Are changes in professionals' work environments altering their skills and knowledge?

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A growing body of literature documents changes to professional workplaces over time. Traditionally collegial and fairly flat in structure (Bucher and Stelling 1969; Cooper et al. 1996), the organizations in which professionals work are becoming larger, more corporate, stratified, and more 'business-like' in their operations (Muzio and Ackroyd 2005; Allan et al. 2019; Brock 2006; Cooper et al. 1996). New Public Management practices have meant that many of these changes affect both public and private sector workplaces (Currie et al. 2008). In these changing work settings, professionals are more closely managed than in the past (McGivern and Ferlie 2007; Noordegraaf 2016). As their workplaces rationalize, there are signs of an increased emphasis on efficiency and work intensification (McGivern et al. 2007; Currie et al. 2008). There are also signs of increased precarity and instability (Livingstone 2019b). Some professionals have fewer opportunities for promotion (Muzio and Ackroyd 2005). At the same time, there is evidence of professionals moving into management in significant numbers – often working as professional-managerial hybrids (McGivern et al. 2015; Livingstone 2019). However, these hybrid workers may find that their influence and decision-making opportunities are not particularly high (Livingstone-ref). There is also evidence that professionals' decision-making power and autonomy have decreased over time (Livingstone - ref).

Scholars have explored what these changes mean for professional workers. Notably, they have identified a shift in meanings of professionalism (Evetts 2006). Traditionally professionalism was characterized by professional autonomy and values including collegial

authority, occupational control of work, and discretionary decision-making (Evetts 2006: 141). Recently this occupational professionalism has been supplanted by organizational professionalism that substitutes "a discourse of control … [that] incorporates rational-legal forms of decision-making, hierarchical structures of authority, standardization of work practices, accountability, target-setting and performance review" (Evetts 2006: 140-1; see also Faulconbridge and Muzio 2008). These trends may reduce autonomy and increase routinization (Ritzer and Walczak 1986, 1988). They are also associated with increasing stratification and inequalities within professions (Waring 2014; Noordegraaf 2016; Freidson 1994).

There remains much debate, however, on the impact of these changes upon professional skills and knowledge. While some researchers identify routinization and skill decline, others highlight innovation and expanding managerial roles as evidence of new skill demands. The impact of workplace change might also be variable – affecting professionals differently depending on their organizational and professional roles.

This paper explores the impact of workplace change on professional skills through a case study of the Ontario engineering profession. Drawing on survey and interview data, I explore engineers' skill use, and explore how workplace change affects skill acquisition and use in professional practice. Implications of the findings for theories of professional skills and workplace change are considered.

Professions and Skill

'Skill' is socially constructed, and definitions of what constitutes skill not only vary across social-historical context, but they are infused with power (Braverman 1974; Adams and

Welsh 2008). Some groups have been more successful in having their skills recognized than others (Braverman 1974; Gaskell 1983; Adams and Welsh 2008). Even dictionary definitions vary widely, although most contain similar elements: *Skill entails the possession of knowledge, proficiency, experience and aptitude to do something well* (Adams and Welsh 2007; Webster's Consolidated 1954; Dictionary.com 2018). Virtually by definition, professionals are skilled workers, whose knowledge, training, and manual proficiency has been recognized by society (and usually by states) as being socially valuable. Professionals groups are regulated with the aim of ensuring that only those with the requisite skills can practice, and that professional practice is done in a manner that protects the public interest (Adams 2018, 2016). Professional education and training was historically standardized and formalized to ensure that professional practitioners were largely interchangeable – equally skilled and knowledgeable, and able to use their skills and knowledge to help others (Larson 1977).

Skill is a multi-faceted phenomenon. For example, skill is not simply something possessed, but it is also something exercised. Is it the possession of skills, or their exercise on the job, that marks a worker as skilled? Some researchers measure skill in terms of worker training, but widespread evidence of underemployment at work, suggests that looking at only the possession of skills, and not their exercise, results in an incomplete picture. There are also many different kinds of skills – technical skills, interpersonal skills, soft-skills, manual dexterity, tacit skills, knowledge, judgement, education, experience and training, among others. Research on skill rarely addresses all dimensions; doing so is quite difficult. National occupational classifications have taken many of these dimensions into account, for instance assessing 'general educational development', 'specific vocational preparation', 'cognitive complexity' and 'routine activity' (Myles 1988; Adams and Welsh 2008). Nevertheless, these classifications have been

criticized for rater bias, and for ignoring other dimensions of skill – many of which are important in female-dominated jobs (Boyd 1990; Gaskell 1983).

The complexities inherent in defining and measuring skill make it very difficult to assess changes in skill over time. Studies assessing skill change have provided clear evidence of both deskilling and skill upgrading (Spenner 1983). Scores of case studies examining change within specific occupations, dating back decades, have documented deskilling (see for example, Braverman 1974; Cockburn 1983; Kraft 1977; Heron and Storey 1986). At the same time, aggregate studies of the labour market as a whole have found evidence of skill upgrading (Form 1987; Spenner 1983; Livingstone). If there is a trend towards routinization over time, as some suggest, it seems that innovation brings new knowledge, new technologies, and new skilled jobs, which offset skill decline within jobs. Nevertheless, few studies have examined skill as a multi-dimensional phenomenon, and explored trends in multiple areas of skill: for example, technological change might reduce the need for manual skill is some sectors, but increase the need for knowledge of technologies (Livingstone 2019). Moreover, as the percentage of the population employed in the services sector increases, demands for soft skills, interpersonal skills, and related abilities (such as emotional intelligence) may increase, even as demand for other skills decreases. Given the complexities in measuring skill and skill change over time, our understanding of skill trends remains murky.

Professionals experience skill change like other workers in the Canadian labour force. However, there is no agreement in the literature about the nature of skill change over time. Some scholars have documented routinization and standardization. For instance, tasks that were once under the purview of only a select group of professionals – like making wills and other legal documents by lawyers, or giving health advice, and injections by doctors – have become

standardized to the point that many others with less training perform these tasks (Rothman 1984; Coburn 1994). Yet Freidson (1984, 1994) and others have countered that professions are actually fairly resistant to deskilling, because professionals drive research and innovation which generate new knowledge and skills. Hence, as some aspects of their work become routinized, new knowledge, techniques, and practices take their place. Freidson's (1984, 1994) argument has been influential, but even he postulated that change could be on the horizon. Dramatic changes to professional education and employing organizations appear to be transforming practice. Professions scholars have documented these trends, and have provided predictions of what these trends might mean for professionals in the coming years.

The first of these accounts, I refer to as the deprofessionalization thesis. Beginning in the 1970s and 1980s, scholars argued that workplace change was undermining the discretion and expertise that has long distinguished professionals from other workers in the labour market. Critical of blindly optimistic predictions of skill upgrading and professionalization prevalent in this era, Marie Haug (1975) highlighted evidence of decreasing autonomy, challenges to professional authority by increasingly educated and vocal consumers of professional services, technological change, and other trends she felt could undermine professions' distinct status in society. Such arguments were expanded by neo-Marxists and neo-Weberians. Influenced by Marxian theory, some argued that professionals were experiencing proletarianization brought about by employment, and exposure to the capitalist drive for the extraction of surplus value, control over the labour process and exploitation (Derber 1983; Coburn 1994). Derber (1983: 313) argued that professionals may maintain a degree of technical autonomy, but they are experiencing 'ideological proletarianization' – they increasingly lack control over the goals of their work, and the ends to which their work is directed. Neo-Weberian scholars, highlighted the

impact of rationalization on professional workers. For instance, Ritzer and Walczak (1986, 1988) argued that the spread of formal rationality in society contributed to a decline in professional power, and especially those characteristics like discretion and the exercise of judgement that distinguished professional workers from others. The deprofessionalization and proletarianization theses suggest professionals may experience deskilling. At the very least, they predict that professionals' authority and discretion are on the wane. These trends could contribute to skill decline, or skill change, in the long run.

The second set of explanations, I label the 'hybridity thesis.' A plethora of recent studies has explored hybridity within professions brought about by organizational and professional change (for example, Noordegraaf 2007, 2015; McGivern et al. 2015). Organizational change means that professional workers are increasingly subject to management strategies and business principles (as discussed above: Cooper et al. 1996; Brock 2006; Allan et al. 2019). Professionals in these contexts face competing institutional logics, as the principles of professionalism -- valorizing high quality services, the public interest, and collegial control – and those of rationalizing organizations – prioritizing efficiency, fiscal management, and tighter worker control -- conflict with each other (Ritzer and Walczak 1988; Noordegraaf 2007; Currie et al. 2008). Nevertheless, professions are adaptable institutions, and the outcome of this conflict is one of hybridity and combination. That is, modern professionals absorb and combine the two logics to produce a focus on 'efficient quality' and they accept that low-cost services provided under increased scrutiny is in the public interest (Noordegraaf 2007, 2015). Hybridity is particularly felt by professionals in managerial positions as they are confronted on a daily basis with combining the competing logics of professionalism and managerialism, and seek creative ways to do so (McGivern et al. 2015; McGivern and Ferlie 2007; Waring and Currie 2009). The

hybridity literature is not explicitly focused on skill change, but it tends to be optimistic in its outlook, and suggests that navigating competing logics leads to new skills related to interdisciplinarity, social interaction and management (Noordegraaf 2007). The hybrid professions literature draws attention to what can be gained through hybridization: new managerial skills, improved (i.e. more efficient) service provision, and updated practice that better fits today's world than traditional professional structures (Noordegraaf 2007, 2015). Nevertheless, some scholars using this approach, like their deprofessionalization counterparts, highlight the potential for lost autonomy due to more managerial oversight, rationalization, and management by metrics (Waring and Currie 2009).

A third set of explanations about change affecting the professions can be found in the restratification thesis (Waring 2014; Noordegraaf 2016; Reed 2007). This argument also dates back decades, to Freidson's challenge to the deprofessionalization thesis. Freidson (1984, 1994) did not deny that organizational change and rationalization were impacting professionals; however, he did reject the argument that rationalization *undermined* professions. Rather, he claimed, professions were more adaptable than deprofessionalization scholars believed, and professionals found ways to resist these trends. Specifically, elites within the profession sought ways to maintain professional dominance. For example, professionals in research and university settings generated new professional knowledge to counter routinization elsewhere, and professionals working in corporate settings found ways to protect the professionals working underneath them, and sought ways to influence others around them, in a manner that extended (rather than undermined) professional values (see also McGivern and Ferlie 2007; Correia and Denis 2016). Although these elites helped to maintain professionalism in the face of social trends and actors threatening to undermine it, there was a risk, Freidson (1984, 1994) argued:

stratification within professions could undermine collegiality and the standardization seen to be at the core of professions by Larson (1977) and others.

The restratification thesis has gained in popularity recently as scholars identify divisions within professions – divisions between managers and workers, across gender, ethnicity and country of origin, and across field (Waring 2014; Noordegraaf 2016; McGivern et al. 2015; Livingstone 2019). It has been bolstered by accounts of professional change exacerbating such divisions. For example, Muzio and Ackroyd (2006) show how elite lawyers at UK law firms have endeavoured to ensure their own security and incomes, by undermining those of their junior colleagues. Allan et al.'s (2019) recent study of the impact of financialization in UK law firms provides evidence of within-firm conflict and competition among lawyers as they fight for clients, promotions and perks. These studies suggest that some professionals are gaining (or maintaining) privileges at the expense of others. Perhaps, then, skill upgrading for some is coming at the cost of deskilling for others.

To summarize, all three of these accounts of workplace change in professions, advance predictions about skill change. First, the literature suggests that rationalization has decreased autonomy and leads to routinization, associated with skill decline. Building on this literature, the hybridization thesis is more optimistic, pointing to skill gains and skill change – professionals develop organizational and managerial skills as they adapt to their hybrid roles. The restratification thesis suggests the impact of workplace change on professionals may vary within and across organizations, and within professions based on gender and other characteristics.

This paper assesses all three of these arguments by exploring skill and workplace change among Ontario, Canada engineers. Specific empirical questions are as follows:

1) Do engineers believe their skills are increasing or decreasing over time?

2) What impact is workplace change believed to have on engineers' skills?

3) Do perceptions of skill trends vary across professional strata?

Data and Methods

Data for this project come from an online survey and follow-up interviews conducted with a sample of professional engineers and engineering degree holders (without a professional designation) in Ontario, Canada in 2017. The survey and interviews were part of the broader *Canadian Workplaces in the New Economy* project exploring the changing nature of professional work (Livingstone). The research was conducted in partnership with the Ontario Society for Professional Engineers (OSPE), a provincial professional engineering voluntary association dedicated to supporting the profession's interests. OSPE circulated the survey link among members and others in its networks. Approximately 600 engineers answered the survey in its entirety – a number that would represent only 7.5% of OSPE's membership. As is increasingly the case with on-line surveys, no claim to empirical generalizability can be made.

Survey questions asked about engineers' work, skills and education, and explored their opinions on a variety of professional and social issues. Several questions touched on skills, underemployment, skill acquisition, and workplace change. Spenner (1983) and others have identified the complexity of skill, and the difficulty of measuring skill through single measures. Spenner recommends that measures focus on at least two dimensions: autonomy-control and substantive complexity. As we have seen there are several other dimensions that can be explored as well. In this project we assessed both skill and autonomy-control as distinct measures. As findings respecting autonomy-control have been recounted elsewhere, the focus here is on skill.

Skill was not defined for respondents – rather on the survey and in interviews they answered based on their own perceptions of skill, which given the complexity of the concept may be variable.

Key survey measures used here include questions assessing job complexity, skill use, the impact of workplace change on skill:

* Do you consider the body of knowledge you bring to your job to be complex?

* To what extent can you use your professional knowledge and skill in your current job?

* In the past 5 years has the skill required to do your job become greater or lesser?

We also have measures of workload change, managerial status, gender, and other differences to assess variations across time and professional strata.

Frequency distributions were assessed and bivariate analyses were conducted to assess engineers' skill levels, changes in skill over time, and variations in reported skill across social grouping.

After the survey, follow-up interviews were conducted with 53 engineers; 51 of the interviews were recorded and transcribed with participants' permission. Interviews were conducted over the phone, over skype or in person, and they lasted between 40 and 70 minutes. Interview questions followed up on several issues that emerged from preliminary survey data analysis. Questions focused on workplace change, work experiences, skills and training, among other issues.

Transcripts were analysed, by hand, with a focus on how participants discussed their skills, workplace change, and the impact of the latter on the former. Special attention was paid to

engineers' discussions of skill change and skill acquisition, and whether these discussions varied across structural location (manager / employee) and gender.

Survey Findings:

Engineers' skills and knowledge

Engineers are skilled professionals, but survey findings reveal a skill picture that is complicated (Table 1). First, it is worth noting that most engineers consider their knowledge to be complex: fully 86% of participants indicated that "the body of knowledge" they bring to the job is 'complex' or 'somewhat complex'. Still it is notable that only 27% of respondents indicated their knowledge was 'very complex' with the remaining 59% indicating it was 'somewhat complex'. Second, many engineers report their skills are not fully utilized on the job. Only about a ¼ say they can 'fully' use their professional knowledge and skill at their current job. About half, 51%, indicated they had more knowledge than their job actually requires, and 43% indicated they had the skills to cope with more demanding duties. Only 15% felt they needed additional training to do their jobs well. These responses suggest under-employment.

At the same time, engineers pursue many development opportunities to enhance their skills, suggesting skill upgrading. Over 50% of respondents indicated they had undertaken some formal training or education in the past year. Most also reported informal learning activities, including (in order of importance): reading about new developments (56%), reviewing standards and codes (44%), visiting websites and online forums (38%), attending webinars (36%), attending conferences (32%), and learning through trial and error (26%). Engineers also learn from their colleagues, with 47% reporting seeking advice from someone knowledgeable to advance their job skills. They pursue these learning activities to enhance their technical skills

(76%), their managerial skills (56%), their soft skills (54%), and their financial and business skills (33%).

This ongoing learning seems necessary as 63% of respondents believe the skill required to do their job has become greater in the last few years, with 12% saying ‘much greater’ and 51% saying ‘somewhat greater’.

Table 1 Frequencies on Selected Skill Variables

Do you consider the body of knowledge you bring to your job to be complex?

Very Complex	26.8%
Somewhat Complex	59.5%
Not very or Not at all Complex	13.7%

To what extent can you use your professional knowledge and skill in your current job?

Fully	23.5%
Moderate to Good	64.3%
Little to Not at all	12.2%

Which of the following alternatives best describes your skills at work?

I need more training to cope	15.3%
My duties correspond with my skills	41.3%
I have skills for more demanding duties	43.4%

Do you have more, about the same, or less knowledge than your job actually requires?

Much more	17.7%
More	33.5%
About the same	35.8%
Less or Much Less	12.9%

Learning Activities

Formal Training in past year	54.5%
Informal Learning – Reading	55.9%
Informal Learning – Reviewing Standards	43.6%
Informal Learning – Websites	37.7%
Informal Learning – Webinars	36.3%
Informal Learning – Conferences	31.8%
Informal Learning – Trial and error	25.7%

Informal Learning – Technical Skills	75.9%
Informal Learning – Managerial Skills	56.4%
Informal Learning – Soft Skills	53.8%
Informal Learning – Financial / Business	45.9%
Seek Advice from Someone Knowledgeable	46.6%

Bi-variate analyses were conducted to assess variations in skill complexity and skill use across organizational position and gender (as well as several others that were not statistically significant). As Tables 2 and 3 show, differences between managers and employees were evident, as were variations across gender. Managers were more likely to view their knowledge as very or somewhat complex than were employees. Also, more employees than managers reported having jobs that did not use their skills and expertise. With respect to gender, men were more likely than women to report that their knowledge was 'very complex' and more likely to report using their skills on the job. Almost 1 in 5 women engineers said their jobs used their skills and knowledge only a little, or not at all.

Table 2: Knowledge complexity by managerial status and gender

Amount	Manager	Employee	Men	Women
Very complex	30.1%	23.2%	29.2%	13.5%
Somewhat complex	62.1%	55.7%	58.6%	68.5%
Not very or not at all complex	7.8%	21.1% ***	12.2%	18.0%**

*** p<.001, ** p<.01

Table 3: Use of skill and knowledge by managerial status and gender.

Amount	Manager	Employee	Men	Women
Fully	24.8%	24.2%	24.6%	18.8%
Moderate to Good	69.1%	60.1%	64.9%	61.7%
Little to Not at all	6.1%	14.8% **	10.5%	19.5%*

** p<.01, * p<.05

Skill Change

Differences in perceptions of skill change over time were also evident across managerial status (but not gender). Engineer employees were much more likely than managers to report no skill change over time. As Table 4 shows, managers and employees were equally likely to experience significant skill increases or decreases; however almost 42% of employees indicated the skill required to do their job had stayed the same, compared to only 27% of managers.

Table 4: In the past 5 years, has the skill required to do your job become greater or lesser?

	Manager	Employee	Total / N
Much greater	12.1%	12.0%	62
Somewhat greater	57.5%	42.5%	260
Stayed about the same	26.8%**	41.6%**	172
Somewhat / Much Less	3.6	3.8%	19

** p<.01

Skill change was also shaped by workload change. As Table 5 shows, engineers who had experienced an increase in their workloads, were more likely to report that the skill needed to their jobs increased, than were others. Those whose skill levels remained unchanged were more likely to report no workload change or workload decline. These findings suggest that rationalization trends raising workloads may also raise skill demands; however, this is not always the case since many also report no change and a few report skill decline.

Table 5: Reported Skill Change by Reported Workload Change

Skill change	Workload Increased Greatly	Workload Increased Somewhat	Stayed the same	Workload Decreased
Much greater	25.8%	9.1%	6.9%	4.8
Somewhat greater	46.9%	60.3%	41.2%	45.2
Stayed about the same	21.1%	29.2%	48.1%	45.2
Somewhat / Much Less	6.2%	1.4%	3.8%	4.8

X^2=59.99, *** p<.001

To summarize, the survey findings suggest that engineering work requires at least 'somewhat' complex skills, and that skill demands are increasing over time. Although there is evidence of underemployment, this is accompanied by skill upgrading through education, as is consistent with the literature (see Livingstone 1998). Many of the skills engineers endeavor to acquire are managerial and business-related – as is consistent with the hybridity thesis. In line with the stratification thesis, skill does vary within the profession. Managers report more skill and more skill upgrading than their employee counterparts. Gender differences favouring men are also evident.

Overall, the survey paints a fairly optimistic picture pointing towards hybridity and skill enhancement. The qualitative research findings provide a more nuanced picture.

Interview findings

In interviews engineers were asked about skill change and the impact of workplace change on skills and knowledge. Three key findings emerged. First, and in line with the quantitative findings, reported skill trends are variable, with some respondents reporting considerable upgrading, while others reported none. Second, engineers who report having to learn new skills, suggest the skill acquisition process has changed. With workplace change, engineers often lack opportunities for deep skill development, and instead must learn on-the-fly. Third, although there is evidence of skill change, it is not easily captured by any of the three 'theses' explored here. Differences across strata are evident, but there are meaningful consistencies as well. There is value in combining all three theses to understand reported trends.

Complexity, skills, and workplace change

Respondents were asked about keeping their skills up-to-date. Most talked about the same activities they mentioned in the survey: reading, surfing the web, attending webinars and conferences, and talking to colleagues. However, some indicated they felt more pressure in this area than others. For example, Macauley (employee), reflecting back on a career over a quarter-century long, claimed "Basically, I don't see a lot of change or a lot of difference in terms of what I did … you know like 25 years ago." He elaborated,

> A skill is the ability to solve the issue, to analyse the issue, to resolve the issue. Not punching numbers into a computer and, you know, coming up with an answer. That's not problem solving, no…. The skillsets don't change. The tools have changed, but the skillset is the same and you know, that's something that, you know, you have to think about.

Thus, Macauley (employee) reported little significant change over time, except to keep up-to-date with the latest tools and technology. Similarly, Levi (manager) said that most of the information he needed to do his job was old and established. He felt little pressure to keep on top of the latest developments in his field. In a similar vein, Gabriella (employee) claimed "there are not many changes in our field." Nevertheless, she felt that "even after 20 years of working, you may be surprised by something you see"; hence some reading and skill acquisition was necessary. For the most part, Derrick (employee) relied on 'acquired experience' in his work. Linc (employee) claimed, "most of the learning that I do is actually applying the same thing to a different problem or industry for example." For him, learning was incremental.

Some more recent graduates talked about a narrowing of their skills after a few years in the labour force. According to Milo (employee),

> There's so much you learn and so much you absorb in school. But I feel that once you get employed, those jobs end up being very specifically focused on certain portions of what you know. So you end up continuing those and keeping up with

> those because you use them daily in your job. But pretty much everything else requires an active effort if you don't want to get rusty and forget those things.

Milo tried to keep some of his skills up-to-date, but had to do so "in his spare time." Cheryl (manager) concurred, saying engineering program "course content isn't something I really use on a daily basis." She also expressed concern that her engineering skills were "depleting or decreasing."

In contrast, a number of respondents emphasized that learning was "a constant process" (Gemma, employee). Dylan (employee) also reported a constant need to upgrade:

> The stuff that we can do now changes so fast. If any engineer is not staying up-to-date, I think they're asking for themselves to be out of the labour market. If you want to engineer the same way you did 30 years ago, it's not going to work today.

Ying (employee) concurred:

> I think if you want to keep current, like keep your company I guess having a competitive edge, then you definitely have to learn like new techniques or new code, and companies are often just switching different techniques of doing things.

Palmer argued that the need for upgrading depended on the field, work role, and motivation.

> There are some people who do a little bit less than others. And in my field, it's quite a bit – and what I do is that I … in my designs I always do what's best for the client and the project, so that always means using a lower-cost technology, a different technology, and in doing that, I have to update my skills by reading up the technology, learning about the programming, the software interfaces, you know, new techniques for things. (Palmer, self-employed)

Engineering branch and company demands were influential in shaping experiences. Some fields experienced more technological or regulatory change than others, mandating upgrading. It is not entirely clear that experiences varied across managerial status – except that those who had moved into management talked about having to expand their managerial and interpersonal skills.

Overall, interviews painted a mixed picture of skill change.

Skill acquisition – changing contexts

What became particularly evident in interviews, however, was that the context for learning and acquiring new skills had changed. Engineers traditionally learned on the job, but opportunities for learning at work are diminishing, they claimed. Derrick (employee) explained that in the past, "we somehow had training and there was more time for self-education and stuff. Today no, because you have to charge every hour against the job." Palmer discusses workplace change resulting in engineers "constantly being squeezed to give more." Gabriella explained that this work intensification left little time for training. When asked about keeping her skills up-to-date, she replied that at her company they were "too busy to spend any time on that. I mean, the work rate is very, very high, and it is really frustrating for me because we never spend time on learning and reading."

Quinn (self-employed) summarizes the changes, resulting in less on-the-job training:

> In the past, engineering workplaces "were very oriented towards developing their professional people. So they saw you as their most important asset, and that's the way you were treated. You know, they paid competitive salaries. They trained. It was never a problem. Your boss's job – and this was a stated fact – was to facilitate you working and developing. …. In the 1980s this changed. Now, people are a commodity; your professional people are just a commodity. …And that's exactly the same way as they treat people here; like, you come in, they want someone to, you know, drive a blue car, they'll say, get me a couple of blue car drivers. Okay, blue car's done, they're going to do a red car – do you train them to do red cars? No way, you just lay them off, get rid of them. Find a red car guy. So people are viewed as – engineering people are simply viewed as a commodity.

Similar stories were told by others:

I think companies are looking…when they look to hire someone, they want that person to have exactly the skillset they're looking for. They're not willing to train (Zoe, employee)

We, as an industry, were too spoiled and instead of training our own people, we would go abroad and hire people from abroad. And so now companies are in the position where they are starting to realize that they have lost that human capital (Delilah, self-employed).

In Canada, engineering firms are often reluctant to invest in engineers' skill development.

Nonetheless, survey findings show that most engineers do seek out new skills. Much of this learning they do on their own time, or in short bursts as they are working on a project. They reported investing in their own training, using vacation time to attend conferences or short courses (see Margaret, below). A large number recounted reading on their own time, talking to colleagues they felt knew more than them, or searching the internet. Self-learning can be important to career advancement, but when time is short, people may be tempted to learn just enough to complete a task before moving on to the next project. When asked about keeping up-to-date, Simon (owner) somewhat cynically says, "typically you Google it and for 90% of the time that's enough technical information to make a reasonable judgement in a field that you're not familiar with." Caelan (employee) concurs. When asked how engineers keep their skills up-to-date, he replied,

> They don't. They get pigeonholed and they go into management. They do a lot of reading and a lot of just Googling and personal skills dev[elopment].

Like others, Baldwin, linked this tendency to learn on-the-fly to the current focus of the firms employing engineers: "The competitive environment … encourages people to do as little as possible in order to get the job and carry on."

These responses, suggest that workplace rationalization is not necessarily leading to fewer skills, but is altering how new skills are acquired. New knowledge gained may be more superficial, more ephemeral and utilitarian. Workplace change may bring greater job complexity for some, but for many, it just brings work intensification: work "has gotten more busy"

(Macauley), and while technological change may bring more tools to do the work, it doesn't make it more complex.

Workplace change, then, may sometimes bring deskilling (or narrowing of skills) and sometimes skill upgrading (acquisition of new skills). What is clear, however, is that the context for acquiring new skills has changed. Workers learn in brief moments, when they can, and on their own time. There is a need to learn more, but often at a more superficial level. Or, in Macauley's case, at a 'practical level'. As a result, "you sort of know less about – probably know less about your field, but it's easier to dabble in others" (Simon).

Variations across strata

Analysing the interviews closely we can observe some differences across managerial status and gender. For example, managers were more likely to discuss acquiring new communication and people skills, while employees were more likely to mention keeping up with technology and regulatory codes. Moreover, several women discussed having their skills questioned by colleagues and clients, while this subject did not arise among the men (see also Adams 2019). Still, it is not so much the differences, but the similarities that are most striking. Regardless of managerial or employee status, and regardless of gender, participants highlighted how today's engineering workplaces offered few opportunities for skill acquisition, and that it was comparatively rare for a company to invest heavily in its workers. Skill development was increasingly seen as a personal journey. People had to invest in themselves. Some respondents saw this as problematic, while others did not. Margaret (manager) provides a clear example of the latter attitude:

> Like if young engineers don't join the technical societies to find their tribe, they're not investing in themselves and if they're sitting there and looking and saying, "Oh my God, I'm a victim, my company isn't investing in me", well invest in yourself…. There's no excuse with the internet now, you can find your tribe.

Regardless of how people felt about this change, most agreed that the context for skill acquisition had changed in engineering. Rationalizing organizations appear to see training as an inefficient use of resources. The burden is on the individual to acquire the skills they need when they need them. The best case scenario is that personal investments in courses and independent study leads to future career success. However, at least some of the time, investment in skills was piecemeal, fragmented, and focused on completing one task before moving on to the next. While skills are being acquired, it is not clear that professional skills are being enhanced in any meaningful way.

Conclusion

A large body of research agrees that professional workplaces are changing, altering what professionals do and how they do it. Although linked, the deprofessionalization, hybridity, and restratification theses advance different arguments about the impact of workplace change on professional skills. The deprofessionalization thesis highlights rationalization reducing autonomy and leading to routinization. The hybridity thesis is more optimistic about workplace change, suggesting professionals acquire new skills as they take on new organizational roles. The re-stratification hypothesis suggests that the impact of workplace change on skill varies by organizational position and professional characteristics.

Study findings suggest that trends in skill use in the engineering professions are not neatly captured by any of these theses, even though all three capture different aspects of engineers' experiences. Rationalization is occurring, like the deprofessionalization thesis

contends, and engineers' workloads have increased as a result. Those with rising workloads actually experience the need for new skills, not fewer – according to the survey data. However, the interview findings suggests that engineers' higher workloads leave little time for skill acquisition, forcing engineers to learn on their own time, and learn just enough, through google and other sources, to do the job. Skill acquisition in these contexts may be fragmented and piecemeal.

There is also support for the hybridity thesis, as many engineers have been expanding their managerial and business skills with workplace change. Engineering managers report more skill acquisition in the survey; however, in interviews they raise similar concerns to their employee counterparts respecting skill loss, and lack of time for meaningful training opportunities. The impact is variable – as the restratification hypothesis argues. However, it is too early to say whether the upgrading of some professionals comes at the expense of others. Moreover, the observed differences are not entirely straightforward. Managers clearly learn more and learn differently than their employee counterparts, but seem to be subject to the same pressures altering their learning environment. Other factors, not considered here – like branch of engineering, and employing firm characteristics – may be highly relevant in shaping internal variations, and are deserving of more attention.

Ultimately, observed skill trends suggest the need for a more nuanced theory of professional change that combines the restratification, deprofessionalization and hybridity theses.

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