simply put, as new tools and technologies were introduced, this created new skills that firefighters’ at both departments needed to continually train upon to

keep their abilities up to par. In sum – new tools/technologies created new skills, each new skill creates another task the firefighters can perform, and each new task brings with it some new level of complexity (even if these skills are somewhat simplistic, following the logic of my conceptual model the overall substantive complexity of training is increased). However, unlike recertification that was mandated, there was somewhat greater ability for firefighters to implement autonomy/control-related dimensions of skill during the non-mandated “as needed” training. Here firefighters – particularly the immediate commanding officers – were able to decide what types of training would be beneficial for their company/companies to engage. As they were often the ones overseeing the immediate incident, they were the individuals who were able to make this immediate decision. However, while some levels of the autonomy/control-related skill dimension appeared to exist among firefighters during the task of “as needed” training, this was not always the case. As noted by the RCFD above, in some instances a superior commanding officer such as a fire chief was able to determine the precise training that was to be enacted.

New recruit

The training of newly recruited firefighters was a type of training that straddled the fire station and non-fire non-emergency contexts and appeared to be handled differently in both the WCFD and RCFD. In the WCFD, the training of new recruits was in part a function of the current structural change caused by hiring a new wave of firefighters and increasing their personnel by approximately 50 percent. Here, as these new firefighters all had begun serving as firefighters in the WCFD at

the same time, a standardized training program was established by the department to help familiarize these new recruits:

“Because I’m new, I actually have a probationary manual that I have to work on. And what it does is it familiarizes me with Waterville City, how the department operates. There’s several different sections in it. Um, like one section I have to do self-study on like the department’s standard operating guidelines. So there’s a question and answer I have to do research and that sort of thing. Then there’s another section with being familiar with major landmarks in Waterville City, like specific buildings that we may respond to a lot like the hospital, or like...the high-rise senior living centers. You know, we have to memorize our addresses, what our job is as an engine company when we respond there. Where the closest hydrants are, different things like that. What the box alarm is. And then there’s another section that I have to do that familiarizes me with the major streets in Waterville City. What they do is they start at the very beginning with like the major thoroughfares through Waterville City...and as the months go on they branch off of those so the whole goal is at the end of a year, after doing this self-study with the maps we should be pretty familiar with the entire City of Waterville.” (*WCFD firefighter*)

This discussion by a WCFD newly recruited firefighter displays a few things that are worth noting. First, this training of newly recruited firefighters follows a standardized manual (which was of a “workbook-style,” similar to one might have during their schooling) that all new firefighters are required to complete. Not only is this training standardized, but the firefighters are simultaneously working through the manual together such that all are required to complete certain components of this manual on a monthly basis. Furthermore, this training was supervised by their commanding officer, and this manual dictated precisely what was needed to be trained upon. Also important to note about this new recruit training in the WCFD is that while it did involve discussion of issues that any firefighter would encounter in this task, there was a large emphasis on local knowledge surrounding Waterville City, the same local knowledge that adds an element of complexity to the fire related and non-fire related emergency contexts. This included more knowledge than simply

being able to perform a task such as establishing a water supply and suppressing a fire, but also included knowing the environment and issues specific to areas of Waterville City (i.e., precise hydrant locations, locations and positions of certain buildings, etc.).³⁷

In addition to this formal training occurring in synchronization among the rookie firefighters at Waterville City, informal training of these greenhorns also occurred in part at the fire station among both departments, more prominently in the RCFD. This tended to involve more informal conversations and discussions with veteran firefighters who had experience in dealing with different tasks.³⁸ For example, one seasoned pump operator at the RCFD occasionally met with firefighters to discuss different techniques used when operating a fire engine to supply water to attack lines. In most instances, he stated that this informal training would be initiated by these firefighters themselves, perhaps due to a problem that arose at an incident such a partial malfunction of the apparatus and a need to manually override the malfunctioning computerized operating system. Thus, this type of informal training was not driven by department requirements, but rather instigated by newer firefighters themselves. Furthermore, the senior firefighters were also able to use their own autonomy/control-related decisions to determine the best method and manner to proceed with this type of training. In fact, many of the senior firefighters at the RCFD

³⁷ Although the interviews unearthed the details of this formal training process at the WCFD, only one firefighter (a captain) in the RCFD mentioned that there was a formal training program for new recruits. However, it was unclear as to how structured this new recruit training program was in the RCFD. It was speculated that because of the sheer number of emergency response calls taken by fire companies in River City, and the daily training that was implemented by the RCFD, a standardized training program for new recruits similar in size and magnitude of that in the WCFD.

³⁸ Although this type of informal training is listed here as “new recruit” training, it should also be noted that even firefighters who are no longer rookies may have informally collaborated with their fellow firefighters to review and refresh specific skills. Thus, this informal training was not solely limited to new recruits.

appeared to enjoy when these younger men and women firefighters took it upon themselves to gain knowledge used to perform different skills and corresponding tasks. This initiation and autonomy/control-related dimension was viewed by the senior firefighters as a sign that the new recruits were not just here “for a paycheck,” but rather they truly desired to be a firefighter.

Receiving an Emergency Call

The preparation to respond to an emergency call was a skill that blurred the lines of the fire related emergency, non-fire related emergency, and fire station job-contexts. However, although it occurred in the fire station, this task directly pertained to handling fire and non-fire related emergencies. Due to this direct link to emergency situations, this skill was discussed in-depth during the chapter regarding fire related emergency job-context (**Chapter 5**), and will not be reiterated here in any detail.

Summary

Although the fire station job-context was where the men and women of the Waterville City and River City fire departments were able to recover from the demanding tasks of fire related and non-fire related emergency job-contexts, there was a constant barrage of tasks that needed to be completed with each of these tasks requiring numerous skills from the firefighters. While some of these skills and tasks may have blurred the lines of multiple job-contexts (i.e., new recruit training), others were enacted specifically within the fire station context. While these skills were needed to be completed by firefighters at the fire station, in some instances their completion facilitated the successful completion of other tasks outside of the fire

station (e.g., properly checking one's PPE and SCBA ensured that s/he could enter an ignited house to fight fire).

Problem solving, decision-making, and discretionary components skills at the fire station remained relatively unchanged. When performing equipment checks/assessments, housecleaning duties and general maintenance, incident reporting, and recertification and "as needed" training there was little evidence that the use of these skill aspects had changed in any real manner in the New Economy. Furthermore, as the components involved in completing these tasks were dictated by either department guidelines, their superior officers, or even national mandates, there was little room for firefighters to have autonomy/control-related aspects of skills. Although the completion of these tasks may have to be interrupted by emergency responses, and some extent of flexibility existed as to when they were actually completed, this still did not evoke any real change to the autonomy/control-related skill aspects used by firefighters. In fact, the only instance where evidence existed which showed problem solving and discretionary based decisions were able to be made was during the informal, one-on-one style of new recruitment training. Here firefighters took initiative upon themselves to work with each other to refresh and improve one another's knowledge.

Unlike the autonomy/control-related skill dimension that existed in the fire station job-context, the dimension of substantive complex did appear to show some change during the New Economy. In regards to the tasks of checking/assessing equipment and within-station training, the introduction of new tools and technologies to the fire department created a need for a working knowledge of these tools,

subsequently adding a new level of complexity to these tasks. However, this increase in complex was not direct, but rather a bleed over from other fire related and non-fire related emergency job contexts. Because these tools and technologies existed in these emergency contexts, they also now had to be checked over and trained for while firefighters were in the fire station job-context. On the other hand, the introduction of computers directly increased the skills needed at the fire station when filling out incident reports. However, it should be noted that this increase was only present for certain firefighters: in the WCFD, those who chose to use computers, while in the RCFD, those who were commanding officers and were required to complete incident and other reports. While these tasks within the fire station showed some signs of increasing, there was also evidence that the level of complexity for certain tasks decreased, as with the instances of housecleaning and general station maintenance.

Perhaps most interesting about the fire station job-context was the role technology played. To put it bluntly, overall it had less impact than might be expected. This is perhaps most surprising in regards to the introduction of computers and how they were utilized to complete incident and other reports. According to the routinization logic used in the conceptual model presented in this research, it was expected that routinized tasks such as the completion of incident reports could be eliminated from the firefighter's duties at the fire station. However, in both the WCFD and RCFD these computers and accompanying technology had not yet been implemented in a manner which would allow for the removal of reporting and its accompanying skills. In addition, as not all aspects of this task were completely routinized (i.e. the narrative aspect of the incident report), the logic of the

routinization removing skills was not applicable to the entire process of incident reporting. Arguably, the introduction of computers on the WCFD did increase the skills of the department's firefighters to a limited extent. At River City, while computers were able to remove certain routinized portions of the incident report, there was still a general increase in the skills used by the commanding officers to complete the reports. This included the River City government's implementation of additional reporting that needed to be completed. Thus, while according to the ALM hypothesis there was potential to eventually decrease the overall skills needed to perform incident reporting, this had not yet been realized. Instead, the use of computers was unfamiliar to these firefighters, and in turn actually had only a slight increasing effect on their skills.

Thus, taken collectively it appeared that in the New Economy no drastic change in firefighters' skills occurred within the fire station job-context. While there were some signs of increase in skill during specific tasks, both the skill dimensions of substantive complexity and autonomy/control-related remained at a relatively similar level as in the past. In addition, the only task where technology had the ability to make a direct impact upon the skills firefighters used in this job-context appeared to be the movement towards computerization of incident reporting. Even without using three tiered conceptual model, the acknowledgement of the relatively static nature of fire stations tasks was noted, and numerous firefighters viewed the day-to-day tasks required within the fire station job-context the same as they ever were. Even prior to the New Economy, they saw themselves as still filling out incident reports, still sweeping the floors, and still checking the fire apparatus.

Chapter 8: “We Could Be Constant All Day” – Non-fire Non-emergencies

Responding to fire and non-fire related emergencies and handling the tasks that these job-contexts entail is obviously the most important duties that firefighters in both the Waterville City Fire Department (WCFD) and River City Fire Department (RCFD) must face. In addition, there is also a wide assortment of tasks that need to be completed at the fire station by the firefighters between emergency calls. However, this does not comprehensively account for all the tasks that these firefighters need to complete on a regular, sometimes day-to-day basis. There still remains the non-fire non-emergency job-context which includes the final series of responsibilities that these firefighters must perform, including in-service and fire hydrant inspections, smoke detector installation and maintenance, public education, public relations tasks, and outside-of-station training. As with the other job-contexts, each of these tasks has its own substantive complexity and autonomy/control-related skill dimension, and is affected by different technologies in unique manners.

Although these tasks appear rather unique, there were a few common threads they each shared that placed them into this particular job-context. First, each of these tasks occurred away from the fire station; however, they were not emergencies (as categorized by the present research). Thus, while these tasks did need to be completed, they did not have the manner of urgency present in other tasks falling in the non-fire non-emergency category. True, they may have taken priority over the tasks that were to be completed at the fire station; however, they were not more

important as to trump those that occurred in the fire and non-fire related emergency contexts. Second, unlike the tasks falling in the fire and non-fire related emergency job-contexts, this series of tasks were attempted to be scheduled. True, they did not always occur precisely when scheduled; however, they never-the-less were routinely scheduled such that the firefighters would have an ideal time and place to complete them. The third and final commonality that transcended each of these aforementioned tasks in the non-fire non-emergency job-context was that each was considered a type of public service. True, there was inevitably some benefit to the firefighters in completing each of these tasks (some more than others). Yet the main purpose of them was to provide some non-emergency or fire prevention service to the citizens residing in either Waterville City or River City. Thus, although the urgency of this task was lacking, they were still important duties that the firefighters had to fulfill on a regular basis.

Inspections

In-service inspections

Firefighters in both departments I interviewed were all required to regularly conduct in-service inspections. What was needed to be accomplished during this task was quite simple. A particular fire company would go to a business or public structure to examine the building and its contents in an effort to ensure that all fire safety codes were followed and the business owner was not in violation of any of these codes. For example:

“Is the address physically posted on the front? Um, are all the hazards that that company [**business being inspected**] might have well established and properly taken care of (sic)? For instance, if they have to mow a lot of grass, is a lawn mower parked

in an area it shouldn't be with gasoline? If they use some sort of cutting material, gas, setaline torches, are they properly secured where they're supposed to be? Is there lighting issues where if the power'd go out people can't escape from a fire? We're checking off all these things to make sure these records are there, who owns the building, who to contact in the middle of the night if we got to get in there." (*WCFD firefighter; author's notations in brackets*)

When walking through buildings and performing an inspection, the firefighters have a paper form (similar to a checklist) that contains the various items that must be examined by the firefighter to ensure that each item is being properly followed and not in violation of the fire safety code. If a code is in violation, the firefighters then must notify their department's fire marshal(s) who will then take the necessary sanctions against the building owner to ensure that the safety code is met and brought up to regulation. Thus, to successfully complete these in-service inspections, a basic level of complexity is involved. Firefighters do need to understand what the safety codes are, what aspects of the structure they need to examine to ensure that the codes are being followed, and how to report any violations to the appropriate person within their department. At the same time, these firefighters do not need to memorize these safety violations as they are printed in ink on the forms used to perform these in-service inspections. Thus, the forms themselves help limit the amount of complexity involved in this specific task.³⁹ However, even with these forms, it appears that the amount of complexity involved in the task of in-service inspections has been increasing during the New Economy.

³⁹ It should be noted that one firefighter at the RCFD I interviewed had worked at the Fire Marshal's Office and stated that although these in-service inspections are performed; they may not be performed by the firefighters in a truly adequate manner. This was due to the fact that although the firefighters are instructed *what* fire codes to check, precisely *how* to check them is not strongly discussed and trained upon. It was mentioned that although these inspections were performed, they may not have necessarily always been performed in a proper manner. Therefore, according to this interviewee there is actually a "false sense" of the level of substantive complexity involved during these building inspections. While this one interviewee's claims cannot be taken to be representative of how this task is performed at the WCFD and RCFD, it is an important exception to note.

As stated by another WCFD, both an increasing number of safety codes and new fire prevention technologies have increased the number of items needed to be inspected, subsequently increasing the substantive complexity involved:

Interviewer (I): Um, have those sorts of duties...changed since you've been here?

Firefighter (FF): Oh, yes! A lot more regulations, a lot more laws have been implemented. Just an example, this year we come up with a new form for our building inspections because we (sic) don't have the fire hoses in the hallways anymore. That's been out of place for three years.

I: You really don't see them now that I think about it.

FF: *But*, we're still finding them in places. So that's a big thing. You can't have them anymore. The hoses weren't safe, they were hurting people. So you don't see them anymore. But the connections are still there because we use them; our fire hoses connect to them. We look for that. Uh, businesses, apartment buildings, houses that have been converted into businesses; so we got to make sure they're safe to hold the occupancy of how many people's going to be in there and what's going to be in there. Fire alarm systems are getting bigger and more complex and integrated. Um, a lot more standards and laws for us, not only for the safety for firefighters but safety for the occupants. So they're **[business inspections]** much more in-depth. (*Firefighter's emphasis italicized; author's notations in brackets*)

One final note about the substantive complexity dimension of in-service inspections should be made here. That is, even with the increased quantity of codes and new technologies present in the structures, this did not change the physical procedures that occurred when the firefighters performed their tasks. The firefighters at both the WCFD and RCFD still physically had to enter the structure with their fire company and visually (or physically) check that the codes were not being violated.

These in-service inspections occur more as a "behind the scenes" event. Initially the public benefit provided by these inspections is quite apparent: they are occurring so that the businesses inspected are operating with the proper safety precautions in place, which will protect the occupants of the building. However, there

are multiple benefactors of this task's completion. In addition to the public, the building owners themselves also benefit. Properly following all the fire safety codes may prevent any legal actions occurring when a fire occurs. However, the most interesting benefactors are the firefighters themselves. Almost all those I interviewed noted that these inspections were a great benefit to them. As one interviewee put it, they are "for our safety and for the public's safety" (*RCFD firefighter*). By entering these structures, the firefighters used this task to help familiarize themselves with the interior of the structure and its contents. This familiarization was uniformly recognized throughout the interviews, as all those firefighters I talked to recognized that this familiarization, even if not completely retained, could be used to their advantage if a fire related emergency ever occurred within this particular structure:

"The big benefit, you end up getting some of these places you would [**not**] otherwise be. You'd be surprised even after a year or two you'll remember things you saw if you have to go back in the fire conditions." (*WCFD firefighter*)

While the interviews provided some evidence that the substantive complexity skill dimension of in-service inspections has shifted over the past 20 years – even within the past few years for that matter – this effect has not been felt in the autonomy/control-related dimension. An analysis of the data from the interviewees shows that the discretion and decision-making aspects of this skill which the firefighters possess have not been tempered with any time over the past few decades. For the large majority of firefighters, the discretion involved during in-service inspections is rather limited. This is because the majority of the decision-making and planning is completed by the fire marshal(s) at each department. Each year, these fire marshal(s) generate a list that contains the buildings that their respective fire

department is to inspect during the upcoming year. This list is then distributed to a small number of firefighters who are charged with the task of assigning to individual fire companies a series of buildings that need to be inspected. This assignment is completed slightly differently at each of the two fire departments. At the WCFD, a firefighter on each shift is provided a list of buildings needed to be inspected. This firefighter (who may or may not be the battalion chief or captain) is then charged with assigning individual fire companies with a number of structures that need to be inspected.⁴⁰ Over a one to two month period in the spring/summer, these fire companies would then go out and perform these in-service inspections over the course of a few shifts. While this task occurred during a once-a-year period for the WCFD firefighters, at the RCFD it was an ongoing process. At the RCFD, the captains have a list of which buildings need to be inspected by the fire companies under their command. These captains then make a schedule for each of the companies under their command. These companies would then have an assigned weekday in which they would go and perform these in-service inspections. These inspections were not conducted once a year during a specific time period as with the WCFD, but rather were completed on a continual basis throughout the entire year.

Thus, as is obvious from this description, there is a relatively low level of the autonomy/control-related dimension present in the task of in-service inspections. Although the scheduling of these in-service inspections is slightly different at each department, it does not overall have any apparent impact in changing the autonomy/control-related dimension. However, it is important to note that there are

⁴⁰ A small number of the firefighters I interviewed stated that each company was assigned roughly ten to 11 inspections that needed to be completed; however, the remainder of the WCFD firefighters interviewed provided no indication that this number was accurate.

two specific issues that can affect the timing that these tasks are completed. One of these concerns, which affects both departments, is that although non-fire non-emergency tasks such as in-service inspections are assigned on certain days, both fire and non-fire related emergency tasks take priority and have the ability of shifting the timing that this task is completed. The second concern, which is specific to the RCFD, was that in 1999 the River City government installed a computerized management program that monitors various activities of the different agencies and departments within the River City government. This had an effect on a number of different tasks that RCFD firefighters completed in the non-emergency job-context, including the creation of a biweekly (i.e., per pay period) quota that required a specific number of in-service inspections to be completed per specific fire company. Thus, in both of these instances, while the timing and sheer volume of in-service inspections were affected, this had no effect on the levels of autonomy/control-related skill dimensions involved. The same level of discretion and decision-making was present during an in-service inspection, regardless of the number of inspections performed, or when exactly they were performed.

Hydrant inspections

In addition to in-service inspections, firefighters at the RCFD also had to complete fire hydrant inspections in the areas surrounding their fire stations. This is an extremely important task: simply put, fire cannot be suppressed without the availability of water. Therefore, the process of performing the task of hydrant inspections begins when specific fire hydrants are detailed by the RCFD administration. The captains receive this information and assign to individual RCFD

companies what specific hydrants to check. The citywide computerized government management program has also affected these hydrant checks in that (similar to the in-service inspections) it has placed a specific number of hydrants that need to be checked throughout the biweekly pay period. Again, this has no bearing on the skill involved, but rather simply the volume of hydrants inspected.

In regards to the skill dimensions involved with the hydrant inspections, the accomplishment of this task requires a relatively simple series of manipulative tasks:

“We do hydrant inspections once a week. We go out and we check them and make sure they’re not busted or broken and we turn ‘em on and make sure the water flows and they drain properly and shut off. And if there is something wrong with it then we have a system of sending in reports and all. The City Water Department owns ‘em. We do the inspections and then we send the reports in to the Water Safety Officer. And they notify the Water Department and they come in and make the repairs. And if its out of service, if its dry or whatever, we have collars that we put on ‘em, tighten it down and this way the engine company coming in knows that hydrant’s dead and look for the next hydrant.” (*RCFD firefighter*)

Thus, overall the substantive complexity and autonomy/control-related skill dimensions present in this particular task are (again, similar to in-service inspections) not at an extremely high level. However, unlike the in-service inspections, the substantive complexity involved in this task was not reported as changing in any manner. Furthermore, there was no clear evidence in the interviews I conducted and analyzed that any technology involved with the fire hydrants had affected the task itself. Thus, while the firefighters in the RCFD do need to possess the skill required to successfully check fire hydrants within River City, it is not an extremely complex or involves a large number of discretion. Regardless, it still is a task that needs to be completed, and the fact that it does require a certain amount of skill (albeit not extremely high), should not be discounted.

Smoke Detector Installation and Maintenance

It has been long known that the use of smoke detectors can serve as a valuable method in preventing injury and death from a fire (Gorman, Charney, Holtzman, and Roberts 1985; Mallonee, Istre, Rosenberg, Reddish-Douglas, Jordan, Silverstein, and Tunell 1996). Thus, there is a long history of smoke detector programs existing in U.S. fire departments (for example, see Gorman et al. 1985; Sults, Sacks, Briske, Dickey, Kinde, Mallonee, and Douglas 1998.). As for both the WCFD and RCFD, smoke detector programs have existed for a rather lengthy period of time, and were implemented prior to the New Economy. In both the WCFD and RCFD a service is offered to residents of their respective cities where firefighters from the department will come to your home and either (a) install a smoke detector if you do not have one, or (b) check the smoke detector(s) you do have to ensure that they are in proper working order. To perform this task at each department, a fire company would go to a specific street or location within Waterville City or River City, and simply begin knocking on the doors of residences. If someone answered the door, the firefighters would:

“Go in, check their smoke detector; make sure they have them in the proper locations that they’re working. Replace ‘em if they’re not, or if they don’t have ‘em.” (*WCFD firefighter*)

This basic idea was that this task should be repeated numerous times over the course of the firefighters’ shift, and on an annual basis, over and over again, reiterating the importance of smoke detectors to the residents of the city:

“So we go knock on every door, and in our inspection district and it’s divided up throughout the year. And ‘Hey, do you have a smoke detector? Have you checked it regularly? Change the batteries when you change the clock?’ You know, ‘have a nice day.’ It’s...but we repeat that, and repeat it and repeat it.” (*RCFD firefighter*)

In addition, both departments also have a form in which information and data is collected on each household that has a smoke detector installed. Here, basic information was collected from the household's resident(s) and manually recorded by the firefighters. Similar to the building inspection, these data collection instruments contained areas which specified the information being requested from the city resident and also provided space in which the firefighters could write the resident's answer. Thus, the precise data that was collected was not needed to be remembered by the firefighters themselves, but simply read from the forms. Thus, overall the mental procedures involved in performing smoke detector "canvassing" (as referred to in the WCFD) or "home inspections" (as referred to by the RCFD) are not as overly complex as when compared to performing many of the tasks involved with fighting fire or handling non-fire emergencies, and the data collected from my interviews provided no indication that mental and manipulative integration used during this task had changed over the past 20 years.

A similar level of complexity also appeared to be apparent in the manipulation involved with installing smoke detectors. The firefighters would manually install these smoke detectors into the home. However, interviews with the RCFD did give indication that basic hand tools carried with firefighters in the RCFD have allowed for a further simplification of smoke detector installation:

"The installation of smoke detectors in River City, we actually use a toilet plunger. And that was a tool given to us. So think about that. **[Laughs]** So yeah, we have a toilet plunger where we come in and we use double-sided tape on the smoke detectors. We can't use the screws because we're going into people's houses. We don't want to damage their home so we use double-sided tape. So we can't reach a lot of ceilings so we use a toilet plunger. And that is an assigned tool." (*RCFD firefighter; author's notation in brackets*)

Instead of having to manually screw in smoke detectors, basic tools – a toilet plunger and tape – are used to quickly and efficiently apply a smoke detector to the ceiling of a residence. This removes some of the basic manipulation needed when installing smoke detectors, and (as mentioned above) also prevents the possibility of residents becoming angry over the firefighters putting any holes in their ceilings from screws. Furthermore, it also cuts down on the time it takes to install a smoke detector (e.g., one WCFD firefighter stated it took approximately 15-30 minutes to perform a smoke detector installation for a single home). As there is a much larger number of residences in River City compared to Waterville City, and the fact that the RCFD has a much higher call volume compared to the WCFD (i.e., receives more emergency calls annually compared to the WCFD), the ability to save time on a non-fire non-emergency may potentially be a more important consideration at the RCFD than compared to the WCFD.

While there was a difference in the manner (and substantive complexity) that was needed by the firefighters at each department when installing smoke detectors, there was a more pronounced difference along the lines of the autonomy/control-related dimension. This was due to two factors, both internal and external to the fire departments. First, internally there were different procedures at both departments in the decision-making revolved around smoke detector installation and maintenance. At the WCFD, there was a much more regulated schedule for firefighters to follow when performing this task. The main reason for this was that the WCFD is unique in that it had a firefighter who served as the Fire Prevention Officer (FPO) of the WCFD and ran both the public education and smoke detector programs. In order to run these

programs, on multiple occasions the FPO had written and received various grants to fund a multi-faceted, large scale fire (and injury) prevention program within the Waterville City borders. This external funding created an extra pot of money that could be used to fund these prevention programs, and in essence this appeared to create a higher level of overall fire prevention that was conducted by the firefighters in the WCFD.

In regards specifically to the smoke detector program at the WCFD, while it had been initiated by the FPO in the 1980s, within the past 20 years there was a shift in how decisions were made regarding the installation and maintenance of the smoke detectors. The FPO began conducting basic visual and graphic data analyses of the Waterville City limits which was used to take a more scientific approach to the smoke detector program by the WCFD. In fact, during my interview with the FPO at the WCFD, he showed me a map used to account for the residences in Waterville City. It was delineated according to Census tracts, and contained data points for various types of fires according to those that involved fatalities and/or large amounts of property value being lost. Two of these zones, referred to by the FPO as *hot zones*, fell in the downtown area of Waterville City and contained the large majority of these more destructive fires. According to this prevention plan, the WCFD firefighters canvassed one of these zones one year, and the remaining zone the next year. Thus, any given residence located in these two zones was canvassed every two years.⁴¹ For the remaining zones, the FPO had a rotation set into place where any residence falling

⁴¹ This does not imply that every single residence was physically able to be inspected by the WCFD when scheduled, as it was not always the case that the residents were home, or would even allow the inspection to be conducted. Even when the firefighters make multiple attempts at inspecting the residence, it was not always the case that one of this smoke detector installation/maintenance was performed.

in one of these remaining zones would be inspected by the firefighters once every five years. As the WCFD FPO stated, “I know exactly where we are going. I could tell you where; we could figure it out up to 2020 where we’re going.”

While this systematic plan for smoke detector installation/maintenance was created by the FPO, it had to be realized at the ground level by the firefighters, as they are the ones required to go out and physically install and check the detectors. Here, the FPO would give one of the officers on each shift the information as to what streets and residences needed to be inspected by the firefighters. The officer could then assign the day, time, and specific residences to which the firefighters were to go and install or check for smoke detectors. This assignment occurred the duration of one month in the spring/summer, and as it followed a fairly rigid schedule when and where it was conducted (considering the fact that emergencies took priority). The WCFD firefighters on each company had little room to make any decisions on the performance of this task, but rather went ahead and performed it as instructed. Furthermore, with the use of a more systematic approach by the FPO in the past (approximately) 15 years, one could assume that the possibility exists that the autonomy/control-related skill dimension aspect of this task may have been further erased over this time period, even if slightly.

In addition to this internal factor, there was also an external factor that created a difference in the method of smoke detector installation and maintenance. As part of the grants received by the FPO on behalf of the WCFD, a variety of community partners had been established with the WCFD which in turn could be used as a

method of establishing contact with residents of Waterville City (with particular focus on the elderly) and scheduling appointments to go and install smoke detectors:

“Say somebody new signs up for Meals on Wheels. As part of their screening they check to see if they have smoke alarms, how old they [**smoke detectors**] are, if they’re still the nine-volt battery-type, and then they refer it to Jane. If we’re doing any type of marketing campaign like on the radio, T.V., or whatever, any calls that come in about the smoke alarms, Jane gets them. And what she does is sets it up so that two to three days a week she will take an engine company and physically go with them to do smoke alarm installations by appointment; people who have physically called us, for one reason or another, to give them a smoke alarm.” (*WCFD Fire Prevention Officer; author’s notation in brackets*)⁴²

Thus, numerous organizations and media enterprises operating in Waterville City independently from the WCFD have partnered with the WCFD to create a list of persons for whom the firefighters need to install smoke detectors. The result is appointments that are made by those individuals working in the fire prevention aspect of the WCFD, and not the firefighters. Here we see that in this situation there is little discretion available for the firefighters as they must follow a specific appointment schedule when it comes time to install these smoke detectors. In fact, during one of the WCFD shift meetings I was able to attend, there was a sentiment made by a number of firefighters on that shift regarding the lack of autonomy/control-related skill they had during these instances. The point of discussion here was one instance in where these appointments overlapped with a local NFL football team’s weekly game. Not only were the firefighters themselves finding this to be an issue, but it was also stated that many of the citizens of Waterville City who had these appointments scheduled were also not thrilled that they overlapped with the game. Because, these

⁴² Meals on Wheels is a national, not-for-profit organization that delivers meals to people in need. The person referred to as “Jane” by the FPO is an individual who was hired with money from one of the WCFD fire prevention grants to assist the FPO with the smoke detector program. The name “Jane” is fictitious.

decisions were made above the firefighters, this task had to be completed and no autonomy/control-related skill was able to be enacted.

The RCFD had a somewhat similar method of smoke detector installation and maintenance. The specific residences and areas which fire companies were to inspect came down to the captain of each company from the administration office, and then the captain used this list of houses to assign certain shifts of his/her fire company specific residences at which to perform these home visits, or inspections, regarding smoke detectors. However, there were some differences in how this task was performed when compared back to the WCFD. First, these inspections were not conducted over the course of one spring/summer month, but rather were continuously conducted throughout the calendar year. In addition, there was no systematic method supported by data that was used to inform and subsequently assign specific areas that smoke detector installation/maintenance was to be performed. Instead, the firefighters would simply go to one street, then onto the next, etc. Once the company's entire area was covered, it would simply be repeated again.

Finally, as with the building and fire hydrant inspections, the River City's computerized government management system also set quotas on the number of hours of these home visits that needed to be completed by each company. Eight hours was required per period, and with each company having four shifts, this equated to two hours of home visits per shift per biweekly pay period. Thus, these differences did allow the RCFD firefighters more freedom to choose when exactly this task was to be completed during that two week period. However, in regards to the autonomy/control-related dimension involved in this skill, there was still not much

difference from the WCFD. The task still had to be completed, and had to be completed in a particular manner, leaving little room for discretion available to the firefighters.

Public Education

Many of us might remember that during the course of our primary and secondary education we were subjected to a series of fire drills throughout the academic school year. Often when exiting the building a local fire company would be outside to greet and maybe even talk with the students about fire safety. This same sort of procedure still remains today. It was something that I remembered quite clearly as a high school student. In fact, during the course of my interviews with the RCFD firefighters I came to realize that the local River City high school I attended was visited by the firefighters of one particular fire engine company that I interviewed. Thus, while this practice of fire drills remains, there is also a number of additional public education tasks for which the firefighters are responsible. Over the course of my interviews at both the WCFD and RCFD, public education appeared to be a primary task the firefighters performed in the non-fire non-emergency job-context. While this public education could occur in a variety of manners, there were four dominant types of public education that were discussed consistently through the course of interviews. To distinguish these types of public education, I will use the following terms: school demonstrations, non-school demonstrations, post-incident outreach, and expanded programs.

School demonstrations

Public education that occurred in the form of school demonstrations is traditionally what one would think about when discussing the role that firefighters played in public education. These demonstrations included either the WCFD or RCFD sending firefighters to a specific school in an attempt to increase the students' knowledge regarding fire prevention and fire safety:

“They also want us to have a rapport with the kids for schools so we kind of; what they do, we adopt a school. We adopted one down here...It's an elementary school. We usually go there the first day of school, let 'em be seen and know that they know that we're here for 'em. Uh, Fire Prevention Bureau will sometimes get requests from the schools, especially during Fire Prevention Week, for presentations. We'll go down there with 'em and assist the fire prevention guy. We'll have a guy dress up in his turnout gear and stuff and they talk about smoke detectors, get the kids involved with it. Give them handouts and stuff to take home. So that's a big part of the education, you know, in that. So yeah, that's very prominent today. And it, it works. It has a purpose.” (*RCFD firefighter*)

Through interviews with the firefighters, it was discussed that these demonstrations were carried out in similar ways. Firefighters from a specific company would be assigned to go to a school and assist a presenter from their respective fire department during a demonstration given to students. While these could occur throughout the year, often they roughly coincided at the beginning of October during or around National Fire Prevention Week (for details about National Fire Prevention Week and its history; see IPS 2003). These often included both a formal presentation, but also a question and answer session where students could ask any questions they have related to fire prevention and safety. The portion of the school demonstration in which the firefighters were most involved with was providing a real-life example of what a firefighter looks like when s/he is actively fighting a fire. This was particularly important to the younger children as:

“One of the things we want to make children aware of what (sic) a firefighter in a breathing apparatus looks like. So that if they see that, when they need to be rescued they don’t think it’s not Darth Vader coming to get them!” (*WCFD firefighter*)

As for the skill dimensions present during these school demonstrations, there is a basic amount of substantive complexity involved. Firefighters must be able to properly don their personal protective equipment (PPE), or turnout gear, and be able to show the children basic tools and techniques that are commonly used during their day-to-day tasks in both the fire and non-fire related emergencies. As for the autonomy/control-related dimension, the scheduling of these demonstrations was done for the fire companies via one of their administrative offices, and the material that was provided to the students during the presentations was not directly developed by the firefighters themselves, but rather through their respective department’s fire prevention personnel. Therefore, the firefighters themselves had a limited role in the discretion and decision-making involved with the scheduling and development of these demonstrations.

However, there was another skill involved with the task of public education, not only during these school demonstrations, but also with the other types of public education. This was the skill of communication. While the firefighters were not solely responsible for presenting the information during the demonstrations, they remained a vital part in donning the PPE, giving a physical demonstration, and also helping answer any questions that the students might have. They were faced with effectively relaying and detailing information to large numbers of children in terms that these children would be able to understand. In turn, this aspect of the task certainly created a much higher level of skill involved during these school demonstrations than one

may initially believe. In fact, these communication skills are something that needs to be developed (take for example, the Toastmasters organization), and can even be associated with anxiety that may have some form of adverse affects on individuals (Daly, Vangelisti, Neel, and Cavanaugh 1989). In fact, one WCFD discussed the difficulty he faced with not only speaking in front of people, but also simply the difficulty he has with being the center of attention when donning his gear in front of students. While this feeling was only noted by one interviewee, it does emphasize the point that not only are these communication skills present, but they also do require quite a bit of skill that quite often may very well be overlooked. In each of the remaining three types of public education tasks that the firefighters I interviewed faced, there was evidence that this communication aspect was present and required a higher level of skill than may appear on the surface during this task.

On final item worth mentioning was that during my interviews with firefighters at the RCFD, they also discussed that fire drills were also a common type of school demonstration in which they assisted:

“We do fire drills twice a year. We do ‘em in April and September...So we set up a fire drill and then we time students how long it takes them to get out and so forth. We send reports to the Fire Prevention Bureau.” (*RCFD firefighter*)

Thus, these are again scheduled by the Fire Prevention Bureau for the RCFD, and also involve only a moderate level of complexity. Regardless, there are still aspects in these types of school demonstrations that combined with the others mentioned above do in fact increase the skills needed to be possessed by the RCFD firefighters.

Non-school demonstrations

Another type of public education that was consistently mentioned throughout the interviews was non-school demonstrations. The firefighters I interviewed mentioned how schools were not the only locations at which they assisted with the provision of fire safety and prevention demonstrations. Other types of organizations also received these demonstrations. These included assisted living communities/retirement homes (mentioned by firefighters at both the WCFD and RCFD), and church groups, organized daycare facilities, and other various community gatherings (all mentioned by the WCFD firefighters). While these demonstrations may to some extent have overlapped with those that occurred within schools, it could be assumed that these types of demonstrations were not identical, but rather tailored to the different audiences. For example, one would expect the demonstrations provided to first graders in an elementary school to not be identical to those presented at an assisted living community. Unfortunately, while many firefighters mentioned these types of public education, relatively little description was provided as to how exactly these were carried out. Therefore, although the data shows that non-school demonstrations were conducted by the firefighters at both departments, too little data exists that describes these types of demonstrations. Therefore, not enough evidence was provided to make claims regarding the skill involved in these types of demonstrations, although one could assume it may be somewhat similar to that found in the school demonstrations.

Post-incident outreach

Unlike the previous two types of public education that were scheduled continuously throughout the year by the WCFD and RCFD's contact with schools or other organizations, the third type of public education occurred in wake of certain fire related incidents. There was not one specific definition or type of incident that would necessarily cause this post-incident outreach from occurring. However, there were some certain characteristics that may have influenced the decision to hold this outreach. For example, fires that resulted in a fatality may be cause the fire department to conduct post-incident outreach public education. In addition, in neighborhoods or areas where a large number of fires had occurred over the course of a short period of time may also have led a departmental decision to conduct this type of education. A third example that was also mentioned was if suspicious fires (i.e., those that may have been or were intentionally set) may have also spawned this public education to occur.

As is fairly obvious, the primary goal associated with these types of public education is to have somewhat informal conversations with local citizens about fire safety and prevention, with the hope that this type of incident can be prevented and will not occur again. Depending on the unique situation, this may involve a number of actions, including handing out literature, checking smoke detectors, answering questions any citizens may have regarding fire safety, or sometimes even more. For example, one WCFD firefighter mentioned that their FPO may take some of the persons residing near an incident to tour the burned house and see the damage that a

fire has created, or at least talk about the incident and bring a real-life, familiar image to the local citizens. To quote one WCFD firefighter:

“I was going to say that another time we come out into the neighborhood – significant fires. For instance, we have a fire in the north end of Waterville City in January and there’s one not less than a year before in that same neighborhood and for what it was worth, two nights maybe, the shifts went out and canvassed the neighborhood educating them about fire safety, I believe doing smoke detector checks, I’m not 100% sure on that. Um and it just so happens they went back and pulled records and the house that did catch fire we had been in there before and installed a smoke detector... The neighbors, when you go and tell them stuff like that, their ears peak up and they really listen to you. So that’s a time that uh, our Public Educator, likes to get us out there and educate the public.”

Thus, it is hoped that by physically seeing the destruction caused by a fire, or simply discussing the fire’s origin and destruction, neighbors may be able to understand the importance of fire safety and take a more active role in fire prevention and safety. However, this also shows that in addition to being able to communicate effectively with the public, there are also a slew of other skills required during this task. The firefighters must both know proper information on residential fire safety, and must be able to check and potentially install smoke detectors. Thus, in addition to this skill of communication, the firefighters must also need to produce a similar amount of skill used when performing smoke detector checks and maintenance. Furthermore, knowing and being able to provide the proper fire safety/prevention information also increases the amount of knowledge one needs, further heightening the substantive complexity involved in this task.

Expanded programs

While the above three types of public education may have been standard fare for all the firefighters I interviewed, the final type (expanded programs) was unique to

the WCFD. In fact, although I can only make direct comparisons between the two departments at which I conducted interviews, the majority of the WCFD firefighters I interviewed who discussed their expanded programs also mentioned that these programs were not common to the majority of fire departments around the U.S. (past literature also supports this claim, see Gielen, Dannenberg, Ashburn, and Kuo 1996). Through the course of my interviews, it became apparent that the reason these programs were developed into an effective form of public education was through both collaborations with other agencies and organizations throughout the City, but also via the external funding that had been secured by the WCFD's FPO. Through my interview with the FPO, it was apparent that he had a long history of securing external funding which was used to develop and maintain these expanded public education programs which occurred within the WCFD. There were two types of expanded programs that occurred in Waterville City, all connected to the school demonstrations.

The program involved a Fire Prevention Trailer that was able to be transported from school to school in Waterville City. This trailer was used to visually demonstrate to the children fire safety at the home:

“Well we didn't used to have a Fire Prevention trailer that shows kids. That puts kids in situation that they have to identify hazards in their own home, you know. The kids will come into the house-trailer-type thing that's pulled behind a vehicle or something and there will be certain props around the room that they have to identify as fire hazards and that kind of thing. It also shows 'em; there's also a bedroom, simulated bedroom in this trailer where we fill with fake smoke – it doesn't hurt them or anything – we'll hit a smoke detector. After telling them how to get out of the place, you know, they actually got to crawl out of the building, or come out of a window with our help, or they have to call 911 on the phone that we have there. So all this stuff, it's come a long way. We didn't used to have it when I first came in, so that's cool.” (*WCFD firefighter*)

The firefighters who were assigned to a certain school would be able to assist children in walking through this trailer and create the interactive environment that was used to teach about fire safety. To effectively assist in navigating students through this trailer, a certain amount of substantive complexity and was needed to be used by the firefighters. Furthermore, this particular skill dimension was inevitably created through the introduction of this trailer (i.e., the technology). As the trailer had not previously existed in the past, with its introduction, it created the need for a new level of skill that was otherwise not needed. While the affect on complexity was apparent, it was not clear the amount of additional (if any) autonomy/control-related skill that was needed to assist with this particular expended program aside from that brought by the communication skills used.

The second external program was referred to as the Children's Village. As it is explained by a WCFD firefighter:

“Uh, I teach out at Children's Village. I'm an instructor there and that's a two-day program for the second graders in [our] county and various school districts. One day is police safety which a police officer will teach them those safety-related skills. We teach them about, uh, 911, how to call, they should know their name and address. Not only where they live, but where they are if there's an emergency where they are. Uh, smoke detectors. They take a tour of a burned house. They learn the difference between good and bad fires. Let's see, I'm thinking off the top of my head here, but there's a lot of stuff out there. We teach them how to crawl low in smoke. We teach them 'Stop, Drop, and Roll.' We teach them different ways of getting out of a house, how they're supposed to have two escape routes, the best way out and a second way in case that way's gone. There's a doll house...that has five different rooms in it and has a smoke machine and we teach them that if they can't get out of the house that's on fire, if they stay in their bedroom that they're pretty much safe for at least five to ten minutes until we can get there, and in the City of Waterville they're pretty lucky because there's no residence within the town limits that's anymore than three minutes away from a fire truck arriving on the scene.” *(Author's notation in brackets)*

Children's Village is similar to the trailer in that involves a very interactive demonstration to teach children what to do in case of a fire and fire safety. However,

it is unique for a few different reasons. First, the Village is only experienced by children once during the course of their schooling – during the second grade. A handful of firefighters I interviewed stated that this was because that over the course of using the Children’s Village it was the second graders that were the most receptive of this type of expanded program. A second unique factor of the Village is that not only is the WCFD involved with the Children’s Village, but local police department(s) also participates. Finally, while all firefighters could be expected to assist with the previous three types of public education tasks, and even with the Fire Prevention Trailer that is transported from school to school, not all firefighters are expected to assist with the task of public education at the Children’s Village. In fact, during my interview with the FPO at the WCFD it was discovered that the firefighters had to volunteer in order to work out at the Village by signing up on a list. Working out at the Village was considered overtime (for which the firefighters were financially compensated), and there was quite a large list of names of individuals who had volunteered to help with this particular public education.

The Children’s Village and program was brought to fruition in the early 1990s, and (as with the trailer) was a technology that subsequently increased the substantive complexity involved with the task of public education. The firefighters who taught out at the Children’s Village all needed to possess the mental and manipulative knowledge integration to successfully use this technology to teach the second graders who attended. Again, this may have not clearly affected their autonomy/control-related skill, yet it clearly did increase the complexity used during the task of public education. Thus, as for the expanded public education programs

that occurred in the WCFD, there was clearly an increased level of skill needed to not only teach fire safety to the children, but to also be able to successfully use the technologies that assisted in teaching these lessons.

Public Relations Tasks

The task of public relations was the final task that occurred in the non-fire non-emergency job-context that was revealed by the interview data. This particular task was interesting, as many times it did not appear as an independent task in its own right, but rather was supplemental to many of the other tasks that were performed by the firefighters. In fact, in analyzing the interview data, it was somewhat difficult to discern to which job-context(s) this task belonged. However, during certain instances establishing good public relations was one of the primary goals, and therefore it was decided it could best be discussed in the non-fire non-emergency context. Regardless, it should still be noted that this task definitely blurred the lines of the three job-contexts previously discussed.

In the non-fire non-emergency job-context, there were two types of public relations that the firefighters would perform. In some instances, this public relations task may include a basic service. For example:

“Sometimes we do public services like putting flagpoles on flags (sic). Sometimes we do light bulbs. Say West End Little League, they needed some light bulbs put up, and those kind of service things, you know. As long as it doesn’t cost the citizens of Waterville City a lot of money or anything like that, and our officers don’t have a problem with it we usually go ahead and take care of something like that.” (*WCFD firefighter*)

In these types of public services, basic maintenance tasks were to be performed, requiring a limited amount of complexity and the use of basic tools that the

firefighters have in their possession, such as ladders. In regards to the autonomy/control-related skill dimension, as this above quote shows, sometimes the firefighters themselves can decide to act upon a request and may not require complete discretion from their commanding officers. However, there are other times when the discretion is more limited and the officers or even administrative offices may have to schedule this type of task. For example, one type of public relations task that firefighters I interviewed reported completing was doing a “stand-by” when neighborhood fireworks may have been lit off. During these tasks, a fire company was individually scheduled to be at a specific location at a specific time, thus eliminating the ability for a fire company to have any discretion as to whether or not they should be involved with this task.

Other public relations tasks overlapped more with fire safety and prevention education:

“We do go to church, not socials, but church bazaars or festivals and we’ll go stand by there and again we’ll talk about fire prevention. And the biggest hit is the kids seeing the fire engine. We’ll get one of the junior members don (sic) all their turnout gear and show them how it works and so on. So that’s other stuff we do outside of regular emergencies.” (*RCFD firefighter*)

Thus, the substantive complexity skills required here parallel very closely those used during school (and even some non-school) public education demonstrations.

Although there may not be an extremely high level of complexity used, there is never-the-less a certain level of complexity that must be possessed by these firefighters. In addition, the autonomy/control-related skills that firefighters need during the communication aspect of public education demonstrations are also needed here with these types of public relations tasks. During these public relations, although

there is an initial autonomy/control-related aspect that is dependent upon whether or not a public relations task is scheduled or occurs more sporadically, there may be a type of instance where the firefighters have more autonomy/control-related skill than they may receive credit for. For example, while giving a public education demonstration at a school, they are assisting a speaker from their respective department and playing a supporting role during this task. However, during these public relations tasks, the firefighters often appeared to be at these events with only the other firefighters in their fire company. Therefore, the firefighters play a primary role in providing public education or completing basic public services (such as installing light bulbs) with relatively full control over the situation and deciding how to best proceed. Therefore, a higher level of autonomy/control-related skill may be present than one may initially see upon the surface.

As mentioned above, aside from public relations tasks that are somewhat independent, there are also elements of public relations that need to be performed in the three other job-contexts as well. For example, during a fire related emergency, both during and after the fire certain firefighters at the scene must also interact with citizens of either Waterville City or River City in a variety of manners. This could include either getting information regarding how a fire began, attempting to minimize the property damaged when suppressing a fire, or even coaxing them to exit a third story window when trapped in a room by flames. In the non-fire related emergency context, this may include as talking to witnesses of car accidents, getting background information as to why a person may have been unconscious, or discussing with witnesses why a stabbing or shooting had occurred. Finally, at the fire station there

are simple tasks such as answering the telephone and “problem solving” (quoting a WCFD battalion chief) with a citizen on the phone, or even giving a brief tour of a group of neighborhood children or kindergarten class who stops by to look at the fire truck. Thus, while there specific public relations tasks that need to be accounted for that occur in the non-fire non-emergency job-context, there are also elements of public relations that supplement tasks that are part of the remaining three contexts, each inevitably creating a need for some basic skill elements that may not be the most important and dominant skill needed in that job-context at that specific time, but a skill that is never-the-less important.

Outside-of-Station Training

As mentioned in the previous chapter discussing the firefighters’ tasks at the fire station (**Chapter 7**), training was one task that occurred both within-station, but also outside-of-station. This outside-of-station training included both new recruit and evolution types of training, and will be discussed here.

New recruit

As mentioned in **Chapter 7**, a good portion of new recruit training occurs inside the fire station. However, while many of the skills needed by firefighters can be discussed and reviewed within-station, the firefighters I interviewed provided data that supported the claim that actual experience was a vital ingredient to performing these tasks properly. Whether it is throwing ladders, suppressing the fire with a hose, establishing the water supply, or even driving the apparatus, the new firefighters need to practice these skills (the more similar to an actual incident, the better) in order to

learn them. A prime example of this is discussed by a WCFD firefighter I interviewed who was on a truck company and discussed one of their newer firefighters and the training this new recruit was currently going through:

“And sometimes it takes you a few weeks to teach somebody something, and if they come in with no, with no experience where you got to get the license, it takes seemingly forever. Just hour and hour of backing the thing [**fire truck**] in the slot, pulling it out and trying again. And it gets better every time you take them out and some days it just wears; you get weary of it. It’s so mundane a task your mind just kicks out of gear.” (*WCFD firefighter; author’s notation in brackets*)

Although not all new firefighters were being trained as drivers, this was simply one example of the type of new recruit training that occurs outside of the fire station and in the non-fire non-emergency job-context.

Evolution

Evolution is the final type of training to be discussed, and is solely performed in the non-fire non-emergency job-context. Evolution training is simply taking the entire fire company (or in some instances, entire battalions) and physical practicing the tasks that are needed to be performed quickly and properly when actually fighting a fire. This type of training is regularly scheduled to be performed by firefighters.

However, there are times when more evolution training may occur compared to other times throughout the year:

“Uh, spring and fall we do a lot more outdoor training. Summer’s kind of hard because it’s oppressively hot or nice. Um, you know, so again it’s a seasonal thing for some of the more hands-on stuff. Some of it we don’t really have much of a choice. We got to do it.” (*WCFD firefighter*)

Thus, in certain instances it does not appear there is much room for autonomy/control-related skill to be exercised by the firefighters; however, they are required (and very willing) to do a certain amount of evolution training. At the same

time, there does appear some room for discretion as to the precise amount of training that does occur, although it may only be left up to the officers. In the example above, the WCFD firefighter shows how this discretion is exercised based upon the weather outside.

In addition, during instances when major fire incidents occur, these can have an impact on evolution training. For example, while fighting a fire, if a certain task does not go smoothly, or if for some reason is not properly performed, the skill required to successfully complete this task may be practiced through evolution training by that company or battalion in the near future. As with the standard evolution training, this may be from a direct order from one of the battalion chiefs, or may even be a task that an individual captain or lieutenant wants to practice with his/her fire company.

Thus, as for the substantive complexity dimension, and for the impact of technology on the outside-of-station training, it is truly dependent on the particular tasks that are the subject of this evolution training. For example, the same level of complexity involved with using a ladder at the scene of a fire is present while training on using a ladder in the non-fire non-emergency context. As for technology, the same technology used when establishing a water supply for a fire engine at a fire related emergency is present during training. True, as there is no true life-threatening situation present the pressure may not be the same as during a true fire related emergency; however, the same mental and manipulative integration is needed to perform the skill in either context. Furthermore, the same tools and technologies are being used in both contexts.

With the autonomy/control-related skill dimension, however, it is a different story. Here, during evolution training the firefighters themselves do not have the amount of discretion and decision-making skill present as when fighting a fire. In this instance, their commanding officers decide precisely what is to be trained upon, and when it occurs. Furthermore, even during instances in which evolution training that is not regularly scheduled is performed, this decision is still only being made by a select number of firefighters and not the majority. Thus, during the evolution training, the impact of technology and complexity remain consistent with that at the scene of a fire, yet the autonomy/control-related skill is at a lower level than when dealing with an actual emergency.

Summary

Through the need to be able to successfully perform a multitude of tasks required when fighting a fire, the need to be able to deal with a multitude of other non-fire related emergencies, and the need to maintain the fire station, the firefighters from both the WCFD and RCFD are consistently busy throughout the majority of their shift. However, even with the slew of tasks set before them that need to be completed within these three job-contexts, the firefighters are also responsible for a variety of tasks that occur outside the fire station that are not actual emergencies. Just because these tasks are not full-fledged emergencies, and arguably do not require the heightened level of absolute skill needed during fire and non-fire related emergencies, it does not imply that the tasks performed during the non-fire non-emergency job-context are in anyway unimportant, or do not require a certain level of skill that these firefighters must possess. In turn, these tasks may round out the time available on the

firefighters' shift. This was nicely put by one lieutenant I interviewed who was discussing trying to fit in the various inspections and smoke detector installation/maintenance tasks that his truck company was assigned:

"It's just; we could be constant all day. All day long. I have to stop these guys and say 'Okay. Between this hour and this hour we're going to eat lunch. I'm not going to make any guarantees, but we're going to try and get something for lunch.' And then we'll kick up after lunch." (*RCFD firefighter*)

Thus, throughout the course of the day these firefighters are consistently busy, using some type of skill to complete a certain task that may be required.

Perhaps one of the most unique aspects of the non-fire non-emergency job-context was the very low impact that technology had on the skills that firefighters needed to use to complete the various tasks they were assigned. Unlike the fire and non-fire related emergency job-contexts, there were no devices such as hydraulic rescue tools or the computerized fire engine pumper that drastically shifted the way they performed tasks. For the most part, any tools or technology used was located in a somewhat secondary role. For example, during the in-service and hydrant inspections, and smoke detector installation and maintenance, there was technology present, but external to the fire department as it was present in the structure. While these technologies may have been slightly altered over the years (e.g., fire safety codes in commercial buildings), they appeared to only have a minimal affect on how the firefighters performed the tasks associated with these technologies. As for public education, public relations, and outside-of-station training, the firefighters did use a variety of tools located on their fire apparatus. Tools such as ladders, hoses, and turnout gear (i.e., PPE) were all used during these tasks. However, they were not used in a different manner than when used during an emergency. There was one exception

to this relatively miniscule impact of new tools/technology in the non-fire non-emergency context. It occurred for the WCFD firefighters by the introduction of the Children's Village in the early 1990s. This introduction subsequently created its own set of public education skills that the WCFD firefighters who taught at Children's Village needed to possess, both along the lines of substantive complexity and autonomy/control-related skill dimensions.

Similar to the absence of skill change resulting from technology, there appeared to be a relatively stagnant level of skill found in both dimensions of the non-fire non-emergency job-context throughout the course of the New Economy. Overall, a fairly basic level of substantive complexity and autonomy/control-related skill was present in performing in-service/hydrant inspections, smoke detector installation and maintenance, public education, public relations, and outside-of-station training. However, a few important points should be noted here. First, there were apparent departmental differences in regards to these non-emergency tasks, and in turn this created differences in skill needed by the firefighters. For example, although basic, a certain level of skill was required from the RCFD firefighters to perform hydrant inspections. However, the data showed that these were not regularly performed by the WCFD firefighters; this skill was not needed on a consistent basis. Second, as the WCFD firefighters had a more expansive smoke detector program that was enacted in a more systematic fashion, there was a slightly lower level of discretion during this task than in the RCFD; however, there was a greater level of complexity involved with actually installing the devices. Finally, due to the expanded programs of public education used in Waterville City, there was clearly a level of skill needed by

firefighters in the WCFD to teach using the Fire Prevention Trailer and Children's Village that was not present among the RCFD firefighters. Finally, the skill used in some of these non-fire non-emergency tasks parallels that involved when performing specific tasks in fire related or non-fire related emergencies, although the context they are being performed in may arguably not create the heightened level of skill needed to perform these tasks (i.e., putting on PPE in less than one minute to successfully respond to an emergency call in a timely manner). Thus, there is some evidence of overlap in skill that is used here.

In sum, technology appeared to have somewhat a small impact, and the skills used in this particular job-context by the WCFD and RCFD firefighters remained fairly consistent throughout the course of the New Economy. However, what was perhaps the most interesting finding here was the difference between the two fire departments. There were clear differences in the precise tasks performed during this job-context, and the levels of skills used by firefighters in the two departments. While the most notable difference between the two departments may have been the use of first aid and medical care, the differences in the non-emergency context spread throughout many of the tasks performed in this context.

Relative to the levels of skill present in the fire and non-fire related emergency contexts, the level of skill needed in the tasks performed in non-fire non-emergencies was not as high. However, this claim in no way discredits the fact that a number of skills are required to complete these tasks. All five tasks discussed did require a certain level of mental/manipulative integration and problem solving/discretion/decision-making in order to be properly and successfully

completed, and further added to the large, collective number of skills for which the firefighters at the WCFD and RCFD were responsible. These skills were an important component of performing one's job as a firefighter in both the WCFD and RCFD, and without them the tasks set forth for by their occupation would not be met.

Chapter 9: Conclusions and Discussion

Conclusions

This research was undertaken with the purpose of addressing both the improvement of the conceptualization of skill and expanding generalizability of case studies past manufacturing and “white-collar” occupations. This was done by conducting a comprehensive examination of firefighters using a multi-tiered conceptual model that contained the concepts of job-context, skill dimension (substantive complexity and autonomy/control-related [Braverman 1998/1974]), and the Autor, Levy, and Murnane (ALM) routinization hypothesis (Autor et al. 2002, 2003a, 2003b). Data was collected through semi-structured, in-depth qualitative interviews, and this conceptual model was used to guide the analyses of these data in an effort to draw conclusions surrounding two research questions that inquired about the skill change of professional firefighters in the New Economy, and the impact of technology on this change.

Change in skills used by firefighters

The first research question posed in this study was: how have the skills used by firefighters to complete the tasks required by their occupation changed in the New Economy? In order to answer this question, skill is discussed in regards to tasks that need to be performed in four different job-contexts: fire related emergencies, non-fire related emergencies, the fire station, and non-fire non-emergencies. In each of these contexts, the two dimensions of skill discussed by Braverman (1998/1974) were adopted – substantive complexity and autonomy/control-related – in order to examine

how skill used by firefighters in the New Economy had changed. Thus, using these dimensions and job-contexts as a guide, the above question can be answered.

The fire related emergency job-context was the first job-context discussed. As mentioned above, it was the context with which the firefighters I interviewed most easily identified. While firefighters appeared to spend the least amount of time during their shifts in the fire related emergency job-context, the volume of tasks that needed to be completed while in this context was more than any of the other three. While not all tasks completed during a fire related emergency required an extremely high level of mental/manipulative integration or decision-making abilities, overall the absolute level of skill was at a quite high level. As each task needing to be completed in order to extinguish a fire required a specific level of skill, prior to an incident firefighters were prepared to enact a certain set of skills depending on their assigned task(s) at the scene of a fire.

Through analyzing the interview data, the evidence provided some indication that showed during certain points in the job-context, the substantive complexity and autonomy/control-related aspects of the tasks being performed had diminished. In preparing for a fire, this was particularly evident in that autonomy/control-related aspects of both receiving an emergency call and navigating/driving to a fire emergency had shown some indication of decreasing, particularly through the introduction of new technologies such new multi-sensory alarms in the fire station, the connection of printers to the gong, and particularly the replacement of manual transmission apparatuses with automatic transmissions. In fact, the introduction of manual transmissions also removed some of the complexity involved in driving the

apparatus. While there was some slight removal of skill from the preparation stages of a fire related emergency, the only clear indication of skill removal in the fire related emergency context occurred among engine companies while actually fighting a fire. New pumps automatically regulated and distributed water flow which allowed the firefighters operating the pumps to use less skill than was previously required.

Although there were signs of skill change in these two aspects of the fire emergency job-context, the duties performed by a truck company at the scene of a fire, and the tasks needed to be completed after a fire had been “knocked down” remained relatively stable in regards to skill change. Overall forced entry, search and rescue, using ladders, and ventilation still required the same level of complexity and discretionary dimensions as it had in the past. However, there was also some indication of some increase in the skill required (particularly in regards to complexity). This was simply a result of the introduction of new tools such as the hydraulic rescue tool, aerial ladders, and even technologies external to the Waterville City Fire Department (WCFD) and River City Fire Department (RCFD) themselves, such as new housing materials and construction. New skills were now required to effectively use these technologies. As for the overhaul, salvage, and equipment/apparatus checks performed post-fire suppression, the data showed that the skills used had remained mostly unchanged since prior to the New Economy. Some limited adjustments of skills in these two contexts existed, such as those brought about by the introduction of the TICs, and these changes should be noted. Thus, for the fire related emergency job-context, an overall a high absolute level of substantive complexity and autonomy/control-related skill had been used by firefighters in the

fire related emergency job-context, and this remained throughout the New Economy. While there were certain instances in which it appeared skills had diminished among firefighters within this context, new skills (often brought about by new technologies) did appear to further add to the multitude of skills that firefighters used in this context.

Thus, while the skills used in fire related emergencies have become somewhat stagnant, and appear to have even decreased in some manners, a different picture arose through the data analyses in regards to the non-fire related emergency job-context. Compared to 20 years ago, firefighters at the WCFD and the RCFD now needed to complete tasks with much more complexity and discretion than was previously needed. In particular, the manipulative and mental integration that was needed to handle automobile accidents, first aid/medical care, performing CPR and using AEDs, and even performing the more simple mechanical/maintenance tasks (except for addressing floods) had all increased. This heightened level of skill was created in some instances due to the introduction of new tools and technologies, whether it be internally to the fire department (i.e., hydraulic rescue tools, the EpiPen®, etc.), or externally (e.g., new models/styles of automobiles, heightened use of smoke detectors in buildings, etc.). However, not all of this higher level of complexity was due to technology. In some instances the nature and types of non-fire emergencies that were addressed by the fire department had changed (e.g., the RCFD introducing new levels of Emergency Medical Service [EMS] training). Thus, it was a combination of factors that were responsible for spawning this change.

A new heightened level of skill was also found in regards to the autonomy/control-related skill dimension in the non-fire emergency job-context; however, it did not appear to have risen to a level equivalent to the substantive complexity in this context. For example, it is rather apparent of the changing complexity over the New Economy for firefighters when involved with handling automobile accidents, conducting CPR and using AEDs, and even some mechanical/maintenance tasks, yet it does not appear that the autonomy/control-related dimension had shifted for these tasks in the same manner. Thus, while the direction of the skill change found in this autonomy/control-related dimension parallels that of the substantive complexity dimension, the absolute levels of skill appear to differentiate.

Aside from the skill change found in this context, an examination of first aid/medical care warrants a bit of further attention. A few things stick out here as important. First, the skill change experienced by firefighters in regards to this particular task is arguably the greatest out of any other task in any of the four job-contexts. With the increasing volume of EMS calls, new technologies introduced, and higher level of training required by firefighters, this type of task has become a advocate of skills that have now become a dominant factor in the job of these firefighters at both the WCFD and RCFD. One firefighter in the RCFD went so far as to hint that he could foresee the day when he and co-workers were no longer firefighters with EMS training, but more EMS workers with firefighting skills. However, the other important point in regards to this task was how the skill change that occurred during the New Economy differentiated between the two departments.

Technology spawned skill change that resulted in a heightened level of skill occurred for both dimensions in both fire departments. However, the structure and organization of the RCFD further increased the skill among firefighters used during first aid/medical care situations. In the beginning of the New Economy the RCFD had begun to train their firefighters as paramedics that allowed more complex medical procedures to be performed by their firefighters and with that a heightened level of decision-making and discretion. In addition, for the WCFD the amount of discretion was minimized when the local EMS service arrived at the scene of a medical situation; however, in the RCFD this new heightened level of medical training (i.e., paramedic) allowed this discretion to remain with the firefighters themselves.

In the third job-context examined, the fire station, the skills used by firefighters prior to the New Economy had for the most part been continued throughout the past few decades and into the present day. Overall the level of skill used here was not at an extremely high level; however, perhaps this was not too surprising. Checking equipment, housecleaning and chores, and filling out reports are all fairly basic tasks. They are tasks that remain vital to the WCFD and RCFD in order to keep the station and fire apparatuses in proper working order and ready to respond to emergencies that may often be life or death situations. Thus, even if they involve basic manipulation and decision-making, they never-the-less have an important role to play.

In regards to skill change involved with fire station tasks, it remains rather limited. In regards to the autonomy/control-related skill dimension, there did not appear to be any indication of change in regards to these tasks performed at the fire

station. For the most part these tasks were detailed to the firefighters by either their officers or their respective department's administration. However, there were some small signs of an upward shift of the complexity involved in a few of these tasks, particularly incident and activity reporting. Computers were introduced to both the WCFD and RCFD to use during incident reporting. At the RCFD, all officers who completed incident and activity reporting were required to use online software to enter data and complete forms. Interestingly, although this was a rather basic data entry task (and some routinized components were able to be completed automatically for the firefighters), the method in which computers were introduced did not remove any skill. Furthermore, many of the captains and lieutenants kept a written journal as had always been done. Thus, computers did not appear to eliminate any skills, but rather added additional complexity to a task that could potentially be eliminated by this technology if it was implemented as such. In the WCFD, computers had also been introduced and could (to some extent) be used for reporting. However, these computers had not yet been uniformly introduced, and the software used to enter data was not used by the firefighters themselves (rather by the administrative help), which truly had a little increasing effect on substantive complexity (albeit an increase nevertheless). All in all, in the fire station job-context skill change was rather minimal, with the data providing some evidence that the complexity in this context had increased slightly.

The final job-context, and arguably the most easily overlooked, was the non-fire non-emergency. In this context, there was clearly not much change in either the substantive complexity or the autonomy/control-related skill dimensions. Perhaps a

slight increase here (i.e., complexity involved with in-service inspections) and a *slight* decrease there (i.e., discretion involved with smoke detector installation and maintenance in the WCFD), but skill appeared rather unchanged in the non-fire non-emergency context across the board.

However, there was one exception specific to the WCFD. Through the Fire Prevention Officer at the WCFD a number of grants had been received which assisted in funding expanded public education programs in Waterville City. Not only was the department able to invest in drafting and implementing these public education programs, but the funds were also able to be used to support two new technologies: a Fire Prevention trailer and Children's Village. These expanded programs relied heavily on the WCFD firefighters. Although the firefighters were not all directly involved with the design and implementation of these programs, many of them volunteered to work in conjunction with the Fire Prevention Officer and other WCFD personnel to run the day-to-day operations of these public education programs. In turn, these programs brought a new set of mental/manipulative integration and discretionary skills that were needed to be used by the firefighters in this department. Thus, although the overall pattern of skill change by all indications remains relatively absent, in this one instance there is evidence of an increase in both skill dimensions (more so in regards to complexity than autonomy/control-related) among the WCFD firefighters.

In order to understand skill change experienced by firefighters in the New Economy, past research may have been tempted to do one of two things. First, there is the temptation to only examine the tasks that fall in the fire related emergency job-

context. If this was the case, the conclusions reached would indicate that the firefighter's skills have remained relatively stable moving into the New Economy, with a slight decrease in skill being evident. The second possible conclusion would be to lump all the skills together and draw one summary conclusion. If this approach were taken, the conclusion drawn may arguably indicate that overall skill has increased throughout the New Economy. However, by taking an approach that placed skills into job-contexts and noting two different dimensions of skill, a more complete and thorough understanding of skill change has been reached. Here it shows that the complexity and discretion involved in the fire related emergency context has remained fairly stable, with a slight decrease in prepping for a fire and the engine tasks during a fire, and some increase spawned by new technologies. This overall picture is much different when considering the remaining three job-contexts. In the non-fire emergency context, skill has change by increasing in both complexity and discretion. However, this parallel movement among these two dimensions is different in an absolute sense, where there appeared to be a greater increase in the substantive complexity skill dimension. A similar pattern is found at the fire station for substantive complexity (more is required than previously needed), yet in regards to the autonomy/control-related dimension there is no concrete evidence of any change. Finally, although skill change had occurred in all three of the aforementioned job-contexts, during non-fire non-emergencies a constant level of skill involved with both dimensions has remained (with *one* exception – expanded public education programs in the WCFD) Thus, overall there are unique patterns of skill change (or lack of) found in each of these job-contexts.

Both the WCFD and RCFD experienced this change in a similar fashion; however, two pronounced regional (or local) differences did exist that affected the skill among the firefighters in both these departments. In the WCFD, external grant funding allowed the introduction of expanded public education programs that brought both the Fire Prevention Trailer and Children's Village to the WCFD. In turn, although skill in the non-fire non-emergency job-context remained relatively unchanged, this particular exception did increase the complexity and discretionary skills needed (albeit to different levels). This shift was not present in the RCFD; however, in the non-fire emergency context there was also a differential skill change among both the WCFD and RCFD. While both departments experienced increasing skill in this job-context, the advanced levels of training in first aid/medical care at the RCFD and the corresponding skill increases were subsequently bigger at the RCFD versus the WCFD (and were arguably the biggest change that occurred to skill among the firefighters). Therefore, in addition to recognizing these broader patterns of skill change across both departments and differences in change at the job-context level, in regards to certain tasks skill change also occurred differently between the WCFD and RCFD.

Technology's role in skill change among firefighters

In the second research question, it was inquired as to what has been technology's role in the change of skill used by firefighters to complete the tasks required by their occupation. In order to examine this aspect of the skill, again in each job-context, in each skill dimension the impact of technology was examined. In an attempt to best understand how this role has played out, Autor, Levy and Murnane's

(2002, 2003a, 2003b) routinization argument (i.e., the ALM routinization hypothesis) was adopted and used as a conceptual guide. The ALM hypothesis argues that computerization and IT are able to either supplement or compliment different tasks and the skills that are needed to achieve them. During instances where skills are routinized, this technology may be able to operate according to an “IF-THEN-DO” logic to replace routinized skills. However, if the skills are not able to be easily routinized, technology may be adopted that complements these skills.

In the fire related emergency job-context, the role of technology paralleled the overall skill change patterns found. In fact, the removal of certain skills used in preparation for a fire and at the fire among engine companies was an outcome of the implementation of new technologies to the fire department. Perhaps this is no surprise, as technology has long played an important role in the U.S. fire service (Coleman 2004), and clearly continues to do so today (even if it does not have the high level of impact it once did). In regards to preparing for a fire, there was some slight evidence of certain instances where firefighters’ skill may have somewhat diminished. Multi-sensory alarms were beginning to be introduced to the WCFD’s fire stations that allowed more selectivity in signaling an incoming emergency call, (determined by a set of guidelines based on geography, but also the individual concerns regarding the call). In doing so, some autonomy/control-related aspects were removed. The introduction of printers and computers to the RCFD’s alerting systems allowed for the removal of some of the skill in navigating to the scene of a fire emergency. This computer technology was able to store geographical data on roads and streets (i.e., a routinized grid in which one could drive) which could *potentially*

replace both complexity and autonomy/control-related elements involved in this task. However, due to non-routine aspects of this task such as traffic patterns, road closings, and time of the day, not all skills involved here were routinized and (per the ALM hypothesis) were not replaced. In regards to driving, automatic transmissions were (or in the case of the WCFD, still are being) implemented. This decreased the complexity involved with using manual transmissions at both departments.

In the fire related emergency job-context, the only clear pattern of both substantive complexity and autonomy/control-related skill dimensions being removed as a result of technology replacing routinized tasks (Autor et al. 2002, 2003a, 2003b) was at the scene of a fire in regards to the operating the engine. A computerized control was added to the pump that followed basic physics involving the routinized amounts of water pressure needing to be supplied to attack hose lines. Thus, the complexity involved with this task had decreased. Interestingly enough, some of the discretion previously used by the firefighters operating the pumps also was removed by this new technology; however, it did not follow the ALM hypothesis. Throughout the course of the interviews I conducted, it appeared that individualized considerations may have been made by the pump operators as to how much water to supply based on the burning structure and the firefighter using the attack line. This was in no way routinized, but as these pumps were now governed by computers, this individualized consideration was no longer able to be made. Interestingly enough, while these computerized pumps decreased the skill involved in pumping water, from the interview data the new hose diameters and new nozzles being used in both

departments were found to have little to no direct impact on the skills used by firefighters (i.e., did not spawn any changes).

While the above technologies followed Autor et al.'s (2002) notion that routinized skills can be supplemented by computerized technology, this pattern was not found in regards to truck companies while at a fire, or after the fire had been "knocked down." In fact, in some instances the introduction of new technology had somewhat of an opposite effect where there were even some indications of additional skill now being required. Simply by their basic introduction, hydraulic tools did create some level of increase of skill in the substantive complexity dimension used in forced entry. However, thermal imaging cameras (TICs) did not really have this affect on the truck companies' tasks. Although they relied on routinized physical properties, they were not regularly used by the truck company in search and rescue, thus the impact was negligible. The only other new technology introduced through the fire department was improvements on the aerial ladders. However, while their new designs were able to remove some of the basic routinized manual procedures involved when *preparing* to use the aerial (i.e., removing the steering wheel), how it was used was very situational and depended on considerations such as when the truck company was due to the scene, the proximity of the truck to buildings, etc. Thus, in some ways the removal of complexity in the preparation of the aerial ladder was subsequently negated by the actual use of the aerial ladder, as the considerations noted above did not allow for this use to be completed in a routinized manner.

Finally, after a fire was knocked down, the only new technology that affected the firefighters was the TIC as it was being used during overhaul. This single

technology had a differing effect on the two different dimensions involved in this one task. Through its use, firefighters needed to learn new mental and manipulative skills (i.e., actual how to use the technology). At the same time, its thermal imaging technology recognized heat patterns (which follow routine laws of physics) alleviating the necessity of firefighters to find any remaining burning/smoldering embers or fires through more rudimentary manners that rely solely on the help of basic hand tools.

Thus, overall technology has played a rather significant role in the change of skill used in the fire emergency context, particularly at the scene of a fire (specifically the computerized pumps, the greatest removal of skill in the fire related emergency job-context). In this aspect of this job-context, the ALM hypothesis appears to be followed rather closely. On the other hand, fire trucks at the scene of a fire and after the fire has been “knocked down” were areas of the fire emergency context where technology appeared to have slightly increased the skills used in this particular job-context.

In regards to the non-fire related emergency job-context, many new tools and technologies were implemented over the course of the past 20 years. The overall effect of these technologies created an increase in the substantive complexity and autonomy/control-related skill dimensions to the respective skill in which they were related. Based on the manner of skill change that was experienced in this job-context, this was rather expected. However, in applying the routinization hypothesis to this context, a more complex relationship is revealed. Although there appears to be a

uniform shift in skill during both dimensions, the reasoning behind this shift is both due to non-routine and routine skills.

According to the ALM hypothesis, technology will be used to complement non-routine skills involved with a specific task. This would then increase the amount of skill needed to perform a task. This is the case with a variety of technologies introduced in the New Economy. For example, in dealing with automobile accidents, it is shown that hydraulic tools were adopted and used to perform the task of cutting and prying open cars. This increased the complexity (i.e., firefighters could now perform a task not able to be done before), without truly affecting the discretion involved in the task. Depending on the type of car and the impact/damage of the accident, this could be handled in a number of ways and was not a routine skill. Furthermore, car-related technologies (e.g., airbags, gas/electric hybrid motors, etc.) have also been continuously changing throughout the past 20 years, and are dependent upon a specific car company/model. Therefore, this new technology has created a non-routine situation which has created not only an increase in complexity, but also in discretion when a firefighter is faced with handling one of these car accidents. In the various mechanical/maintenance tasks, other types of technologies were introduced to perform non-routine tasks. These included absorbent materials (for fluid spills), hot sticks (for electrical problems), and gas meters (for testing gases or odors). These technologies were all used to perform fairly simple tasks with fairly low to moderate absolute levels of skill. However, these tasks were non-routine and complemented by these technologies. The result was an increase in the substantive complexity, albeit a rather slight or modest increase. However, the autonomy/control-

related dimension remained rather unaffected. Furthermore, with the introduction of full-fledged paramedic training for new firefighters, additional medical supplies and tools (e.g., various drugs) were able to be used by firefighters to perform non-routine skills, increasing both dimensions.

The second manner in which technology in the non-fire related emergency job-context involved increase skill was in fact through routine skills being replaced. At first this appears contradictory to the ALM logic; however, stepping back and providing a bigger picture allows for one to see why this is the case. For example, the process of administering a shock to medical patients was based upon an initial reading of vital signs. Initially this could only be completed by paramedics. However, as these vital signs follow routinized and rhythmic biological patterns, in the past ten years the introduction of the AED to the WCFD and RCFD allowed for this computerized device to determine the proper routine patterns and administer a shock accordingly. Thus, the AED was able to minimize certain routine skills. In the process these skills which once belonged to only paramedics could now be simplified by this technology to an extent that they were able to be performed by firefighters who had a lower level of EMS training. Therefore, the original placement of the skill mattered. This skill originally did not belong to firefighters, but due to logic of the Autor and colleagues (2002, 2003a, 2003b) argument, it was able to be captured by technology and transferred from solely paramedics to firefighters trained only in basic EMS. This same logic can be applied to the affect of other medical devices, particularly the glucometer and EpiPen®.

The only technological innovation to have a clear role at the fire station appeared to be the computer that was used to complete incident and activity report. The role of this technology was not necessarily what might have been expected, as in its current state, both the WCFD and RCFD were not using computers in a manner which was replacing the routine components involved with the task of incident and activity reporting. At the WCFD, computers had not yet been implemented at all fire stations to use in the completion of reports. Furthermore, while they could be used for basic typing and printing of reports, software programs and intranet connections that would allow much of the complexity involved with this task to be removed had not been introduced. Thus, the role of computer technology in the WCFD, at least to the firefighters, was not extremely unnoticeable.

Only the RCFD had a widespread implementation of computers. True, the computers at the RCFD did allow for some basic information reported during this task to be removed from the task itself. Yet the computers themselves added a large amount of complexity that for many of the senior firefighters who traditionally completed reporting, was rather complex. Furthermore, even with the implementation of this technology, a number of officers still kept a paper and pencil log of the incidents and activities they completed. With this in mind, not only was the complexity of this task heightened by the need to learn computer technology, but (in the eyes of the firefighters) it created double the amount of work for firefighters completing this task as both electronic and paper forms were being completed. Thus, these computers were actually not used in a routinized manner that would minimize the complexity of this skill. This was particularly interesting as it would appear this

would be the one aspect of the fire station job-context in which one might assume to see the routinization hypothesis used to show the supplementation of many of the skills in this task by a computer.

Technology played a relatively small role in the fire station context (compared to the fire and non-fire related contexts), and its effects in the non-fire non-emergency job-context followed a similar pattern. In fact, with one exception the effects of technology in the non-fire non-emergency job-context were not very noticeable. This one exception was the introduction of the Trailer and Children's Village to the WCFD. The introduction of these technologies subsequently created new skills. This in turn increased the mental and manipulative integration needed to be used by the WCFD firefighters, but also the amount of discretion and problem solving they needed to display when handling the children who participated in these two expanded programs. These skills were non-routinized, and did not exist prior to the introduction of these two technologies.

Clearly technology does play an important role in the skill change of firefighters. Above it was noted that the biggest change in skill was apparent in the non-fire related emergency context. Not surprisingly, this particular context was also where new technologies had the largest role. The new technologies introduced increased the skill involved in many of the tasks examined, and did so according to the ALM routinization hypothesis. Furthermore, this increase was more present in the complexity skill dimension versus the autonomy/control-related skill dimension. In the fire related emergency context, the role of technology again mirrored the movement in skill change. Here it was clear that technology removed some of the

skill involved in the preparation for a fire and at the scene fire among engine companies. However, what was unique in this job-context was that not only was the decrease in skill apparent in the complexity dimension, but the effects were also felt in the autonomy/control-related dimension. Thus, not only did the directions in which skill was affected differ between the non-fire and fire emergency job-contexts, it also differed in which dimensions it affected. While these two portions of the fire related emergency job-context were affected, among truck companies at the scene of a fire, and after a fire had been “knocked down,” the data found new technologies to actually have increased skill.

There was only a relatively small role played by technology at both the fire station and in non-fire non-emergencies. However, what was interesting here was that the impact of technology itself differentiated between the two fire departments. For example, for the RCFD technology did play a role in skill change (increased the complexity involved with reporting incidents and activities), while in the WCFD the introduction of the Fire Prevention Trailer and Children’s Village heightened both skill dimensions among the WCFD firefighters. Thus, although the role of technology in these two contexts was small, it was important to note as it differentiated according to the two different departments studied.

While the ALM hypothesis (Autor et al. 2002, 2003a, 2003b) did allow for an understanding of the impact of technology on skill change among the firefighters I interviewed, its integration with Braverman’s (1998/1974) skill dimension conceptualizations further enhanced the understanding of technology’s role on skill change, as its impact was able to be examined across both the substantive complexity

and autonomy/control-related dimensions of skill. The interview data showed here that only one new technology, the engine pumps used to supply water at fire related emergencies, removed skill from both dimensions in the “technologically deterministic” (Vallas 1990) manner that Braverman expected. On the contrary, the new technology introduced in most instances appeared to required additional skills be learned by the firefighters who used them, in many instances affecting the substantive complexity and autonomy/control-related dimensions to different extents. Thus while the diminishing skill level hypothesized by Braverman was not found, the use of his skill dimensions in conjunction with Autor et al.’s hypothesis did provide insight that may have otherwise gone unnoticed.

A final conclusion to make is that again, the use of multiple job-contexts and multiple skill dimensions allows for a more thorough and intricate examination of technology’s role on skill change. By not noting the multiple contexts involved with firefighting skills, a researcher might draw conclusions based on only a certain number of skills. Arguably these skills examined may more readily fall into the two emergency job-contexts, which show that technology does play a somewhat significant role in skill change. Yet, when considering all the skill in the fire station and non-fire non-emergency job-contexts that skill does *not* radically affect, it appears that drawing conclusions from solely the two emergency contexts inevitably leads to a bias in the results. Furthermore, although an increase or decrease in skill might yield a higher/lower level of one skill dimension should not be taken to imply that a shift in the other dimensions will automatically be the result. Furthermore, the use of Autor, Levy and Murnane’s (2002, 2003a, 2003b) routinization hypothesis has

also provided a basis in which to assess the manners in which skill has (or has not) changed within each skill dimension. Collectively this multi-tiered conceptual model has shown that while technology does have an important effect on the skills used by firefighters to complete their tasks, its role is more important in some job-contexts than others, and has a greater effect on the substantive complexity dimension than the autonomy/control-related. Therefore, although its role is important to recognize, it is also important make sure that the impact of technology it not overestimated.

Discussion

Limitations

As with any research, the preceding study did face some limitations. These need to be considered when interpreting the results and discussing the research's implications, and therefore they will be mentioned here. First, the conclusions of this study were reached through the analyses of data that came from two independent fire departments in the state of Maryland. These conclusions can confidently be generalized to these two departments, and to some extent other professional (i.e., non-volunteer) fire departments in the state of Maryland. However, caution should be warranted to stretching this generalizability much further. True, the skill change and impact of technology found here may be similar to other fire departments in the U.S.; however, this assumption cannot fully be supported through the use of this case study. Furthermore, these results also cannot be assumed to accurately represent skill change and technology's impact in the public service sector as a whole. Thus, while generalizability is somewhat more limited in case studies such as this (it is a commonly noted limitation), the benefit is that much more detail is able to be

discovered, and that this method allows a more detailed analyses that may have otherwise been missed.

The second important limitation to note is that the method of data collection – the use of semi-structured interviews – may have not been the absolute ideal method to use. Arguably, observations (either participant or non-participant) or their integration would have been an ideal manner in which data could be collected. Yet due to the danger and risk posed by a number of tasks that firefighters must complete, this method of data collection was simply not able to be utilized to an extent where enough quality data could result and be used to answer the research questions. It should be noted that while this “ideal” method was simply not a reality, I still was able to spend much time around the fire stations at both the WCFD and RCFD when I was not conducting interviews, including a number of more formal observations, and also ride along with two firefighters to a non-fire emergency response. Regardless, interview data was truly the primary data used in this study and that was systematically analyzed.

Another point to note here was that as the interviews I conducted were sometimes interrupted (i.e., an incoming emergency call to which the interviewee had to respond), special considerations had to be made by myself as the interviewer such that the interview could begin again upon the firefighter’s return. This also was not ideal, but was simply the nature of interviewing firefighters who work rotating schedules in an often unpredictable occupation.

Finally, as discussed in the Literature Review (**Chapter 2**), research on skill has faced a variety of conceptual and measurement issues, and subsequently there

have been numerous conceptual and operational methods used in its study. Because of this issue, the ways in which researchers have approached the study of skill has varied widely, and in turn its study has been approached in a variety of different manners. Thus, while I attempted to conduct as thorough of a review of the theoretical and empirical literature as possible, and integrated what I believed to be some of the most justified, dominant, and best concepts and methods as possible into a model to guide my research, this is not to say it is *the* definitive model for studying skill change and is the one method that should be used. I do strongly believe that it is a well-informed model that has potential to be used in a variety of studies that empirically examine skill, skill change, and the role of technology on skill change; however, at the same time I recognize there are many other conceptual and operational considerations that were not included in this study. Thus I would encourage future research to use this particular model, but at the same time be open to building upon it to further our understanding of this topic. Although this point may not necessarily be a limitation per se, I feel that is still an important consideration that should be noted.

Implications

Albeit limitations exist, there also exist a number of implications that have resulted from the findings of the above research. The first, and arguably one of the most important, is that in order to continue to seek an understanding of skill change in the New Economy, we must take a more complex and systematic approach to our empirical research. As the results of this study show, skill change among firefighters did not occur uniformly and in a linear fashion (i.e., up/down, yes/no,

increase/decrease, etc.). Rather, it occurs in a much more multifaceted manner. While in some job-contexts of the occupation it was found that skill has been drastically altered, in another context there was little or no affect at all. Furthermore, in one job-context present in firefighting, the skills drastically increased, yet in another it was lowered to a rather basic level. Furthermore, just because the complexity involved in completing a task required of firefighters is heightened, it does not imply that the discretion and decision-making will follow suit. Thus, these contradicting changes are important to note if we are to truly recognize the intricacies involved with skill change, and build upon this present research.

This more complex understanding must also be applied to determine the role of technology in skill change. Through increasing computerization of the workplace, most would clearly expect that with computers and computerized devices becoming ever-present in a wide variety of occupations, they will continue to have an impact on workers' skills. This was clearly true for the firefighters in this study. Thus, the routinization of tasks (or lack of), and consequently the impact computers have on these tasks, is a valuable research vein for scholars to pursue; however, it is not enough. Integrating this argument with the conceptual foundations laid down by past researchers must also be accomplished. This is precisely what was sought to be accomplished in this present study. In doing so, it was found that through this manner arguably a more complete understanding of technology's role on skill can be found. Thus, an important consideration for future research is to strive to achieve a more detailed and holistic understanding of skill change and the impact of technology on this skill change.

However, in order to achieve this more complete understanding we also need to attempt to create and use better and more theoretically-informed conceptual models in our research. As shown here, by doing so the result may be that a much greater understanding of exactly *how* firefighters' skills have changed in the New Economy, and *how* technology has impacted these skills, has been achieved. Thus, a second important implication that should be derived from this research is that we must place our focus not only on the results of our research, but also how they are reached. This implies that we not only continue to put thought into the conceptualization and measurement of skill, but also strive to build upon these past foundations. Obviously, the specific type of study, population being examined, or even resources available play a role in accomplishing this task. However, they should not be *the* guiding factor as to how we conceptualize and measure skill. As Spenner (1985) noted, these considerations were once a driving factor of sociological research on skill. However, this should not be taken to imply it is the best method of research. As sociologists and researchers we conduct studies with the intention that other researchers will adopt ideas and improve upon them. Thus, I argue that to gain a complete understanding of skill change, we need to adopt better conceptual arguments. This is precisely what the conceptual model in the present study was used to do, and as a result it led to extremely interesting results. Whether or not this study's conceptual model is the best model to follow could be argued. However, the results of this study make it difficult to argue that using more thorough conceptual arguments is *not* a beneficial avenue for future research to consider.

Another implication is that future studies should strive to increase the generalizability past professional firefighters in two fire departments. This could be accomplished by conducting similar examinations on additional populations of firefighters, occupation, industries, etc. The conceptual model used here may serve as a valid guide in the understanding of skill change among not only firefighters at other departments throughout the U.S., but also in other occupations or industries. While the specific job-contexts would need to be altered, and the individual skills examined would be different, the same model used in the present study could be applied to a variety of studies in a way that could increase generalizability.

Related to the implication of improving generalizability, another implication for future research would be to determine how researchers may be able to operationalize the multi-tiered conceptual model I have introduced in this present study to large-scale quantitative studies. A review of the literature shows that different findings have been made by researchers depending on if they have conducted their research through the use of qualitative case studies, or if they utilized large-scale quantitative analyses of secondary data. One reason for these differences clearly involves the differences in how skill is conceptualized and measured. Therefore, by applying the conceptual model used in the present study to a larger scale quantitative study, one might be able to reach a more holistic understanding of scale on a much more generalizable level, and in addition speak to the differences of skill change reported between qualitative and quantitative studies.

A Final Note (Summary)

In the above study, a multi-tiered conceptual model was used to examine skill change in the New Economy among professional firefighters. The results of this study showed the skills of firefighters have clearly changed, and have done so in a non-uniform fashion. While the skills of firefighters have shifted in one manner during the fire related emergency job-context, they have also shifted in an opposite manner in the non-fire related emergency job-context. At the same time, the skills needed during non-fire non-emergencies and at the fire station have remained relatively stable throughout the transition into the New Economy. While these findings are in themselves interesting, it is also important to note that depending on what dimension of a skill is being considered, any changes that have been introduced may not necessarily affect each dimension in a similar manner. A change in one dimension does not necessarily signify a change in another dimension, or even necessarily a change in a similar manner. Furthermore, the role of technology on skill change has also been as complex as skill change itself. New tools and technologies have also had a mixed effect depending on the job-context and skill dimension examined. Thus, through this approach, it was found that the skills used by firefighters in the New Economy have clearly been altered. By taking the lessons learned here from this empirical study of firefighting in the New Economy, it is hoped that the implications of these findings can be taken and applied to future research. Through this effort we can further our understanding about skill change in the New Economy and the impact technology has had on this change.

Tables

Table 1. Overview Comparison between the Dictionary of Occupational Titles (DOT) and the Occupational Information Network (O*NET)

	<i>DOT</i>	<i>O*NET</i>
Format	Book	Database
Flexibility	Fixed format	Flexible system, allowing users to reconfigure data to meet their needs
Reflection of Economy	Reflected industrial economy and the predominance of blue-collar workers	Reflects the occupations of today's labor market and the need for multi-skilled workers
Basis	Task-based – described workers' functions in relation to data, people, and things	Skills-based – describes job requirements and worker attributes, as well as content and context of work using 483 variables
Definition of Occupations	Offered isolated dictionary definitions of occupations	Offers new means of identifying and describing occupations, using a classification system linked to labor market information
Linkage to Other Systems	Required complex crosswalks to other systems	Uses SOC easing direct links to other systems
Skill Transferability	Provided no measure of skill transferability making it difficult to create job clusters or explore career paths	Gauges transferability of skills making it easy to create job clusters and explore career paths across clusters

Source: Adopted from Mariani (1999:4).

Table 2. Example Pattern of River City Fire Department’s Eight-day Rotating Shift Schedule

Type of shift	Day on the Shift Schedule							
	1	2	3	4	5	6	7	8
Day shift	A	A	B	B	C	C	D	D
Evening/night shift	D	D	A	A	B	B	C	C

Figures

Figure 1. Skills Used by Firefighters Conceptualized According to Job Skill Level and Job-context Skill Level

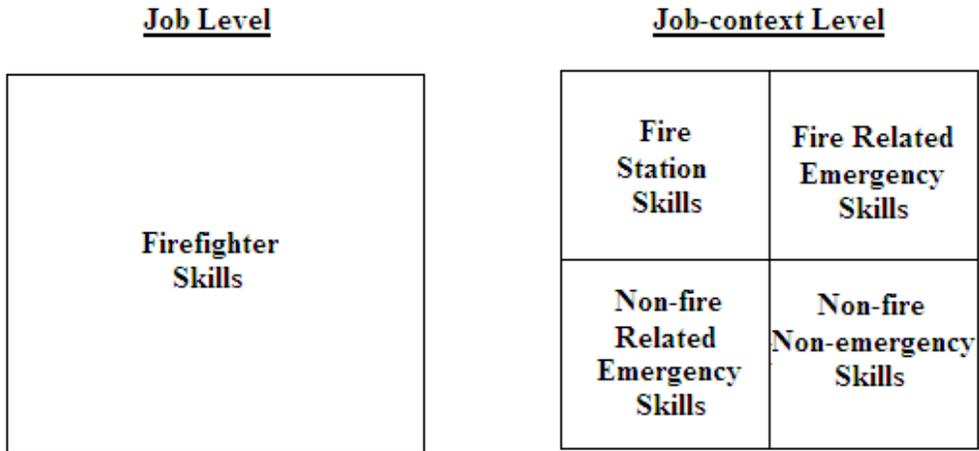


Figure 2. Job-context Skill Levels of Firefighters and Corresponding Dimensions of Skill

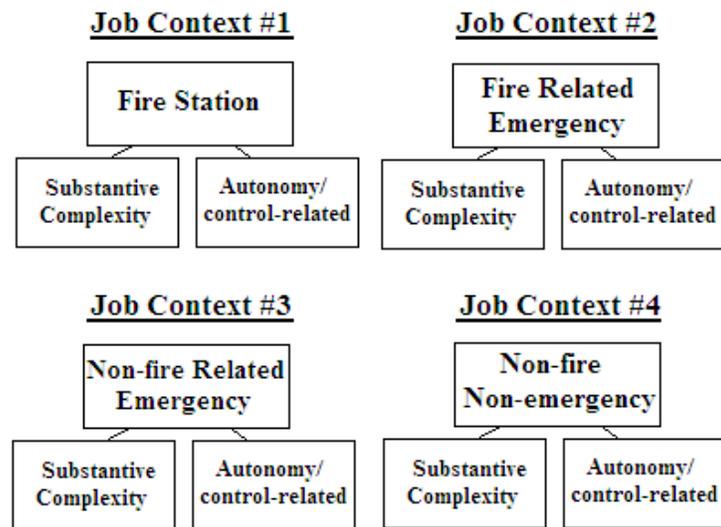
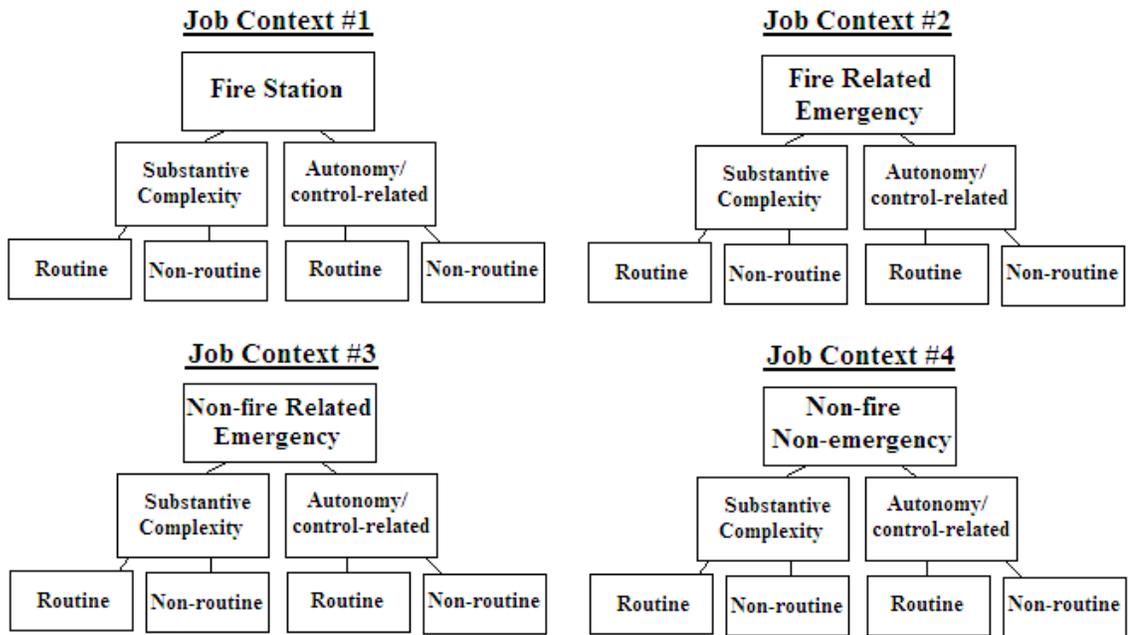


Figure 3. Conceptual Model of the Skills Used by Firefighters in Different Job-Contexts to Complete Required Tasks



Appendices

Appendix A: Questionnaire Instrument

Description of Current Daily Tasks

For the first few questions I would like you to think about the activities and duties you complete during the course of a shift in which you work. Please be as detailed as possible. I would love to hear about even the smallest tasks which at some times may even be taken for granted.

1. In average, how long does a shift in which you work last?
2. Think of the time you spend at the fire station. About how many hours (and minutes) of your shift is spent at the fire station?
3. Could you please describe the different types of responsibilities and tasks that are needed to be completed by you arrive at the fire station? You could simply walk me through the time you arrive to the time you leave and describe how you complete the required tasks and responsibilities.
4. Now I am going to try to understand a little more in-depth the tasks you mentioned above (*Ask for each task mentioned above in Question #3*):
 - a. What needs to be done in order to [Insert Task Name]?
 - b. How often is [Insert Task Name] needed to be completed?
 - c. Was [Insert Task Name] ever completed in a different manner?
 - d. When did this older manner of [Insert Task Name] change?
 - e. Why did this change take place?
 - f. Do you have any opinion on this change? If so, could you elaborate?
5. Think of the time you spend at the scene of a fire. About how many hours (and minutes) of your shift is spent fighting fire?
6. Could you please describe the different types of responsibilities and tasks that are needed to be completed by you when arrive at the scene of a fire? You could simply walk me through the time you receive the call at your fire station to the time you leave the scene of a fire to return back to the station and describe how you complete the required tasks and responsibilities.
7. I am sure in order to fight different types of fire there are different tasks that need to be completed. If I am correct, could you maybe provide some examples?
8. Now I am going to try to understand a little more in-depth the tasks you mentioned above (*Ask for each task mentioned above in Question #6 and #7*):
 - a. What needs to be done in order to [Insert Task Name]?

- b. How often is [Insert Task Name] needed to be completed?
 - c. Was [Insert Task Name] ever completed in a different manner?
 - d. When did this older manner of [Insert Task Name] change?
 - e. Why did this change take place?
 - f. Do you have any opinion on this change? If so, could you elaborate?
9. Think of the time you spend at the scene of an emergency response call which does not involve fire. About how many hours (and minutes) of your shift is spent dealing with these types of calls?
10. Could you please describe the different types of responsibilities and tasks that are needed to be completed by you when you arrive at the scene of a non-fire emergency? You could simply walk me through the time you receive the call at your fire station to the time you leave the scene of addressing the emergency call and return back to the station and describe how you complete the required tasks and responsibilities.
11. What are the different types of these non-fire emergency response calls? Could you describe how the tasks that need to be completed differ from call to call?
12. Now I am going to try to understand a little more in-depth the tasks you mentioned above (*Ask for each task mentioned above in Question #10 and #11*):
- a. What needs to be done in order to [Insert Task Name]?
 - b. How often is [Insert Task Name] needed to be completed?
 - c. Was [Insert Task Name] ever completed in a different manner?
 - d. When did this older manner of [Insert Task Name] change?
 - e. Why did this change take place?
 - f. Do you have any opinion on this change? If so, could you elaborate?
13. Finally, in addition to the types of activities we have discussed above, I know there are also other types of tasks and duties that you must have outside of the fire station that are not considered emergencies. For example: checking/installing smoke detectors. About how many hours (and minutes) of your shift is spent dealing with these types of non-emergency activities?
14. Could you please describe the different types of responsibilities and tasks that are needed to be completed by you when at the scene of a non-emergency? You could simply walk me through the time you receive the call at your fire station to the time you leave the scene of addressing the emergency call and return back to the station and describe how you complete the required tasks and responsibilities.
15. Now I am going to try to understand a little more in-depth the tasks you mentioned above (*Ask for each task mentioned above in Question #14*):

- a. What needs to be done in order to [Insert Task Name]?
- b. How often is [Insert Task Name] needed to be completed?
- c. Was [Insert Task Name] ever completed in a different manner?
- d. When did this older manner of [Insert Task Name] change?
- e. Why did this change take place?
- f. Do you have any opinion on this change? If so, could you elaborate?

Introduction of New Technologies and Effects on the Firefighter

I am now going to ask you some questions about different types of technologies which have been introduced to your job. By technology I not only mean things that have been computerized, but any improvements and innovations that have been introduced. Also, I am not interested in the time prior to 1990, so please don't worry about reaching back past this date.

1. Thinking just of your duties at the fire station, what types of new technologies have been introduced in this post-1990 time period?
2. Now, I am going to try and understand a little more in-depth the technologies you mentioned above (*ask for each technology mentioned above in Question #1*):
 - a. Has [Insert Technology] caused you to not need any skills you had previously needed?
 - b. Has [Insert Technology] created any new skills which you now need? (i.e. Have they complimented any of the skills you use?)
 - c. Do you have any opinion about this technology? If so, could you elaborate?
3. Now I want you to think specifically about computers and computerized devices used at the fire station. Could you briefly describe how these specific computer technologies are used?
 - a. Do you have any opinion about this computer technology? If so, could you elaborate?
4. Thinking just of your duties while fighting a fire, what types of new technologies have been introduced in this post-1990 time period?
5. Now, I am going to try and understand a little more in-depth the technologies you mentioned above (*ask for each technology mentioned above in Question #4*):
 - a. Has [Insert Technology] caused you to not need any skills you had previously needed?
 - b. Has [Insert Technology] created any new skills which you now need? (i.e. Have they complimented any of the skills you use?)
 - c. Do you have any opinion about this technology? If so, could you elaborate?

6. Now I want you to think specifically about computers and computerized devices used at the scene of a fire. Could you briefly describe how these specific computer technologies are used?
 - b. Do you have any opinion about this computer technology? If so, could you elaborate?
7. Thinking just of your duties at non-fire emergencies, what types of new technologies have been introduced in this post-1990 time period?
8. Now, I am going to try and understand a little more in-depth the technologies you mentioned above (*ask for each technology mentioned above in Question #7*):
 - a. Has [Insert Technology] caused you to not need any skills you had previously needed?
 - b. Has [Insert Technology] created any new skills which you now need? (i.e. Have they complimented any of the skills you use?)
 - c. Do you have any opinion about this technology? If so, could you elaborate?
9. Now I want you to think specifically about computers and computerized devices used at the scene of a non-fire emergency. Could you briefly describe how these specific computer technologies are used?
 - a. Do you have any opinion about this computer technology? If so, could you elaborate?
10. Thinking just of your duties at the various non-emergency calls you need to address, what types of new technologies have been introduced in this post-1990 time period?
11. Now, I am going to try and understand a little more in-depth the technologies you mentioned above (*ask for each technology mentioned above in Question #10*):
 - a. Has [Insert Technology] caused you to not need any skills you had previously needed?
 - b. Has [Insert Technology] created any new skills which you now need? (i.e. Have they complimented any of the skills you use?)
 - c. Do you have any opinion about this technology? If so, could you elaborate?
12. Now I want you to think specifically about computers and computerized devices used at a non-emergency call. Could you briefly describe how these specific computer technologies are used?
 - a. Do you have any opinion about this computer technology? If so, could you elaborate?

Background Information

Next, I would like to ask a few different questions about some of your background information. It should not take very long.

1. *(identify the respondent's sex)*
2. What year did you become a paid firefighter?
3. Did you serve as a volunteer firefighter prior to becoming a paid firefighter? If so, for how many years?
4. Did you serve as a paid firefighter prior to working for the *(Insert Name of Fire Department)* Fire Department? If so, for how many years?
5. How old are you (in years)?
6. What racial identity do you identify with?
7. Would you consider yourself of Hispanic ethnicity?
8. What is/was your father's main occupation?
9. What is/was your mother's main occupation?
10. Are you currently married?
11. *(If not currently married)* What is your marital status?
12. What is your official title with the *(Insert Name of Fire Department)* Fire Department?
13. Could you briefly describe to me the different types of companies you have served on during your tenure as a paid firefighter for *(Insert Name of Fire Department)* Fire Department?
14. *(If served as a volunteer prior to their current position)* Could you briefly describe to me the different types of companies you have served on during your tenure as a paid firefighter for *(Insert Name of Fire Department)* Fire Department?
15. *(If served as a paid firefighter prior to their current position)* Could you briefly describe to me the different types of companies you have served on during your tenure as a paid firefighter for *(Insert Name of Fire Department)* Fire Department?

Education and Training Background

Finally, I would like to ask you a few questions about the different types of formal education and training you have received.

1. What is the highest grade level you have completed?
2. *(If attended/graduated college)* What types of college degrees have you completed?
3. *(If attended/graduated college)* What was your major/area of specialization in college?
4. Have you been involved in any vocational or technical training during or after high school?
5. Specific to your current occupation as a firefighter, what types of training have you received?
6. (For each occupation-related training) Could you give a brief description of the training program?
7. (For each occupation-related training) How long did this training last?
8. Specific to your current occupation as a firefighter, what types of official certifications have this/these training opportunities produced?
9. Is there any type of training that you have received and have not yet mentioned?

Appendix B: Potential Technologies Used by Firefighters

Table A. Potential Technologies/Tools Used by Firefighters to Complete Tasks Required by their Job, Listed by Category ^a

Category	Technology/Tools
<i>Safety Equipment/Personal Protective Ensembles (PPE)</i>	<ol style="list-style-type: none"> 1. Accountability Tags (Personal Identifiers) 2. Personal Alert Safety System (PASS) Device 3. Self-Contained Breathing Apparatus (SCBA) 4. Gloves 5. Goggles <ul style="list-style-type: none"> • Safety Goggles • Face Shield • SCBA Face Shield 6. Helmet 7. Coat 8. Pants 9. Boots <ul style="list-style-type: none"> • Common Rubber • Leather Pull-up • Leather Lace-up 10. Hood 11. Pocket Tool 12. Infrared Camera 13. Ear Protection <ul style="list-style-type: none"> • Foam Plugs • Rigid Earmuffs • Headsets 14. Integrated SCBA and PASS
<i>Apparatus/Vehicles ^b</i>	<ol style="list-style-type: none"> 1. Truck Company 2. Engine Company 3. EMS Vehicle/Ambulance 4. Fireboat
<i>Computers & Software</i>	<ol style="list-style-type: none"> 1. Hardware <ul style="list-style-type: none"> • Standard PC Computers • Mobile Data Computers • Mobile Data Terminal 2. Software <ul style="list-style-type: none"> • <i>Firehouse Software</i> 3. Various Training Simulators
<i>Alternative PPE for Specific Situations</i>	<ol style="list-style-type: none"> 1. Wildland Fire Ensembles 2. Ice Ensembles 3. Technical Rescue Ensembles 4. Shift-Water Ensembles
<i>Communication/Emergency Calls</i>	<ol style="list-style-type: none"> 1. Computer-aided Dispatch (CAD) Systems 2. Fire Alarm Boxes (or Emergency Boxes) 3. Fire Alarms (within buildings) 4. Telecommunication Devices for the Deaf (TDD) 5. Personal Pagers/Paging Systems

Category	Technology/Tools
<i>Communication/Emergency Calls</i>	<ol style="list-style-type: none"> 6. Portable Radios (i.e. Walkie-Talkie) 7. Mobile Microphone 8. Call Logs <ul style="list-style-type: none"> • Magnetic • Digital
<i>Self-Contained Breathing Apparatus (SCBA) and Components</i>	<ol style="list-style-type: none"> 1. Backpack/Harness 2. Cylinders <ul style="list-style-type: none"> • Steel • Aluminum • Fiberglass • Kevlar/Carbon 3. Regulator 4. Face Piece
<i>Portable Fire Extinguishers</i>	<ol style="list-style-type: none"> 1. Portable Fire Extinguisher <ul style="list-style-type: none"> • Water • Foam • Carbon Dioxide • Halon and Clean Agents • Dry Chemical • Wet Chemical
<i>Water Supply Components</i>	<ol style="list-style-type: none"> 1. Fire Hydrants <ul style="list-style-type: none"> • Wet Barrel Hydrant • Dry Barrel Hydrant • Dry Hydrant • Specialty Hydrants 2. Water Distribution Valves <ul style="list-style-type: none"> • Gate • Check 3. Portable Water Tank 4. Water Supply Gauges <ul style="list-style-type: none"> • Bourdon • Pilot • Panel
<i>Fire Hoses</i>	<ol style="list-style-type: none"> 1. Fire Hose Types <ul style="list-style-type: none"> • Hard Suction • Booster • Attack • Soft Suction • Small-diameter • Medium-diameter • Large-diameter (Supply) • Occupant Use • Forestry 2. Hose Bed 3. Hose Washer <ul style="list-style-type: none"> • Manual • Automatic 4. House Couplings 5. Hose Storage

Category	Technology/Tools
<i>Fire Hoses</i>	<ol style="list-style-type: none"> 6. Hose Tools <ul style="list-style-type: none"> • Rope Hose Tool • Hose Strap • Spanner Wrenches • Hydrant Wrench • Hose Roller/Hoist • Hose Clamp • Hose Jacket • Hose Bridge • Hose Cart 7. Hose Connectors <ul style="list-style-type: none"> • Double Female • Double Male • Increaser • Reducer • Adapter 8. Wye 9. Hose Cap 10. Distributor/Extension Pipe
<i>Nozzles</i>	<ol style="list-style-type: none"> 1. Nozzle Types <ul style="list-style-type: none"> • Solid Stream (Smooth Bore, Straight Bore, Solid Tip) • Combination • Constant/Set Volume • Variable, Adjustable, or Selectable Gallonage • Cellar or Bresnan • Piercing • Water Curtain
<i>Foam and Foam Application Devices</i>	<ol style="list-style-type: none"> 1. Foam Application Devices <ul style="list-style-type: none"> • Eductor • In-line Eductor • Bypass Eductor • Compressed Air Foams Systems (CAFS) 2. Foam Types <ul style="list-style-type: none"> • Protein Foam • Fluoroprotein Foam • Aqueous Film Forming Foam (AFFF) • Fluoroprotein Film-Forming Foam (FFFP) • Detergent-type Foam
<i>Protective Systems (Sprinkler and Detectors)</i>	<ol style="list-style-type: none"> 1. Heat Detectors (Rate-of-Rise; Fixed Temperature) 2. Smoke Detectors (Ionization; Photoelectric) 3. Gas Detectors (Carbon Monoxide) 4. Flame Detectors (Ultraviolet; Infrared; UV-IR Combo) 5. Electroluminescent (EL) Marking Systems 6. Sprinkler Heads (Old-style; Upright; Pendent; Spray) 7. Sprinkler Pipe Systems <ul style="list-style-type: none"> • Wet Pipe • Dry Pipe • Deluge • Preaction

Category	Technology/Tools
<i>Protective Systems (Sprinkler and Detectors)</i>	<ul style="list-style-type: none"> • Residential • Standpipe • Local Application and Hood • Total Flooding
<i>Ladders</i>	<ol style="list-style-type: none"> 1. Truck-mounted Aerial Ladders 2. Tower Ladder 3. Articulating Boom ladder 4. Straight Ladder 5. Extension Ladder 6. Roof and Hook Ladder 7. Folding Ladder 8. A-frame Combination Ladder 9. Pompier Ladder (or Scaling Ladder)
<i>Forcible Entry and Rescue Tools</i>	<ol style="list-style-type: none"> 1. Power Hydraulic Spreaders 2. Power Hydraulic Cutters 3. Power Hydraulic Rams 4. Air Chisels 5. Reciprocating Electric Saws 6. Striking Tools <ul style="list-style-type: none"> • Flathead Ax • Maul/Sledge • Battering Ram 7. Prying Spreading Tools <ul style="list-style-type: none"> • Halligan Tool • Claw Tool • Kelly Tool 8. Cutting Tools <ul style="list-style-type: none"> • Ax • Handsaws • Bolt Cutters • Wire Cutters • Power Cutting Tools – Saw <ol style="list-style-type: none"> i. Carbide-Tipped Blades ii. Metal Cutting Blades iii. Masonry Cutting Blades iv. Chain Saws v. Recipricating Saws vi. Cutting Torch 9. Pulling Tools <ul style="list-style-type: none"> • Hook • Pike Pole 10. Other Types of Tools <ul style="list-style-type: none"> • Bam Bam or Dent Puller • Duck Bill Lock Breaker • K Tool and Lock Pullers
<i>Salvage/Overhaul Materials</i>	<ol style="list-style-type: none"> 1. Salvage Cover 2. Floor Runner 3. Water Vacuum 4. Other Misc. Tools

Category	Technology/Tools
<i>Hazardous Material Protective Clothing</i>	<ol style="list-style-type: none"> 1. Level A 2. Level B 3. Level C 4. Level D 5. High-temperature Clothing 6. Low-temperature Clothing
<i>Air Monitors</i>	<ol style="list-style-type: none"> 1. Oxygen Monitor 2. Flammable Gas Monitors 3. Toxic Gas Monitors 4. Photo-ionization Monitors
<i>Terrorism-related Items</i>	<ol style="list-style-type: none"> 1. Agents of Warfare/Chemicals <ul style="list-style-type: none"> • Nerve • Incendiary • Blood/Choking • Blister (Vesicants) • Irritants (Riot Control) • Anthrax • Ricin • Radiological Dispersion Devices (RDD)

^aThis list was compiled through examining firefighter training manuals and professional trade journals in preparation of interviews.

^bWhile there are a few general apparatus types, they are also customized towards specific fire departments. Thus, depending on the particular type of apparatus there may be various tools/technologies present.

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