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THE ROLE OF FACTORY TRADE SCHOOLS IN THE DEVELOPMENT AND TRANSFER OF TECHNICAL SKILLS IN THE NORTH AMERICAN AUTOMOBILE INDUSTRY

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ABSTRACT

This research explores the role of factory trade schools in the development and training of skilled metal workers in the North American automobile industry. The establishment of factory trade schools in the early 1900s by Henry Ford and others was not simply an approach to resolve skills supply shortages, but rather represented a strategy to erode craft worker power through the internal development of skilled workers socialized to the enterprise specific requirements of industrial capital. Factory-based trade schools provided industrialists with a mechanism through which to undermine craft worker power in several ways. Factory trade schools displaced craft union control over the recruitment and selection of apprentices. Control over the nature and scope of education and socialization allowed employers to narrow these to the unique technical and social requirements of their labour process. Finally, factory trade schools can be viewed as components of broader initiatives in workplace social control aimed at union avoidance.

Skilled workers remain central to the development and refinement of the machinery necessary for production in the automobile industry. Market pressures associated with the contemporary North American automobile industry continue to drive manufacturers to seek competitive advantage through process improvements that are in large measure underpinned by technological innovation that remains dependent on skilled workers. Concerns over the supply of skilled workers, quality, scope and cost of training, and union influence continue to inform corporate strategies across the automotive industry. Magna International, one of the world's largest automotive parts manufacturers, has established a skills training school to address these concerns. Although separated by a span of close to a century, the trade schools of Ford and Magna share objectives that have remained relatively unchanged over time. These objectives both include and transcend simple technical considerations, and incorporate the transfer of non-technical socialization aimed at inculcating students with norms and values consistent with a firm's productivity goals.

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Introduction

Automobile manufacturers on the cusp of the twentieth century depended heavily on highly skilled artisans to produce automobiles with little more than some crude machinery and expertly handled manual tools (Nevins, 1954; Gartman, 1986; Hounshell, 1984; Babson, 1991; Meyer, 1981). Unlike today's mass produced cars, each an exact replica of the one that preceded it on an automotive assembly line, hand crafted automobiles were a unique creation that reflected the accumulated knowledge and skill of the artisanal labour that contributed to its manufacture. Skilled workers fabricated and fit automotive components by hand in workshops and small factories across the various tiers of the automotive industry Although materials lists of the early vehicles were limited to metal, hardwood, rubber and perhaps some leather, horsehair, and paint, skilled craftsmen transformed these modest raw materials into the various components that gave form and propulsion to the first horseless carriages. While the proportion of skilled workers has diminished over time and their roles have transformed, craft-based skills and knowledge have played a central role throughout the evolution of the automotive manufacturing industry.

This research explores the role of factory trade schools in the development and training of skilled workers in the automobile industry. It argues that the establishment of factory trade schools in the automobile industry was never simply an approach to resolve skills supply shortages, but rather represents a strategy to erode craft worker power through the internal development of skilled workers socialized to the enterprise specific requirements of industrial capital. Factory-based trade schools provide industrialists a mechanism through which to undermine craft worker power in three significant ways. First, factory trade schools displaced craft union control over the recruitment and selection of apprentices. This enabled employers to autonomously regulate the quality and supply of skilled workers thereby shifting the economics of skill supply in their favour. Secondly, control over the nature and scope of education and socialization allows employers to narrow these to the unique technical and social requirements of their labour process. Finally, factory trade schools can be viewed as a component of broader initiatives in workplace social control. Whereas technological, organizational, and managerial control measures more quickly overcame worker recalcitrance among unskilled workers in the early 1900s, skilled workers in the automobile industry, particularly those in the tool and die trades, successfully leveraged their skills to negotiate a more favourable "effort bargain" (Behrend, 1957, p.503), and a measure of control and autonomy over their work. By flooding the toolrooms of the automobile industry with skilled workers socialized under the imperatives of industrial capital, factory owners could erode craft worker solidarity and attack the basis of power that enabled them to leverage favourable terms of employment and more successfully resist management control over their work.

This research will demonstrate that toolroom workers remain central to the development, fabrication, and refinement of the machinery and tooling necessary for

production in the automobile industry. Market pressures associated with the contemporary North American automobile industry continue to drive manufacturers to seek competitive advantage through product and process improvements that are in large measure underpinned by a process of technological innovation that remains dependent on skilled workers. Current research suggests that concerns over the supply of skilled workers, quality, scope, cost of training, and union influence continue to inform corporate strategies across the automotive industry (Lewchuk and Vrankulj, 2005). These strategies include the establishment of firm-based technical training schools by Magna International, and more recently by Linamar Corporation, two of the world's largest automotive parts manufacturers. The goal of factory-based schools however has remained relatively unchanged over the past century; tight alignment between the technical and social elements of worker training with the productivity goals of the firm.

The above issues will be explored through a comparative study of the Henry Ford Trade School and the Magna Technical Training Centre. Although separated by a chronological span of close to a century, these two firms share several underlying similarities that can shed light on the factors that motivate and create openings for firms to engage in direct training of skilled workers. The foundation of each firm's competitive strategy was built on internally developed technologies firmly rooted in the knowledge, skills, and active engagement of toolroom workers. Both firms largely rejected existing training systems as incapable of delivering the quality and quantity of required skilled workers, and have instead chosen to develop and deliver training internally. In both cases, internal skills training is situated within a broader human resource strategy aimed at enhancing management control through union avoidance.

Research Methodology

Data informing research findings on Magna stem largely from two separate semi-structured and open ended interviews conducted with corporate level Magna managers. The first in 2005 was conducted at the Magna Technical and Tooling Systems Research and Development Centre in Brampton Ontario. This interview focused on a general exploration of Magna's skilled labour needs and corporate strategies to meet these needs. A second follow-up interview was conducted at the Magna Technical Training Centre in Brampton in 2006 which focused more precisely on exploring the nature of apprenticeship training at Magna's corporate technical training centre. Requests for an interview of apprentices enrolled at the centre were declined, however the author is confident that documents obtained from Magna's training centre web site provide a detailed source of information describing many facets of the technical and manual training undertaken by students. Research findings on Ford Trade Schools are based mainly on secondary literature with the addition of some available archival material. Copies of the Ford of Canada employee's newspaper, *The Ford Graphic*, obtained through the Windsor Public Library Archives provided a rich source of data describing technical training at the Henry Ford Trade School in Windsor Ontario.

Skilled Labour and Early Automobile Manufacturing

The following section examines the evolution of automobile manufacturing between the late 1800s and the early 1920s. Of particular interest is the role of skilled workers in the evolution of automobile manufacturing technologies over this period. Secondly, this section explores strategies employed by Ford to meet skilled labour needs in the early Detroit automobile industry. Thirdly, the basis of skilled worker power, the conditions under which this power was maintained, and the ends to which it was exercised will also be explored.

In order to grow and prosper in the highly competitive automobile industry of the early 1900s, automobile manufacturers pushed the boundaries of contemporary design and technology in an attempt to market a reliable and affordable alternative to the horse and buggy. To achieve this, they recruited from a skilled workforce whose education, manual training and industrial experience suited them to actively engage in the formative phases of invention, development, and refinement of automobile design and manufacturing technology (Nevins, 1954). In most cases, these workers' skills were acquired, nurtured, and honed under the tutelage of a master craftsman within a system of apprenticeship-based learning and training rooted in archaic traditions that pre-date industrialization. Under this system of skill transfer, apprentices also accepted an obligation to defend their trade's customs and traditions of workplace autonomy, control, dignity, and respect (Clawson, 1980). Harnessing the technical capabilities of skilled workers to the priorities of industrial capitalism would bring factory owners in direct conflict with those cultural traditions, and formed the basis of a class-based struggle over workplace control that persists in today's automobile manufacturing plants.

By the early 1900s, mechanization, and other technological advances had entirely displaced or deskilled many functions once performed by craft workers (Hounshell, 1984). Despite their considerable successes at integrating less skilled labour into automobile production by the early 1900s, industrial capitalists of the early automobile industry could not entirely escape their reliance and corresponding vulnerability to skilled workers. In particular, those workers trained in the more complex tool and die, and associated metal trades possessed skills in short supply in Detroit's booming industrial economy (Babson, 1991). Moreover, these skills remained relatively immune from the deskilling and labour displacing capacity of the era's manufacturing technologies.

Skilled worker shortages presented factory owners with a challenge that was three-fold. Industrial expansion at the turn of the century exacerbated existing shortages and highlighted the inadequacy of traditional systems of skilled trades training to supply the required numbers of skilled workers (Babson, 1991; Gartman, 1986; Smith, 1999). This was of particular concern to manufacturers in Detroit's emerging automobile industry as they relied heavily on the sophisticated skills of their toolroom workers to build and maintain the technologies necessary for mass production. Secondly, factory owners argued that traditional apprenticeship training approaches were cumbersome and

geared toward the development of general skills that were becoming obsolete under the new narrower machine based skills required by mass producers. Finally, in order to consolidate control over the automobile manufacturing labour process, industrialists needed to confront the social and technical basis of craft-based power in their toolrooms. This power was rooted in craft union control over an apprenticeship training system that regulated supply, determined the nature and scope of technical training, and socialized apprentices in traditions that undermined autonomous capitalist control over the automobile manufacturing labour process.

The Ford Motor Company

In 1903, the composition of Henry Ford's workforce reflected a production system that centred on skilled workers. Ford's principle shop assistant, C. Harold Wills, was a tool and die maker who had apprenticed in Detroit's tool-making industry. Ford and Wills hired a workforce that consisted of four mechanics, a pattern-maker, blacksmith, and a draftsman. The shop consisted of two lathes, two drill presses, a milling machine, wood planer, handsaw, grinding wheel, forge, and no doubt an eclectic assortment of handmade tools collected by these men through their apprenticeships and industrial training (Nevins, 1954). Within a year, they designed and produced a functioning prototype of the Model A.

Interest in the Model A was strong, however capitalizing on potential markets required advances in both product and manufacturing technologies in order to produce a simplified, low-cost, and reliable car in sufficient quantities to meet growing demand. Ford, like other automobile producers focused his productive capacity on assembly, and sourced a majority of the vehicles components from others. As Nevins (1954) argues, "Few companies in the United States had the skill, facilities, and the capital to build, and even those with the required resources for such a task were patronizing the parts makers, particularly for engines, bearings, bodies, wheels and tires" (p.222).

This strategy was adequate to meet current needs, however it posed significant problems in the context of expanding demand and tightening labour markets. Production difficulties became exaggerated in 1907 when Ford consolidated control of the Ford Manufacturing division and transferred the manufacture of engines to his existing assembly plant. Ford increased output by hiring workers and investing in more general purpose machinery which he organized on the basis of function. The use of general purpose machinery required workers with above average skills, the very workers who were in the highest demand in Detroit's booming industrial sector.

These constraints presented employers like Ford with a challenge. Attempting to meet growing demand based on existing technologies played to the power of skilled workers, moreover "finding this many skilled workers was not an easy task and managing them presented profit conscious employers with even greater headaches" (Babson, 1991, p.21). Estimates suggest that in 1910, approximately 75% of Detroit's automotive workforce was classified as skilled labour (p.27). A production system based on the

extensive utilization of skilled labour undermines efforts to autonomously control and manage production. Lewchuk (1987) states, "Given the need to employ skilled workers in the early years, Ford had few alternatives but to treat his workers as equals and to solicit effort within a cooperative institutional context." (p. 58). Gartman, quoted by Lewchuk identifies the basis of skilled worker power and argues, "as long as parts required individual fitting, work tasks could not be standardized making it virtually impossible for the foremen to enforce levels and leaving the workers with significant discretion over effort norms" (p.58).

The introduction of flow production principles and concepts of standardization and interchangeability by Ford in 1913 transformed automobile production and dramatically shifted the balance of workplace power by opening opportunities for Ford to replace most skilled labour with unskilled workers. Advances in machine technology capable of drop forging and later cold stamping automotive parts with unprecedented uniformity, facilitated the production of standardized goods and the interchangeability of parts. As Lewchuk (1987) argues, "the introduction of special and single purpose machines meant the end of most vestiges of craft production in motor vehicles" (p.54). Ford's manufacturing methods rapidly diffused across the automotive industry. However, technological advances that displaced craft-based power in the production of vehicles shifted and concentrated craft power among those toolroom workers responsible for the development and fabrication of this production technology. Babson (1991) states,

> Inspired by the examples of Henry Ford, carmakers introduced jigs, fixtures, stamping dies, and other specialized tools and machines that helped eliminate craft skills from production. Yet ironically, even as Scientific Management carried the day on the shopfloor, it could not escape its dependence on the new strata of skilled workers its methods and machines relied on: toolmakers and maintenance workers who engineered the instruments of control (p.16).

Full interchangeability could not be achieved without first developing machinery, tooling, dies and other equipment tailored to the exact requirements of Ford's unique production methods. Moreover, it was unlikely that outside suppliers, who had proven to be mercurial under the previous production system (Nevins, 1954), could be relied upon to deliver either the quantity or the quality of precision parts required under the new production system. Babson (1991) argues, "Only when machine tools were tailored to the specific needs and pace of the production process could the assembly line be assured of a continuous supply of parts, and while outside contracting continued, low cost high volume manufacturers increasingly shifted to in-house production" (p.25). Developing internal production capacities resolved these concerns, however in the process those skilled workers most actively involved in the retooling to mass production gained power. Although the organizational and technological shifts associated with the transition to mass production dropped the proportion of skilled to unskilled workers, it consolidated a position of strategic importance for those skilled workers in the tool and die craft.

Technological and organizational advances facilitated by tooling, jigs, fixtures, and dies originating in Ford's toolrooms reduced or eliminated machinists, molders, forgers, carpenters, welders, painters and countless other skilled and semi-skilled workers from the production of automobiles (Babson, 1991). In 1915, a toolroom of 250 skilled tool and die workers maintained approximately 15,000 machine tools that were instrumental in increasing productivity in Ford's plant. Babson (1991) states, "As late as 1910 three quarters of the auto industry's labour force could still be classified as skilled tradesman; by 1913, the Ford Motor Company's chief stockholders claimed that 70 percent of the firms 15,000 workers could be taught their operation in less that two days time..." (p.28).

Labour market shortages reinforced toolroom worker power within the workplace. In the twenty year period of 1899-1919, employment in Detroit's automobile industry grew from 3,723 to 1,888,059 workers (Babson, 1991, p.28). In 1910, the Employers Association of Detroit (EAD) successfully attracted over 20,000 workers to address shortages, however most of these were unskilled labour and therefore did little to meet needs or stop industry poaching of skilled metal workers within Detroit's dynamic automotive industry (Lewchuk, 1987 p.38). Despite the general skilled job losses associated with the diffusion of mass production across Detroit's automotive industry, growing demand for vehicles resulted in an increase in the absolute number of employed tool and die workers. Demand for toolmakers, die setters, die sinkers more than doubled in the period between 1920-1930 (Babson, 1991, p.36). Klug (1989) argues, "In Detroit as elsewhere, managers recognized that their ability to set the terms under which workers sold their labour in large measure determined the success of their business enterprise," (p.42) however, in a context of a tight labour market in skilled labour, employers capacity to impose favourable terms of employment would have been constrained. Lewchuk (1987) argues, "the labour market proved to be labour's best defense against unilateral management control of effort norms. The period 1900 to 1920 was one of almost continuous labour shortage" (p.36). Moreover, these skills were relatively expensive in Detroit's tight labour markets in toolroom labour. In 1928, Ford's tool and die makers were earning as much as $2.19 per hour at a time when production workers were earning an industry leading 62 cents per hour (Babson 1991, p.51). Earnings in Detroit's countless job shops were even higher for toolroom workers when overtime income is factored. Robust demand was reflected in classified ads that offered tool and die workers high wages, overtime and working conditions that included "less supervision" and an opportunity to utilize their skills in "more varied work" (Babson, p.51). Although specific figures for tool and die worker movement are unavailable, it would be reasonable to assume that many were enticed to move by the higher pay and more rewarding conditions being offered by competitors in Detroit's classified ads.

Skilled labour shortages also drove and shaped the evolution of production technologies across all of Detroit's manufacturing industries which further intensified shortages in the automobile industry. As Meyer (1981) argues, "so great was the demand for labor, that the technical solution became the massive substitution of expensive and sophisticated machines for skilled or semi-skilled workers" (p.6). Shortages in the tool

and die trades were also shaped by factors associated with resource endowments unique to North America. James Foreman Peck (2007) argues that America's labor scarcity and raw material abundance stimulated interest in machinery to replace labour" (p.7), and that this machinery "... reflected American resource endowments, [and] was designed to save labour and to be worked by the unskilled" (p.18).

Detroit's unions at the turn of the century provided little protection for most workers in the automobile industry. Unskilled workers were at the mercy of Detroit's employers as broader labour solidarity was hampered by several factors. Craft unions at the turn of the century were more likely to view Detroit's growing mass of unskilled workers as a threat rather than a possible source of workplace power. The potential for class based solidarity was also hampered by the racial and ethnic diversity of Detroit's industrial workers, many of whom were recent migrants from the US south or immigrants from Europe. As Lewchuk (1987) argues, "immigrant workers had many reasons for accepting managerial control including their experiences in Europe, their expectations of life in North America and their precarious position as unskilled workers" (p.38). Detroit's employers could also rely on favourable legislative intervention on their behalf to outlaw strikes and declare union activities illegal (Lewchuk, 1987). Although the International Workers of the World (IWW) successfully mobilized a strike against Studebaker in 1913, the strike collapsed without obtaining any significant gains for workers.

Detroit's automobile industry employers faced conflicting pressures at the turn of the century. On one hand they were vulnerable to the shortage of skilled workers which gave these workers a degree of bargaining leverage in the workplace. On the other hand however, Detroit's employers were relatively well organized, and not facing a cohesive and coordinated labour movement because industrialization had resulted in a weakened and divided craft unionism. In this context, tool and die workers had considerable individual power, but little collective power. Detroit's employers exploited these favourable conditions by launching a concerted anti-union open shop campaign against the city's craft unions. Led by the EAD, this strategy was a response to a growing sentiment among Detroit's manufacturers that the closed shop system resulted in a balance of workplace power that continued to favour skilled workers interests over their own. An aggressive anti-union strategy that included firings, blacklisting, and the recruitment of strikebreakers was successful in undermining the last vestiges of Detroit's craft unions by 1907 (Babson, 1991; Lewchuk, 1987). Even within a context of weakened unions however, Detroit's tool and die workers successfully exploited labour market conditions to their advantage. Although the EAD was successful in addressing broader trade union power, the automobile industry had yet to devise a successful approach to confront tool and die worker power and control at the point of production.

New Approaches to Meeting Skills Shortages

The spread of mass production eliminated or severely reduced the value of most

skilled workers, and "rendered the traditional apprenticeship system obsolete" (Nelson, 1975, p.96) The minute division of labour and narrow specialization associated with mass production made it both difficult, and from Ford's perspective, unnecessary for most apprentices to learn trades as they were historically defined and demarcated. By 1910, Ford's production labour needs could be met mostly through the use of unskilled workers. He and others at the forefront of mass production were less vulnerable to the power of workers on their shop floors. As a result, they were no longer compelled to compensate the acquisition of sophisticated craft skills with higher wages, and could more readily confront and challenge worker demands for a measure of autonomy and control within their plants.

The technological and organizational advances of Ford's manufacturing system successfully attacked the basis of craft power in manufacturing and weakened the justification for the traditional apprenticeship system in many trades. However, a collateral consequence of this strategy was that it ultimately exacerbated shortages across the metal trades most necessary to support Ford's production system. The impact of this self-inflicted skills shortage was particularly pronounced and problematic in the toolroom given the central role of tool and die specialists in the development, fabrication, and maintenance of new production technologies. In order for Ford and his managers to remain at the vanguard of manufacturing and product innovation, they required the broad skills and commitment of the toolroom workers. Without them, Babson (1991) argues, Ford and other automobile manufacturers undermined their long term capacity to continue developing and implementing new production technologies. To underscore this point, Babson (1991) cites an *American Machinist* article claiming that narrow machine or firm based factory 'apprenticeship' training has resulted in "half-baked tradesman with task-specific skills [that] could not respond to the continually evolving parameters of tool and die making" (p.53).

American production techniques, built on interchangeability and standardization, had rapidly diffused across a diverse range of manufacturing industries by the turn of the century further exacerbating shortages of skilled metal workers in the automobile industry by displacing and replacing the traditional training systems with their own, they severely reduced the flow of broadly trained skilled labour. Braverman (1974) argues the erosion of the apprenticeship system also fundamentally transformed the prime method of the infusion of scientific knowledge into the workplace. He states, "more important than formal or informal training was the fact that the craft provided a daily link between science and work, since the craftsman was constantly called upon to use rudimentary scientific knowledge, mathematics, drawings, etc. in his practice" (p.92). As Nelson (1975) notes , in those industries such as textile, footwear, clothing, woodworking, iron and steel, machinery, tobacco, which were characterized by production technologies oriented to a minute division of labour and a heavy reliance on machinery, craft methods had been displaced and the apprenticeship system abandoned in favour of informal internal training systems that responded to skilled worker shortages and new technologies by narrowing training to specialized machine operation (p.96). Even in fabrication and

other metal intensive industries dominated by specialized machinery that continued to accept apprentices for training, "apprentices seldom got the requisite experience to become an all-round mechanic" (p.96). Most workers simply received sufficient training to meet the needs of the machines on which they worked, or at best, training to meet firm specific technologies.

Factories also had difficulty retaining skilled workers. Under traditional apprenticeship terms of indenture, apprentices were obliged to complete a defined period of service to master craftsmen in exchange for training before they were free to move on to practice their craft as journeyman. This arrangement, which can be traced to the medieval guild system, ensured a degree of commitment between master craftsman and apprentice, system stability, and a high level of craft competency. However, under the less formal factory training systems of the late 1800s and early 1900s, apprentices were ultimately free to pursue better wages and working conditions elsewhere after acquiring even modest levels of training. In a context of skills shortage and intense market competition, employers encouraged this practice by poaching skilled workers from one another, even those apprentices and helpers with minimal amounts of training (Babson, 1991). The breakdown of craft control over apprenticeship training eroded the traditional craft union regulatory function that sanctioned and enforced disciplinary action against apprentices not meeting their contractual obligations to complete their training and abide by the terms of indenture. Clawson (1980) argues, factory foreman who most often "attained their positions because they had been successful and respected skilled workers" (p.129) themselves understood and respected the importance of defending craft customs in maintaining trade integrity.

Manufacturers responded to a pending tool and die, and associated metal trades skills shortage by adopting one of several strategies that emerged in the early 1900s (Nelson, 1975, p.97; Noble, 1979, p.302). Large manufacturers with the necessary resources restructured internal apprenticeship training programs by formalizing training through the establishment of factory or corporation schools to deliver and coordinate training of young apprentices. Smaller firms without the necessary resources or the need for large numbers of skilled workers intensified efforts to promote a government subsidized industrial training policy to finance their internal training systems. Finally, private schools were established, often under the auspices of industrial employer groups organized along sectoral lines, to supply a skilled workforce with industry specific skills (Brandes, 1976; Peffer, 1932). Often, firms employed a combination of the above strategies. Many that established factory schools, also joined with others in organizations such as the National Association of Manufacturers (NAM) and the National Association of Corporation Schools (NACS) to lobby governments to become more active in providing public subsidy for their training efforts (Brandes, 1976, p.52). It is important to note that although NAM lobbied aggressively for public funding, they cautioned against any regulatory role for government in their internal affairs (Gaft, 1998). Training workers was considered too critical and specialized a function to leave to an undeveloped and ill equipped public education system that focused on delivering a form of education

that was out of step with the skills needs of industrial capital (Smith, 1999). This critique of public education and technical training systems to appropriately prepare skilled workers will be echoed throughout the century (Ford, 1922; Gaft, 1998; Lewchuk & Vrankulj, 2005; Sears, 2003).

The Factory Trade School

As noted, many firms responded to the skills shortages in the critical tool and die, and associated metal trades by establishing trade schools within their factories. These schools, often components of broader corporate welfare initiatives, were aimed at the twin goals of enhancing workplace control, while simultaneously securing a stable supply of skilled workers trained and conditioned to the precise technical and social requirements of their labour process (Gartman, 1986; Noble, 1979). Although considerable variation existed across schools, they shared an approach to training that combined a measure of classroom-based general education with shop floor technical and manual training (Peffer, 1932). Secondly, students in most cases were recruited from existing workforces, however some firms broadened their recruitment beyond their factories in order to attract those candidates possessing qualities deemed essential by the firm (Peffer, 1932). Thirdly, students were typically paid at a rate below that of production workers with increases tied directly to successful completion of company determined academic and technical competencies (Peffer, 1932). Fourthly, students shared time between the classroom studying a curriculum of academic and trade related theory that was informed by the manufacturing technologies utilized on the factory's shop floor (Peffer, 1932). Finally, an overwhelming majority of students remained with their employer after completing their training (Peffer, 1932).

Training apprentices posed a complex challenge for employers. In order to develop a stable supply of workers capable of meeting the technical needs of the contemporary automobile industry toolroom, it was in their interest to replicate the breadth and depth of technical education and manual training apprentices received under the craft-based system. However in order for factory owners to capitalize on their investment it was critical that apprentices stayed with the firm upon the completion of their training, and once in the toolroom, committed themselves to applying their skills exclusively in the interests of productivity. Supporters of factory school education claimed they provided the most appropriate environment for manual and technical training in the absence of an apprenticeship system or public skills training regime appropriate to the needs of industrial capitalism. In their view, factory schools represented "schooling under the least artificial conditions possible [in which] no situation has to be created as it must be in a public trade school" (Peffer, 1932, p.122).

Factory school education was also promoted as a mutually beneficial method for employers to reward loyal and competent workers with an opportunity for self-improvement and advancement into better paying jobs and higher occupational standing as skilled workers. Factory owners often recruited foreman and managers from the ranks

of skilled workers (Nevins, 1957, 1959; Babson, 1991), many of whom were trade school graduates who exhibited a measure of "technical creativeness" (Peffer, 1932, p.116) and appropriate attitudes during their studies. Noble (1979) argues, "education was the critical process through which the human parts of the industrial apparatus could be fashioned to specifications" (p.288). Given the displacement of the traditional apprenticeship system, factory-based technical training became critical to fill this need. Critics however argue that the role of factory schools extended beyond technical training to include a role in legitimizing and consolidating capitalist control over the labour process by 'building normative ties of gratitude between labor and capital" (Gartman, 1986, p.245). Forging these ties was especially critical with regard to tool and die workers given their central role in the development and maintenance of production technologies.

Whereas unskilled labour was more readily controlled through technological and organizations measures associated with mass production, control over skilled workers posed a more complex problem. Factory owners had to concede a measure of control over the creative and self-directed application of toolroom skills in order to most effectively capitalize on their knowledge and talent, while at the same time ensure that these skills and associated power were harnessed exclusively to the productive goals of the firm. Gartman (1991) argues, "the only way to ensure that these workers who made their own decisions and controlled their own work would use their discretion to further the interests of manufacturers was to inculcate in them the values of Anglo-Protestant bourgeois culture which corresponded to the requirements of the capitalist controlled labor process" (p.243).

Burawoy's (1985) challenge to key conclusions drawn by Braverman (1974) about the nature of capitalist workplace control is relevant to this paper. Burawoy argues that it is neither possible nor beneficial for managers to exercise complete control over workers. In fact, the pursuit of workplace control "often promoted resistance and struggle and in so doing undermined the extraction of surplus" (Burawoy, 1985, p.45). This research suggests that tool and die workers in particular possess sophisticated skills and knowledge that have proven relatively immune from the deskilling and fragmentation experienced by other workers. These skills are central to the goals of productivity, and are therefore particularly important to the process of capital accumulation in the automobile industry. In this view, a production strategy based on the development of a minute division of labour and the creation of "detail workers" (Braverman, 1974, p.54), and a control regime based exclusively on coercion not only has limits, but in fact is counterproductive. Instead, Burawoy (1985) argues, "workers must be persuaded to cooperate with management...their interests must be coordinated with those of capital" (p.126).

Friedman (1977) argues management control strategies built on limited worker autonomy are more effective for those workers not easily replaced and considered central to the process of capital accumulation. He defines central workers as "those who through their skills or their contribution to the exercise of managerial authority are considered

essential by top managers to secure high long run profits, " and "those who by the strength of their resistance collectively make themselves essential to top management" (p.54). Direct control strategies that maximize workplace discipline through deskilling and intense management supervision are counterproductive with central workers as it limits their scope for "independent activity" (p.51) that can be harnessed to a firm's productivity goals. According to Friedman, in order for a firm to facilitate and harness independent activity among its central workers, spaces of relative autonomy must be created within the broader regime of management workplace control. He refers to this strategy as "Responsible Autonomy", and argues that it contains two main components. First, management must allow "individual or groups of workers a wide measure of discretion over the direction of their work tasks" (p.48). Secondly, management must cultivate workplace social controls aimed at the "maintenance of management authority by getting workers to identify with the competitive aims of the enterprise so that they will act 'responsibly' with a minimum of supervision" (p.48). Friedman argues,

> Responsible Autonomy does not remove alienation and exploitation, it simply softens their operation or draws workers' attention away from them. Its ideal is aimed at accumulating have workers behave as though they were participating in a process which reflected their own needs, abilities and wills, rather than a process aimed at accumulation and profits (p.53).

Burawoy (1985) refers to Responsible Autonomy as a "self-conscious management strategy to pre-empt worker resistance," that "attaches workers to capital's interests by allowing them limited job control, a limited unity of conception and execution" that is rooted in craft-control over work (p.124).

The factory school provided a method to develop technical skills, while simultaneously instilling future skilled workers with norms and values consistent with the control priorities of the capitalist labour process. Under traditional apprenticeships, master craftsman stressed values of autonomy, craft pride, and a sense of mutual respect toward others in the trade, while as Gartman (1986) argues, factory trade school education "emphasized virtues of hard work, loyalty, [and] respect for authority..." (p.97).

Several automobile manufacturers established factory schools to train their own apprentices (Peffer, 1932). Of these, Ford's was the largest and most comprehensive in its goals. Graduates of Ford's Trade Schools entered the toolrooms of Ford's plants, perhaps the last bastion of craft-based power, with a degree of confidence matching that of the metalworkers trained under traditional methods. It will be shown below that Ford's young apprentices were both technically capable and imbued with an ideological indoctrination antagonistic to the social and cultural traditions of craft unionism. Arguably, the young men graduating from Ford's trade schools were among the first generation of apprentices to be taught the technical and social foundations of their craft by agents of capital, and perhaps the first generation with a sense of indebtedness and obligation to the automobile industrialist of the early 1900s, and not to the generations of craftsmen that preceded

them. The following section will explore the role Ford's Trade Schools played in this process. The following facets of the Ford trade school are of particular interest:

- Student recruitment and selection strategies
- Payment and reward structures
- Classroom and shop instruction
- Technical and manual training
- Student socialization

Henry Ford Trade School

Although the opening of the trade school can be viewed as an expression of Ford's "sense of social responsibility" (Gaft, 1998, p.28), his decision appears to be primarily motivated by factors more directly related to addressing skilled labour needs. The opening of the trade school was preceded by his funding of other educational initiatives such as several chartered high schools, and the Valley Farm which were opened to provide disadvantaged young men with educational and life experiences which they would not normally have. Ford was critical of public education which he believed focused on teaching a body of knowledge no longer relevant to contemporary needs and did not appropriately prepare youth with the skills necessary to succeed in the booming industrial economy of the early 1900s. Ford's educational endeavors were driven by a desire to deliver a more "utilitarian" (1926, p.164) approach to education that would emphasize the acquisition of the practical skills and knowledge required by employers. Ford (1926) argued, "a true education will turn a man's mind toward work and not away from it..." (p.164), and it is in this spirit that he established the trade school. It is clear however that unlike Ford's other philanthropic endeavors in providing opportunity to youth, "this desire to aid fitted conveniently with the necessity of providing trained toolmakers in the shop" (Ford, 1922, p. 211). Three other and perhaps more compelling justifications for the establishment of the Ford Trade School can be identified.

First, Ford and others experienced great difficulty securing a stable supply of skilled labour in the early 1900s. Ford stated, "the keeping of vast quantities of machinery in repair, the providing of tools and dies, and the nice adjustment of everything, it will be realized require a multitude of machinists who are master craftsmen" (Ford, 1931, p.134). As noted above, despite the efforts of the DEA to attract skilled metal workers, supply could not meet the growing demands of Detroit's manufacturers especially during war related immigration restrictions between 1914 to 1916 (Gaft, 1998; Babson, 1991). Many factory owners, including Ford himself resorted to poaching skilled and semi-skilled workers from other firms (Nevins, 1957; Babson, 1991).

Secondly, Ford's decision to open a trade school reflected a growing desire for industrialists to become more active in training workers with industrial skills considered appropriate for mass production, particularly in the absence of an adequate public system

of technical education. The National Association of Manufacturers, of which Ford was a member, was active in lobbying governments to fund their training initiatives. It was their belief that the public education system was unprepared to deliver industry skills needs, and "only trade school education would provide the level of training manufacturers required" (Gaft, 1998, p.20). Ford (1922) described public efforts at manual training as "makeshift" (p.211) and inadequate. He argued, "we are distinctly short of skilled men and one of the weaknesses of industry is that in general it has not been able to provide the facilities for training the army of skilled men that are now needed" (Ford 1931, p.134). In the early 1900s, NAM's Committee of Industrial Education NAM advocated a technical training policy based on the following principles:

- Boys should enter technical training at fourteen years of age
- Schools should strive to promote a curriculum and training regime based on the creation of economic value
- Speed and execution should be prioritized in all facets of training
- Instruction should be conducted by skilled tradesman
- The costs of technical training should be 'socialized' through public subsidy

Finally, manufacturers were openly critical of the "un-American domineering and arbitrary methods of labor unions" (Gaft, 1998, p.23) in training apprentices. Craft union traditions of apprenticeship training and cultural transference were viewed as a hindrance to both the acquisition of skills necessary to support the technical requirements of industry, and as a challenge to management power and authority within their factories. Ford (1934) argued, "these men require not only skill but also versatility-and it's harder to get versatility than it is to get skill" (p.135). Factory trade schools presented industrialists with an option to address both issues by displacing craft union control over apprentice training. Gartman (1986) argues, "by maintaining strict control over educational programs, capitalists and managers realized they could produce workers who were not only technically competent, but also ones socially conditioned to the alienated labor the existed in the rapidly changing labor process" (p.243). In this context, the establishment of a factory-based trade school can also be viewed as an element of Ford's broader strategy of workplace control.

Meyer (1981) argues the trade school was a component of a corporate welfare structure, and was an integral element of a "wide-ranging and tightly knit web of social controls over the Ford workforce in order to create, develop, and to instill positive industrial values and disciplined work habits in the Ford labor force" (p.96). Jacoby (1997) notes that welfare work could often be found in those firms in which company founders "hoped welfare activities would reproduce the close ties that had existed when they knew each of their employees by name," and in those firms in which founders expressed a "responsibility to share their wealth and discharge the moral obligations that it imposed" (p.14). However, in worst case scenarios, "welfare work was frequently condescending and manipulative" (ibid) and narrowly directed at shaping workers to goals of productive and control. Jacoby (1997) argues, " the hope was that firms could

recast the intemperate, slothful worker or the ignorant immigrant in a middle class mold: uplifting him, Americanizing him, and making his family life more wholesome" (p.15) Meyer's (1981) exploration of the selective application of Ford's famous *Five Dollar Day*, and Lewchuk's (1993) research on Ford's workplace initiatives in masculanizing work in his automobile assembly plants provide ample evidence of the ways in which workplace welfare programs cultivate and enforce 'positive' workplace social values often by privileging one group of workers over another. A factory school offered an ideal mechanism through which to instill these values to students who would one day hold key positions in Ford's factories.

In early 1916 Ford organized a committee to establish the trade school. This committee included his personal secretary, the heads of Ford's Sociological Department and Americanization Schools, and a plant superintendent who came to Ford with a background in vocational education. In August of 1916, Ford's committee obtained status as a chartered not-for-profit association and opened shortly after at Ford's Highland Park plant in October, 1916. He opened a second school at the River Rouge plant in 1927. This was followed by the opening of factory schools in Canada, England, and Brazil to service the unique social and skills needs of those locations.

The first President of the Board of Trustee was Samuel S. Marquis, a Doctor of Divinity hired by Ford in 1915 to implement the paternalistic welfare policies of his Sociological Department. Reverend Marquis had a history of coordinating programs directed at controlling the social as well as educational lives of Ford's employees.

Recruitment and Selection

The trade school provided students with technical education and manual training that amounted to a pre-apprenticeship in tool and die, machining, and other mechanical trades. Boys as young as twelve enrolled into the school and entered into a comprehensive pre-apprenticeship program oriented toward preparing them for a life of work in the toolrooms of Ford's plants. Ford preferred to hire younger boys as it increased the time spent in training. In some cases, older boys were admitted, however these were the exception rather than the rule (Gaft, 1998). In the early years of the school, students were recruited exclusively from those in underprivileged economic circumstances. All boys (there are no records of any women graduating from the trade school) were either orphans, sons of widows, sole supporters, or from those families that relied heavily on the financial support of their son. Research suggests that Ford broadened recruitment to include the children of employees by the late 1920s. In 1926, Ford (1926) claims to have recruited approximately one fifth of the schools students from the children of his workforce (p.166). Most students however were recruited externally from those who had few options for elevating themselves from poverty. As Gaft (1998) notes, enrollment into the Ford Trade School represented a golden opportunity "...to obtain a craft at a time that many disadvantage youth had to resort to committing crimes in order to qualify for prison based vocational training" (p.54). He cites a prison warden

of the era claiming, "Incredible as it may seem, it can be conclusively shown that American boys in certain sections of our country are actually committing unlawful acts and misdemeanors in order to be apprehended and convicted for same in the hope that they may be punished by being sent to a reformatory institution for juvenile offenders wherein trades are taught, that they may secure an opportunity to learn a trade" (p.54).

Giving preference to the disadvantaged might have appealed to Ford's Calvinistic social values as Gaft (1998, p.28) claims, however the strategic selection of boys from desperate economic circumstances also ensured student loyalty and commitment to their generous benefactor. It is interesting to note that Ford chose not to recruit students exclusively from his existing workforce or their children. Ford's decision to recruit a majority of students from outside his firm reflects a desire to develop and nurture a cohort of skilled workers uncontaminated by the fermenting working class unrest on his factory floors. It could also be argued that Ford's selective recruitment methods would have cultivated a strong sense of loyalty and commitment among those members of his workforce seeking a coveted place in the trade school for their children. It is also worth noting that Ford workers were not unionized in the 1920s and it is therefore reasonable to assume that openings in the trade school were reserved for the children of employees considered meritorious as determined unilaterally by Ford's managers.

Boys were provided with free education and training, while being paid both for the time spent in the classroom and in the school's workshops. Each boy received a scholarship of between 300 to 500 dollars based on their unique financial need (Gaft, 1998). Annual scholarships were paid on the basis of an hourly wage. Regular wage increases were largely based on tenure, however students who achieved high standing in academic courses were eligible for cash bonuses at a rate of an extra one cent per hour for students achieving a grade of B, and two cents per hour bonus for those achieving an A standing. This was a considerable financial incentive given the average wage rate for students was 35 cents per hour (Norwood, p.186). Students became eligible for bonuses at each report card period which occurred approximately seven times per year (Gaft, 1998, p.55). Perhaps most importantly, students were also graded on their "industry" a euphemism Ford (1932, p.211) used to describe desired behavioral, attitudinal other displays of a student's "deportment" (Norwood, p. 186) toward their fellow students and teachers while in training. Other benefits included a cost free lunch, medical and dental care, and a company sponsored savings plan in which Ford would match any deposits by students.

Funding

Ford financed the operating costs of his trade school through two sources. The school's status as a chartered not-for-profit association would have entitled Ford to a measure of tax relief. This arrangement provided Ford with a public subsidy of his internal skills training program at a time of little direct state funding. Secondly, and most importantly, the school was funded predominantly through a unique business arrangement

in which the school supplied Ford's manufacturing plants with goods and services normally purchased from independent suppliers.

Ford assigned trade school staff members to the task of searching his factory floors to find work that could be performed by trade school students. It was Ford's belief that by working on objects of "recognizable industrial worth" (Ford, 1922, p.211), students would gain a sense of pride and responsibility...by being trained on articles which were to be used" (Ford, p.211). These jobs included the repair of hand tools, safety equipment, manufacture of rudimentary tooling, and as Gaft (1998) argues included the production of automotive components for the Model T in the early years of the school (p.58). From the outset, the school was tightly aligned with Ford's production needs. Younger students learned the use of hand tools working at benches repairing assorted tools, safety glasses, and other shop supplies used by workers in the plant, while more advanced students honed their manual skills providing fabricated components to the factory toolrooms.

As Gaft (1998) notes,

> The boy's greatest contribution however was in the manufacture of components and fixtures used in the manufacture of automotive parts. These fixtures represented the extensive tooling and gages required to make the precision and interchangeable parts of the automobile (p.57).

Ford paid the school approximately 70 cents per hour of work for their services while the trade school paid the boys approximately twenty-five cents per hour, the profit was used to cover the operating costs of the school (Gaft, 1998,p.58). One of Ford's expectations was that the school "should be a means to teaching boys to be productive" (Ford, 1922, p.210), and that all work performed in the course of training would be performed under the same conditions and support production in his plants. As Peffer (1932) argues, "all work is for use and not just practice...it must be something which would have to be done in the plant anyway" (p.122). Nevins (1957) estimates that each student on average contributed approximately one thousand dollars in annual production, which more than offset the costs of student scholarship, instruction, and machine maintenance (p.343). Estimates suggest that at its height in 1930, the school occupied three acres of factory floor space (Peffer, 1932, p.120) in which 2,900 students trained on approximately one million dollars in cutting-edge machinery and other equipment (Nevins 1957, p.343).

Technical and Manual Training

Supplying Ford's plants dictated both the manual and classroom components of student training. Students progressed though their training in an environment that closely paralleled the manufacturing process students could expect to encounter once they graduated to Ford's factory floors. Ford equipped the school with current machinery and

organized it to replicate the departmental configuration of his plants. Boys were 'transferred' from one department to another on a progressive schedule in order to learn the use of machinery and organizational layout they would encounter in the future. Forge, die cast, hardening, foundry, sheet metal, nickel plating, valve repair, car repair, pattern making, and tool repair, were all demarcated 'departments' with shop specific machinery on which students produced goods for use in Ford's plants. In 1927, Ford integrated student training more deeply within his factory by establishing school departments within his plants. Ford received state permission to have boys as young as sixteen work within the plants toolrooms as long as they stayed under the "direction of definitely appointed instructors and not under production foreman" (Gaft, 1998, p.63). Interestingly, this initiative occurred at a time of skilled worker shortage associated with the introduction of the Model A in 1928 (Babson, 1991; Nevins, 1954).

School production reflected the high level of student technical competency. Norwood (1931) argues, students engage in the production of goods that were expected to meet "the same rigid scrutiny as those made in the Ford Motor Company shops by skilled mechanics" (p.194). He cites an example of a typical school 'contract' of 2,968 hours which involved the final machining of rough casted components and the assembly of these components into one hundred low-bodied transport vehicles for Ford's Rouge River plant to support this belief (p.195). Many jobs involved the manufacture of intricate machinery involving multiple gears (Norwood). In other cases, students created production machinery to manufacture the mass production of goods. Norwood (1931) provides an example;

> Formerly, outside suppliers furnished the galvanized buckets used by the Rouge Plant painting squads. Now the boys produce them. They first made the drawings, then the blueprints, and then the machinery necessary to turn out the pails in quantity amounts (p.197).

It could be argued that the calibre of skills of the more advanced students differed marginally by degree and not in kind from those of Ford's toolroom workers. Ford was preparing boys to build the machinery and tooling necessary for the mass production of automobile components by having them develop their skills building the machinery, tooling, and dies to mass produce buckets and other products required to support his production system..

Students spent one week of every three in the classroom studying an academic curriculum that complimented their manual training. Students took courses in English, Civics, Geography, Arithmetic, Qualitative and Quantitative Analysis, and more technically oriented courses such as Mechanical Drawing, Metallurgy, and Shop Theory. In all cases however, school curriculum was tightly aligned to Ford's factory. The school's textbooks contained exercises that translated lessons into "concrete shop problems" (Ford, 1922, p.212). For example, students were introduced to world geography by exploring the various materials used in the manufacture of a car, and

tracing their path from source country to assembly line. Automotive rubber components provided the foundation of a class exercise designed to trace a continuous line from Ford's rubber plantations at Fordlandia in Brazil to his various tire, hose, and insulation manufacturing plants, and finally to his assembly lines. Likewise, the study of physics, math, and chemistry provided opportunities for instructors to introduce students to current manufacturing technology through classroom exercises concretized to the inner workings of the plant's machinery. Texts and training manuals were custom produced on site and updated to remain current with plant technology and Ford's current socialization priorities.

Instructors were recruited from the factory floor with many of them former students of the school. Ford believed that "the best instructors obtainable are on staff," (Ford, 1932, p.212) as they knew best the intricacies of Ford's production technologies and were themselves socialized to the requirements of the Ford labour process. This practice ensured a degree of consistency in the reproduction and transfer of skills from one graduating class to another. In the absence of unions, school administrators would have had a free hand in the selection of instructors, and surely would have selected those from the toolrooms they perceived the most likely to reinforce Ford's model of socialization, over the values and traditions of their craft ancestors.

Socialization

Critics of factory schools argue that the schools provided industrialists an opportunity to shape norms and values of students. As Gartman (1986) argues, "a close examination of requirements, methods, and curriculum that more was being taught than technical skills...the school attempted to mold the workers' culture and character in order to habituate them to the alienated labour of the auto shops" (p.243). In the case of the Ford Trade School, values of punctuality, timeliness, accuracy, precision, and industriousness were cultivated and reinforced by a system that rewarded attitudes most conducive to Ford's control over the labour process.

School hours paralleled those of the factory day shift. Students were required to "punch in" at the start of their school day alongside Ford's production workers. Those students who arrived without their punch card were required to return home and retrieve their card before returning (Gaft, 1998). Adherence to factory determined time standards was prioritized in manual training. "All work is done on shop order, on estimated time schedule, based on how long the job would take a skilled mechanic" (Peffer, 1932, p.21). Records suggest that Ford's production managers were engaged in time and motion study early in the 1900s illustrating an approach to production management that paralleled Frederick Taylor's focus on the minute calculations of labour time (Nevins, 1954). As Gartman (1986) argues, Ford "sought to ensure in his school that skilled workers internalized the discipline that made its [time] use as profitable as possible" (p.245). This is not surprising given the central role of tool and die makers in the design and manufacture of mass production technologies.

In all cases, meticulous individual records were kept of each task. These records were used to evaluate and assess student performance. Although classroom grades and tenure factored into evaluations, increases in scholarship amounts and access to prized training opportunities were predominantly determined by mechanical aptitude and attitudinal factors. "It is the marks in *industry* which are used in subsequent adjustments of scholarship" (Ford, p, 211, italics mine). Those students showing mechanical aptitude and the greatest 'industry' were rewarded with assignment in the school's toolroom while low achievers were assigned to practice on those skills associated with the less sophisticated trades (Gaft, 1998, p.157).

All students were required to leave the trade school at the age of eighteen. Most graduated to a more intensive apprenticeship working in Ford's toolrooms under the supervision of an apprentice foreman who supervised the remainder of their training. Trade school graduates joined other apprentices under the age of thirty hand selected from Ford's younger production workers (Ford, 1926, p.169). In order to fully complete their apprenticeship, students spent three years under the tutelage of their apprentice foreman. They were also expected to complete four hours per week back in Ford's classroom rounding out their theoretical knowledge, however at this stage in their training it was to be undertaken after they had completed their full work day. Ultimately, success in the trade school translated into a preferred apprenticeship in the plant's toolroom, and perhaps for the select few, working alongside Ford and his brightest engineers on the cutting-edge of automobile manufacturing research and innovation in Ford's Experimental Room.

The factory trade school represented an innovative approach to securing Ford a supply of skilled workers. An academic curriculum informed by the technical requirements of Ford's production technologies, coupled with a system of manual training that paralleled and replicated the technical and functional configuration of his plants ensured that students would embark on their toolroom apprenticeships with the necessary technical skills. Strategic student selection, teacher recruitment, and a reward system that reinforced Ford's control over the labour process, cultivated "normative ties of gratitude" (Gartman, 1986, p.245), and socialized students to enter the factory imbued with the sense of confidence, entitlement, and "arrogance" (Babson, 1991, p.124) necessary to assume a position of leadership in the toolroom.

In total, the Henry Ford Trade School in Detroit graduated 8,400 students. Records indicate that approximately 70% or almost 6,000 of these found their way into Ford's toolrooms as tool and die makers (Gaft, 1998, p.130). Schools in England and Canada graduated many more to serve their own skills needs. In Canada alone, approximately 600 students graduated from the Ford of Canada Trade School in Windsor Ontario between 1937 and 1961(*Ford Graphic*, 1957). Of these 75% entered the toolrooms of Ford's Windsor operations (Kulisek, 1999). It could be argued that the Ford Trade School, the General Motors Institute of Technology, and various other smaller automobile industry factory schools of Detroit played a role in shifting the organizing

strategy of craft unions from one based on craft-consciousness to one based on a broader class-based politics. In a context in which their monopoly over skills, and their numbers were being eroded by apprentices nurtured in an ideology antagonistic to the craft-conscious union traditions of their European homelands, it is not surprising that the Anglo-Gaelic (Babson, 1991)) vanguard of Detroit's craft unions were forced to redefine their interests by forming allegiance with the mass of unskilled workers outside the toolrooms of the automobile industry.

Factory schools infused the automobile industry toolrooms with technically capable apprentices socialized in "schools of capitalist culture" (Gartman, 1986, p.243) that rewarded individual initiative and enterprise. As Babson (1991) argues, American trained skilled workers "favoured the language of democratic opportunity", a notion that was aggressively cultivated and reinforced by Ford and other industrial capitalists (p.83). Babson's research suggests the older cohort of tool and die workers trained under traditional craft union methods led the drive to industrial unionism in the automobile industry. What remains unclear however is the extent to which this cohort was able to mobilize Ford's graduates in support of the unionization campaign. Eventual unionization of Ford's plants in 1942, suggests that as a strategy to take control of his toolroom, the trade school failed. However, it is worth noting that Ford successfully resisted unionization several years after other automobile producers had succumbed. The role of trade school graduates in delaying the eventual unionization of the Ford Motor Company is also a question that remains unanswered.

Magna International

Magna International is a Canadian based manufacturer of automobile components. Currently, Magna employs approximately 82,000 workers in 224 production facilities spread over 22 countries. Magna reported sales of almost $23 billion dollars in 2005, and is currently the largest employer in the Canadian automotive sector with sixty two production facilities employing approximately 22,200 workers (Magna, 2007a). Canadian plants produce a range of diversified automotive components that span the various tiers of the automotive industry. Plants utilize production technologies that cover the spectrum and range from relatively low skill stamping operations to plants engaged in the high technology manufacture of precision machined engine and drivetrain components. Magna also operates sixty nine advanced Product Development and Engineering Centres in eight countries, eight of which are in Canada.

Although Magna's origins trace to a modest one man tool and die operation in 1957, by the 1970s Magna had grown to become a multi-factory parts supplier to the automobile industry with advanced engineering, tool design and manufacturing capabilities. Beginning in the late 1970s, Magna successfully capitalized on opportunities for a deeper and "higher value added" integration with automobile assemblers that opened up as a result of a continental restructuring of the automobile industry (Anderson and Holmes, 1995, p.659). "During the 1980s there were strong tendencies toward more

outside sourcing of components by assemblers, fewer suppliers, more single sourcing of components and involvement of suppliers in both quality control and product development..." (p.659). Magna's ability to respond successfully to these opportunities was in part related to its technological capabilities. From its inception, Magna's competitive strategy "focused on developing a strong technology base for its increasing diversified auto parts production" (p.659). At its heart, this strategy had a strong "technological focus on continual product development and process engineering rooted in skilled craft work..." (p.659).

Skilled Labour and Automobile Parts Manufacturing

Echoing Ford's concern at the start of the century, Magna like other parts manufacturers in Ontario's contemporary automotive parts sector express concern over the availability of skilled workers. Over one half of parts manufacturers surveyed in a sectoral study of skills needs in Ontario's automotive manufacturing industry anticipated a firm-level shortage of skilled labour over the next five years, while approximately three quarters expressed concern over sectoral shortages (Lewchuk & Vrankulj, 2005). Parts firms were also the most active members of the broader automotive sector in training initiatives to meet anticipate shortages with almost 90% of the province's parts manufacturers engaged in training apprentices. One of the key findings of this research was that skills supply strategies varied across firms in the industry and were shaped by various factors related to how skilled workers were utilized within a firm's labour process. The report states, "how journeypersons are used within the production process, rather than where on the supply chain a company is located is a more accurate indicator of attitudes towards apprenticeship training; concerns about recruiting skilled labour; the kinds of training needed; the role of colleges in the training process; and alternative models for supplying skilled labour" (p.20). Those firms in which the role of skilled trades is broadened to include responsibility for process refinement, and those in which skilled trades were at the centre of a competitive strategy based on technological innovation were most likely to develop internal training systems tailored to the unique needs of their labour processes.

Parts firms falling into this model of skilled trades utilization, were also the most likely to express a preference to develop internal training systems as it allowed them to control and shape every facet of training. Under internal training systems, technical and manual training can be more tightly aligned with a firm's existing technologies. This was particularly important in those firms utilizing proprietary production technologies developed internally. Rigorous recruitment and selection procedures enable firms to select those workers with those skills and attitudes most desired by employers (Lewchuk & Vrankulj, p.69). This was particularly important in those firms in which unique workplace cultural considerations figure prominently. These firms were also the most likely to recruit apprentices from their existing workforces.

Skilled Labour at Magna International

Anderson and Holmes (1995) attribute Magna's success to three key elements of its corporate structure. The first is a decentralized organizational configuration in which production is organized among a network of relatively small manufacturing plants clustered and coordinated into one of ten operating groups. Operating groups assume responsibility for managing the research and development, engineering, quality control, human resource management, and sales needs of individual plants within the operating group. Individual plants also actively engage in identifying potential products and markets. According to Fitzgibbon, Rutherford, Holmes, and Kumar (2004), "incremental innovation" (p.23) at the plant level in which "automotive parts firms rely heavily on their workforce for product and process improvement" (ibid) is a major source of competitive advantage for Ontario's automobile parts manufacturers. At Magna, although "each plant is responsible for its own technical skill, tooling, and manufacturing capacity," (Anderson & Holmes, 1995, p.664), they are supported in these functions by a corporate level Technical Training Centre, and Technology and Systems Tooling Group. The nature of this support will be discussed more fully below.

The second key element of Magna's corporate organization is a corporate level commitment to supporting product and process development through technological innovation. Magna's corporate constitution dictates that a minimum of 7% of pre-tax profits will be allocated to funding research and development. In addition, Magna funds the Magna Technical Training Centre in Brampton, a facility that supports the skilled trades training needs of Magna's Canadian plants (Magna, 2007b).

The final key element of Magna's corporate organization can be found in Magna's low-wage non-union industrial relations system which reinforces a dual internal labour market structure that is demarcated on the basis of skill. As Anderson and Holmes (1995) argue, this demarcation appears along gender and racial lines with higher paying skilled jobs occupied predominantly by white males, and lower paid production disproportionately occupied by women and visible minorities. Access to training provides Magna employees with an opportunity to bridge this divide. However as Lewchuk and Wells (2006) argue, in a non-union workplace in which seniority is not a major consideration in awarding employees access to training opportunities management discretion is often used to "reward employees they consider meritorious " (p.646). As noted, individual Magna plants assume responsibility for securing skilled workers. Plants meet these needs largely through internal recruitment of employees or their children for apprenticeship opportunities at the Magna Technical Training Centre. According to an official of the school, seniority is not a governing factor in the selection process and "plants have their own way of screening people...attendance and issues of discipline, and other factors are considered" (Interview, 2006). Access to training and associated promotion through Magna's internal labour market can be viewed as one of many individualized and contingent workplace incentives identified by Lewchuk and Wells (2006) as key to a broader human resource strategy aimed at cultivating labour cooperation and the internalization of corporate productivity goals.

Magna Technical Training Centre

Magna opened its first technical training centre in 1984 in Newmarket Ontario to train millwrights, industrial mechanics, electricians and most importantly tool and die workers for its Canadian plants. This facility however closed in 1989 because of an industry downturn. It would not be until 1997, that Magna built the present training centre in Brampton. Sourcing of apprenticed skilled trades, according to a Magna official was not an issue over this eight year period as they recruited journeypersons from Germany, Austria, Ireland, Scotland, England, and South Africa to meet the needs of their Canadian plants. Although Magna has relied heavily on the recruitment of foreign trained workers in the past, the opening of the Magna Technical Training Centre (MTTC) signaled a strategic shift in skills supply strategy away from external recruitment to a preferred strategy based largely on the internal recruitment of Magna employees. Magna management identifies two primary reasons for this strategic shift (Interview, 2006). First, increased demand for skilled workers globally, and tightened immigration procedures in the wake of the September 11, 2001 New York terrorist attack have made the recruitment of foreign trained journeypersons problematic. Secondly, it became increasingly difficult for Magna to recruit workers with a broad enough skills foundation for Magna's labour process. A Magna manager states, "we started the training centre because we realized there was a significant need in terms of the skills of the trades people available," and "we were not getting the caliber of individuals that we need to do the work that they need to do in the plants" (Interview, 2006). According to Magna management, skilled workers are expected to possess and develop skills that transcend those historically associated and defined under individual trades. Moreover, skilled workers are expected to utilize these broad skills through the "creative involvement" (Interview, 2005) in process refinement and the re-tooling of existing production technologies. Like Ford, the decision to open a technical training school was motivated by the goals of developing and securing a stable supply of skilled labour precisely trained to the requirements of the firm's production system.

Recruitment and Selection

As noted above, Magna plants assume responsibility for securing skilled trades needs and as such are the first point of apprentice recruitment. Apprentices are selected by plant management based on locally determined criteria and put forward as preferred candidates. All potential apprentices are then screened for suitability by trainers who assess potential apprentices for technical aptitude. Applicants are also interviewed as part of the screening process. Training centre management makes the final decision on applicant suitability and can refuse to accept locally selected candidates. Enrollment numbers are determined by the skill needs of local plants, but typically range between approximately thirty to sixty students a year. Currently Magna draws approximately 90% of the centre's students through internal recruitment (Interview, 2006). Women account for approximately 7% of these students (Lewchuk & Vrankulj, 2005). The rest are

recruited externally, however many of these are children of Magna employees. "Magna realizes that one of the greatest benefits you can give to an employee is to recognize their children and give them an opportunity, so the company has over the years in all aspects not just skills training, given opportunities to the children of Magna employees...you'll find them spread throughout the corporation in various capacities" (Interview, 2006). Recruitment and selection strategies differ significantly from those utilized by Ford. Whereas Ford recruited a majority of his students externally, Magna recruits virtually all of their apprentices internally. In each case however apprentice selection is a strategic consideration that is targeted on the recruitment of those individuals most likely to complete their training and stay with the firm. Few students do not complete their training. Magna management report that fewer than 10% of students do not complete their training (Interview, 2006). In most cases, these are students that have been asked to leave because they are not meeting competency expectations.

Technical and Manual Training

MTTC curriculum parallels the technical and practical mix of the German model of apprenticeship training in which students spend time in both the classroom and in Magna plants engaged in production related support. The foundation of apprenticeship training at the MTTC is trade multi-skilling in which students are exposed to training that transcends traditional lines of skills demarcation. The apprenticeship training schedule is organized as follows:

- 40 hours of classroom time for 9.5 months at MTTC
- 3.5 months of practical experience in production setting usually at 'home' plant
- Return for further 9.5 months of classroom/shop training
- Return to home plant for approximately a year of in-plant training
- Return to facility for about 3 weeks to write their final German certification exam

Magna has adopted the German model of apprenticeship training for two main reasons. Magna management argues that the German model is more suited to cross-functional training of skilled trades. Although apprentices spend a majority of their classroom, shop and in-plant training in their core trade, they also obtain training in several other trades. According to MTTC management, the multi-skilling component of training is critical as "some plants are as small as twenty people...in the small plants the tradesperson is the jack of all trades and must be able to do everything that needs to be done" (Interview, 2006). A manager states, "if we ever shut down a customer plant down like Toyota, GM, or Chrysler, in some cases you're looking at $6,000 a minute and that comes back on us unfortunately...their skills and our investment in them definitely results in less downtime in our plants, [and] improved problem solving..." (Interview, 2006). Training centre management concedes that this approach to skilled trades utilization is unlikely in unionized plants.

> For the most part, we are a non-unionized operation and as a result

> our trades people are very well trained in various areas. We have plants where it doesn't matter if you're an electrician, doesn't matter if you're a millwright, if something is broken down you might be the maintenance person that has to fix it so you have to have a wide variety of skills (Interview, 2006).

The second reason for the adoption of the German model of apprenticeship training is that the acquisition of German certification facilitates the flexible deployment of skilled workers across Magna's global locations. Magna management argues that international respect and recognition of German certification allows Magna to more effectively manage technological transfer across its global production chain. Magna regularly deploys Canadian tradesman to offshore locations to support factory start-up and aid the development of domestic training centres. A Magna manager states, "Magna has a different way of running their business with methods that have been very successful over the years, and when we move into other countries where the culture is very different...you can go over there and show them how things can be done differently and show them how to be successful" (Interview, 2005). Moreover, the MTTC regularly hosts apprentices from offshore locations to train alongside Canadian apprentices.

The Magna Technology and Tooling Systems Group Research and Development Centre is co-located with the MTTC. This facility is a state of the art research and development centre that provides tooling and manufacturing equipment for Magna plants and OEMs. Some of Magna's most current and advanced production technologies have been developed and manufactured internally by the engineering, electricians, machinists, and tool and die makers of this facility. This centre also provides an opportunity for MTTC apprentices to become familiar with internally developed cutting-edge manufacturing technologies and the environment in which it is developed. Apprentices occasionally participate in the development of tooling at the centre if the technology under development has relevance to their home plant. In some cases, apprentices showing promise will be invited to work within the facility after they have completed their day at the MTTC. "This company really encourages suggestions in improvement ideas, so if we can open up their [apprentices] understanding of new things...the facility being next to us allows apprentices to get an opportunity to get an understanding of new technologies coming down the pipe...were not just training on typical old stuff" (Interview, 2005).

Not surprisingly, instructors at the MTTC have significant trade experience, with many possessing certification in more than one area of specialization. Of the centre's eleven instructors, several have apprenticed in Germany under the same training system utilized by Magna. Unlike Ford who drew his trade school instructors exclusively from his factory floors, Magna has recruited instructors with considerable international industrial and teaching experience (Magna, 2007c). Several possess graduate level educations in their respective trades (2007c).

Socialization

It could be argued that unlike Ford who invested a great deal of effort to socialize his trade school students to the requirements of his labour process, Magna's preference for the internal recruitment of carefully screened apprentices ensures that they enter their training pre-conditioned and socialized to the requirements of Magna's labour process. A central component of this socialization is an acceptance of Magna's discipline and reward structures. Referred to as "carrots and sticks" by Lewchuk and Wells (2006, p.650), these structures reinforce and individualize rewards. For example, they cite pay, bonus, job allocation, and access to training, and promotion as contingent on management determined performance and productivity criteria. The same reward systems are replicated in MTTC. For example, all apprentices are paid while attending the MTTC. In most cases, home plants continue to pay apprentices at a slightly reduced rate while at the centre, however new non-Magna students are paid at a rate of $8.50 per hour (Interview, 2006). In all cases, apprentice wages can increase twice yearly by 50 cents per hour, however increases are contingent on the achievement of established performance targets (Interview, 2006).

The MTTC plays a pivotal role in nurturing and training the next generation of Magna management and can therefore be viewed as a stepping stone to promotion. According to a Magna manager, "the type of training we do very much rounds out an individual, it goes beyond their specific trade area and that individual having all of those additional skills as they get years of experience in the company can be promoted up and they typically will be better managers because they have rounded experience and skills so it also works toward our succession planning efforts" (Interview, 2005). Competent tool and die makers in particular are groomed for promotion. Tool and die workers have been central to the success of the company and constitute a significant presence in Magna corporate management. The three top divisional heads of the Technology Systems Group apprenticed as tool and die makers. According to one Magna corporate manger, "the General Manager of the new China plant will be a toolmaker" (Interview, 2005).

Conclusion

The opening of the Ford Trade School needs to be understood in the context of the difficulty in controlling skilled labour in Ford's first few decades. Skilled workers, especially tool and die, were essential to the implementation of Ford's mass production system. The active engagement of tool and die workers was required to develop, build and maintain the technologies necessary for the production of standardized and interchangeable parts, and was central to the process of deskilling the mass production of automobiles. Whereas Ford could more readily control his production workforce through technological and organizational means, tool and die workers presented a more complex challenge. Ford's reliance on their sophisticated skills and knowledge, translated into workplace power that undermined his control over the toolroom labour process. Workplace power was reinforced by labour market shortages that favoured workers with

these rare skills.

Despite being separated by almost a century, Magna International faces the same pressures as Ford with regard to securing a supply of skilled labour. Although their roles have transformed, skilled workers and tool and die makers in particular are central to Magna's competitive success. Magna has developed a lean oriented manufacturing system that is supported and refined by multi-skilled workers trained in skills that transcend historically demarcated craft lines. At Magna, skilled workers are integral to the design and development of new products, manufacturing technologies, and play a role in the transfer and management of these technologies across Magna's global production chain. Like Ford in the early decades of the 1900s, Magna's skilled workers figure prominently in the firms management succession planning. Concerns over both the supply and the caliber of available skilled workers led Magna to establish the Magna Technical Training Centre to respond to these pressures.

The establishment of trade schools by Ford and Magna represents a multifaceted skilled labour strategy that has a number of objectives that both includes and transcends simple technical considerations. These objectives include securing a stable supply of skilled labour, aligning training to precisely support existing technologies, process refinement, and the development of new manufacturing technologies. However these objectives also include the transfer of non-technical socialization intended to inculcate apprentices with norms and values consistent with a firm's productivity goals. This research suggests that in the cases of Ford and Magna, the cultivation of these qualities among their skilled workers is critical to harnessing their commitment and technical capabilities to the productivity goals of the firm.

While factory trade schools provide a mechanism through which employers can supply their skills needs, they also pose a complex challenge. In order for management to build the internal capacity necessary to support technological innovation among their skilled workers, training must be comprehensive and aimed at the development of deep, broad, and sophisticated technical understanding and manual competency. By doing so however, they become more reliant on these skills, and deepen their vulnerability to the power of workers, particularly in a context of tight labour markets in which these skills are coveted by competitors.

This research suggests that Ford and Magna adopted similar measures to capitalize and protect their investment in the training of skilled workers. In each case, strategic recruitment and selection strategies are geared to the selection of those students deemed most likely to complete their training and stay with the firm upon completion. Secondly, instruction and curriculum are laden with the reproduction of norms and values consistent with firm productivity objectives, supported by reward and discipline structures that reinforce these values. There is ample evidence to suggest that upon completion of their training, skilled workers could expect a degree of workplace accommodation which provides them with relatively higher status, reward, autonomy,

and discretion over their work.

In both firms, the trade school is situated within a broader strategy of union avoidance. Henry Ford's socialization goals extended to undermining the last vestiges of craft unionism in his toolroom, and perhaps addressing growing working class unrest on his factory floors in the early 1900s. Ultimately it was skilled workers who were at the vanguard of industrial unionism in the 1930s suggesting that as a strategy to control skilled labour, automobile industry trade schools were only partially successful. Almost a century later, Magna's skilled workers still hold a privileged, and perhaps, powerful position that continues to be rooted in the sophisticated technical knowledge and manual skills of their trades. This research suggests that the technical training apprentices receive at the Magna Technical Training Centre contributes to Magna's competitive success, and reinforces the privileged position and relative power of skilled workers within Magna's organization. At the time of this research, the role of the Magna Technical Training Centre in supporting Magna's successful union avoidance human resources strategy remains unclear. Also uncertain is the willingness of Magna's skilled workers to leverage their power and prestige to lead the unionization of Magna.

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