Technology, Culture and Change

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By

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To my parents who unselfishly gave me the opportunity to pursue the career I wanted; and to the next generation of scholars, Sarah and Adam, as they pursue theirs.

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PREFACE

I first developed a course that examined the interface between technology and culture seven years ago. As a comparative historical/industrial sociologist I wanted to explore how technological change could be understood as part of a broader socio-cultural and institutional environment rather than just be stories of remarkable innovations or significant entrepreneurial behavior. I also wanted to move away from technological determinist ideas that are pervasive on this subject without minimizing the significance of key events.

By examining the long arc of history, I endeavored to discern how key innovations gradually spread through the broader society—sometimes years after their first introduction. I became intrigued how technological narratives shaped consumer culture, how the workplace was transformed by key innovations, and how worker identity changed because of this restructuring. I also wanted to see how globalization in the twentieth century, with reinvigorated trade and commercial relationships between wealthy and emerging economies, simultaneously encouraged material consumption in rich countries but also led to unemployment for many unskilled workers there whose jobs had been displaced following outsourcing. The cultural ramifications of this trend have proved alarming, giving rise in recent years to a resurgent nationalism and populism in several countries. The implications of this political trend have been consequential, with growing concerns over a possible erosion of democratic principles.

Teaching this course over the years has given me a chance to analyze a broad range of issues, from the introduction of general purposes technologies such as electricity and the internal combustion engine, to the reorganization of workplaces. I have examined how movements in the visual arts and architecture responded to many of the disruptions and innovations of the past two hundred years; some embracing change with enthusiastic fervor whilst others lamented the lost past of a presumed idyllic pre-industrial age. I have looked at how our identities have become less constrained by hierarchical class structures and are now flexible and for many in a constant state of re-invention. The ideology of material consumption has both driven economic growth in many countries as well as providing people with standards of living hitherto unknown for such a large

percent of the population. We are healthier than ever before and live longer. But we remain exposed to pandemics and disease. Furthermore, in recent decades growing inequality in what is increasingly a knowledge economy, between those who are well educated and those who are not, has resulted in more pervasive cultural tensions. We have technological tools at our fingertips that improve how we function on an everyday basis. And yet for many, such gains might pale in comparison to what they experience as a loss of self-worth. Whether the current round of new technologies such as Artificial Intelligence will dissipate these concerns or accentuate them, remains uncertain.

I have taught this course every other year and, in each instance, have benefitted from the opportunity of having a group of intelligent students with whom I can discuss these ideas. I appreciate the candor of their opinions and have learned much from a younger generation that is far more tech savvy than I will ever be. Two years ago, I decided the time had come to put many of these ideas on paper and thus this book gradually emerged.

Many of the topics that I discuss in the book are ones that are currently under debate; some heavily controversial whilst other remain largely speculative ruminations on what might occur. As one might imagine, such topics frequently come up in general conversations with friends who have asked me what I am writing about and then proffer suggestions, comments, and sometimes trenchant critiques. They have occurred so frequently over the past years whilst I have been writing this book it is difficult to identify a particular idea or suggested path of investigation. I am extremely grateful for their insights and willingness to share thoughts and have learned much from these people. The following figure prominently in this list: Bill Harlan, Russ Weiss, Dan Petroski, Doug Shafer, Catherine Craig, Steve Rice, John Wise, Ned Williams, MJ Anderson, Andrew Nixon, Cindy Taplin, Roger and Julia Cornish, Christopher Dandeker, Colin Graham, Alan Ward, Arne Kalleberg and Amanda Koontz. My frequent co-author and friend Jonathan Winterton has always been a great source of inspiration and a veritable font of knowledge on changing workforce practices. Immense gratitude to Brad Zabel and Denzil Strickland for explaining the intricacies and subtlety with which the marketing industry shapes consumer culture—together over the years we have had many fascinating conversations about contemporary culture; thanks also to textile technology expert Ann Mathews who helped me comprehend many of the technical details surrounding recent innovation in textiles and apparel.

Colleagues and friends at Wake Forest have also been very supportive of this project, with many dinner or office conversations that have made me re-think some of my presuppositions. Thanks to the following: Ellen Miller for reading many of the chapters and making incisive comments, Page West for helping me better comprehend firm strategic initiatives, Rogan Kersh, Charles and Paula Iacovou, Saylor Breckenridge, Clay Hipp, David Taylor, Joseph Soares, Kline Harrison, Yaohua Shiy, Rob Hellier, Simone Caron, Ana Wahl. The late David Coates was a dear friend from whom I learned much whether solving the world's problems during games of golf or in his encouragement to think through ideas carefully. He also encouraged me to write books and I am thankful for this endorsement of my capabilities. He was a true Renaissance scholar and I miss my many conversations with him.

A version of chapter 9 was presented to the Centre for Employment Relations, Innovation and Change at Leeds University Business School and I am appreciative of the many useful comments made by the Centre's researchers during and after that presentation.

CHAPTER ONE

INTRODUCTION

When I was a child, growing up in southern England, my grandfather would make frequent visits to our house. He was in his late 80s and my father would collect him from his home so he could come and spend the day working in our garden. He decided largely what needed doing and would patiently and diligently set about his tasks, apparently indifferent to whatever my parents suggested might need attention. Despite their occasional grumbling, I think they were happy to give him the opportunity to do something that pleased him and made him feel valuable. To my joy, he would occasionally dig up artifacts such as Roman coins as well as other detritus from centuries past. The coins were duly dispatched to the local museum, but I recall at even my early age how curious it was that people, thousands of years ago, had similar monetary objects to us that were used to buy things. I cannot claim to have pondered deeply the significance of early market economies, but it did fascinate me that not much had changed over the centuries. Transactions were structured and rendered predictable in early societies, presumably in much the same way that occurs today.

Some years later, living in Lincolnshire, I befriended an archeologist who was working on several Roman digs in the area. One day he came to see me and brought an example of a nail that he had found – one of many in a row that at one stage had been used with wood. The wood had long since disappeared, but apart from some rust, the iron nail was remarkably well preserved. He estimated it was from around 55 AD and part of a villa on the site. As one can see from the image below, nothing much has altered in the design of a nail over the past 2000 years!

Fig.1.1 Roman nail

Author's photograph

A nail is a rather simple technological device whose essential function has not changed since its introduction even if its composition has altered. Stainless steel now replaces iron and overall durability might be better but as an effective 'bonding' mechanism, the nail remains, as ever, a crucial part of any construction project or home repair. Yet despite its longstanding utility, it retains a *de minimis* status as a mere commodity, belying its functional importance. We no longer see it as a remarkable technological tool and perhaps its cheapness is part of its ubiquity. However, when first introduced one can only imagine the pleasure that arose; now a product allowed wooden items to be secured without mortice and tenon joints and the requisite carpentry skills this entailed. The nail proved to be a simple and enduring innovation, providing almost anyone with a hammer (also a revised technological tool) and reasonable hand/eye coordination, the opportunity to easily attach wooden objects. As a skilled occupation, carpentry continues to exist but as anyone who has done home repair can testify, one can often get by without recourse to a professional carpenter. A simple implement changed the ways we do things as well as the need for specialist skills. Perhaps this is an early example of de-skilling— an ongoing process that has affected much of technological innovation over the ages.[1]

Other basic innovations have had similar widespread repercussions. For example, the simple stirrup, even in its basic wooden form, transformed key aspects of warfare more than a millennium ago. Its origins are unknown, but its early usage allowed soldiers to stay upright and mounted on horses during battle as well as ride long distances. When armored medieval knights

went into battle on horseback, the stirrup gave them much needed stability and improved their fighting effectiveness over that of foot soldiers. However, one of the best-known exponents of this basic technology was Genghis Khan. Even after his death in 1227, his horsemen continued to terrorize much of Asia and Eastern Europe. By 1241, these armies, by then using metal stirrups, had effectively laid claim to the largest consolidated land empire in history.[2]

Fig. 1-2 Mongolian stirrup

Author's photograph

The stirrup was a simple metal device, attached to the horse via a leather strap at the top and with a rounded base for the rider's feet. It allowed a rider to remain centered and upright on a horse and dramatically improved his

maneuverability in battle. He could easily discharge arrows at enemies in any direction including when riding away from them. Twisting and turning in their saddles these riders presented a formidable mobile force, attacking with speed and then retreating with considerable dexterity.

Yet another simple device, with far more peaceable implications and introduced centuries later, was the zipper. Although people have worn clothes for millennia, the zipper was a product of the industrial revolution and thus a rather late functional solution to sartorial necessity. Previously, clothing was secured with loops and toggles, sometimes buckles and broaches. Early paintings often show garments simply tied or laced together. Buttons were used but this required an overlap in the garment and even though there is evidence of buttons 5000 years ago in what is now Pakistan, it was not clear whether there were button holes to accompany them, suggesting that they might in fact been merely decorative items.[3] When the hook and eye was introduced in 14th century Britain, it removed the necessity of clothing overlap, but the virtue of their smallness in size and reliability was offset by their awkwardness in fastening. Notwithstanding such difficulty, they gradually became more pervasive because of their overall effectiveness in fastening clothing. Perhaps since many early users had the luxury of someone else fastening it for them, this probably also eased the acceptance. Today the hook and eye remains pervasive in bras as well as being a point-to-point fastener at the top of the back of women's dresses.[4]

When the American Whitcomb Juds introduced the first zippers in 1893, they were based on the use of a glide to pull together a line of hooks and eyes. Unfortunately, such an arrangement was not reliably secure as the zip came apart quite frequently. The eventual solution to this durability problem was found by a Swedish immigrant engineer named Gideon Sundback. He replaced the hook and eye system with a metal tooth and socket system; two parallel rows secured together by a puller mechanism. He secured his patent for the product in 1914 and the contemporary zipper that we are familiar with today entered the marketplace of clothing attachments.

Widespread adoption of the zipper, however, did not occur until World War I when the US Navy put them in aviator jackets and then BF Goodrich installed zips on their rubber galoshes.[5] Avant-garde dressmakers soon followed and then the zip became widely used in mass-market garments. Yet even then, it was not always a smooth transition towards acceptance. Aside from concern over the performance flaws of early models, cultural opposition dampened enthusiasm for zips. Many realized that if the product

made it easier to secure clothing, it could facilitate unwarranted entry into or easy removal of clothing. No more grappling with complicated ties and fasteners; clothes could now be quickly unzipped. Functionality now acquired a sexual dimension as the more censorious elements in society viewed zips as emblematic of a path towards depravity and debauchery. It might encourage licentious behavior and certainly undermine basic precepts of morality. Not for the first-time technological innovation collided with cultural norms. What started out as a technical innovation that aided putting on clothes, was mired in a socio-cultural controversy because it meant people could now have their clothing removed more easily. In this instance, technology and culture were not happily marching hand in hand and this was certainly not the first time that a new object with evident benefits was seen through the lens of stimulating the questionable behavior by segments of society.

For technology to become embedded in society and culture it must transcend the allure of mere functionality. Arguably, the eventual acceptance of zippers was a triumph of practical efficiency over morality. But it remains a cautionary tale over the potential impediments to technological innovation when such change runs counter to established practices or normative constraints. What might be intuitively beneficial for some can cause concern for others and even outright opposition for some. Moral uncertainty over change is perhaps not surprising; trenchant resistance even more so if vested interests are challenged. Not surprisingly, the path to acceptance for new technology is often fraught with controversy. In some cases, innovation comes at the expense of jobs, in which case it might be vigorously opposed by those whose livelihoods are threatened. At the same time, it might be welcomed by those for whom it is beneficial. For as historian Rudi Volti argues, the Pony Express lost most of its customers following the introduction of the telegraph as the latter rendered the former obsolete.[6] This was good news for those who benefitted from easier and less expensive communication but alarming for the Pony Express Company and its many riders. Presumably, one might view the telegraph as a subversive force, the destructive effects of which were seen in one industry's decline. On the other hand, it clearly was an invention that reaped a multitude of benefits for economic growth and had a multiplier effect on the efficiency of other industries such as the railways. Without easy communication via telegraph, trains running largely on single track would have encountered logistical problems if they were to avoid collisions. Timetabling was crucial but so was the ability to confirm a train's location on a particular section of track.

There are other cases when new tools might render a radically different worldview. In such instances when established practices are challenged, they can be met with trenchant resistance. One can witness this in Galileo's struggle with the Vatican when he had the audacity to suggest an alternate way of viewing the heavens and universe that was grounded in a newly emerging scientific ideology.

In 1609, Galileo developed an enhanced refracting device that enabled him to see the planets in much greater detail than ever before.[7] Specifically his new telescope allowed him to test theories through observation and experimentation, which eventually led to him challenging traditional theological doctrines of planetary behavior. By refuting the claim of an earth-based planetary system based on the Aristotelian geocentric view widely accepted by the church and substituting it with a helio-centric one, he incurred the wrath of the prevailing religious orthodoxy. His argument for a Copernican planetary system in which the sun was the central force rather than the earth represented a fundamental ideological challenge to established theology. Even though Biblical interpretations of the earth's centrality were loose, they were deemed adequate to satisfy the church's teachings. Copernican ideas suggesting an alternative reality had lingered around the periphery of established thought but were never seen as sufficiently resolute to challenge clerical dogma. Galileo's persistent advocacy of his findings, however, publicly challenged the compatibility of these two viewpoints. His telescope, as philosopher Robert Crease argues, was a real threat to church authorities "not because its discoveries ran counter to moral doctrines, but because it showed that these authorities did not know what they were talking about."[8] When you did the mathematics, it was clear that Copernican ideas were incontrovertible. Not surprisingly, established doctrines became more tenuous the more Copernican ideas took center stage.

The eventual problem for Galileo was that his advocacy of Copernican thought didn't merely suggest a different way of viewing the heavens, it fundamentally challenged the Church's authority to interpret the Bible. This was a challenge on a different order of magnitude and is when he got into serious trouble. By 1615, his attempts to reconcile his findings with supposed Biblical authority were foundering, notwithstanding his convoluted arguments about scientific credibility and its juxtaposition against theological orthodoxy. In the end his ideas proved too provocative for the Church, particularly his firm belief in Copernican thought as grounded in empirical reality rather than as speculative. Religious thinking was somewhat fungible but only insofar as alternative realities were not

thrust into the center of public discourse. Galileo's persistent claims for his scientific approach directly challenged the Church's position, which he viewed as grounded superstition. This stance finally earned him the ire of Church authorities and in 1616 he was sentenced to house arrest.[9] Eventually his ideas would enter the mainstream and his pursuit of scientific investigation as the study of reality would supplant superstition. Alas, he would not live to see the dawn of this new scientific day.

From invention to innovation

When considering the etiology of technological innovation, it is easy to embrace a form of technological determinism in chronicling change. But to do so disguises as well as distorts the complicated process of acceptance and rejection of change as well as the multifaceted dynamics of implementation. It is important to note that invention does not always entail or result in innovation, even though the above cases illustrate such a trend. There are presumably many new things that are invented but few are developed in such a way to dramatically transform how something is done. For innovation to occur one looks beyond mere inventiveness (possibly the introduction of a new product) to focus upon a radically different process or way of doing something.[10] Furthermore, new ideas that lead to a particular invention might not always be appropriated into the mainstream in a transformative way. When invention does lead to innovation the latter's importance comes when it leads to the creation of value, even if it is a commonplace "everyday improvement that makes the complicated a bit simpler or the expensive more affordable".[11] A better way of doing something can be just as important as a new product. If product change occurs via a radically different way of producing it, then innovation becomes *sui generis*.

Josiah Wedgwood was a product innovator as well as a person who transformed the way work in an eighteenth century English pottery was organized. The Chinese had dominated the European market for quality porcelain with local manufacturers unable to match their techniques. But the products were expensive and thus restricted to the wealthy. However, the growing industrial classes during the Industrial Revolution had lofty aspirations and an increased material wellbeing and thus were a perfect market for affordable ceramics if only someone could produce them. It was this new market that Wedgwood catered to as he developed not just new glazes, colors and designs but also ways of organizing work around specialists who performed specific parts of the production process.[12]

Hitherto ceramic work was artisanal, and one worker produced an entire product. In his new Staffordshire factory, Etruria, Wedgwood introduced a division of labor that enhanced the efficiency of production through economies of scale. He trained and paid his workers more than the prevailing rate and created a workplace that was considerably cleaner and safer than that of other factories. He was obsessed with quality and was one of the first to put his name on his products, part of an elaborate marketing scheme in which he named various collections after royalty as well as designing certain collections specifically for them.[13]

Wedgwood's ceramic innovations were remarkable, both the products with their quality and design features, as well as the process whereby they were manufactured. He never attempted to be the cheapest producer; in fact, he eschewed the price cutting that was frequent in the pottery industry, preferring to emphasize the quality of his products and his constant search for improvement in that quality.[14] He was also prescient enough to recognize the growing material wellbeing of the industrial classes and as consumers their desire for affordable, quality dinner ware that catered to their new tea and coffee drinking and hot chocolate consuming tastes. He demonstrated that pottery need not be the crude, functional items for storing that was typical in households. He offered them instead stylish goods that catered to their aspirations and sophistication. In other words, he successfully tapped into the growing wealth and size of the eighteenth-century population who were becoming enthusiastic consumers of manufactured goods. Finally, he did much of this whilst collaborating with like-minded innovative friends with whom he shared ideas and a vision of a transformed industrial landscape in the central Midlands of England. These friends included visionaries such as Matthew Boulton, James Watt and Erasmus Darwin who were leaders in the arts and science during that period.[15] This was an example of an innovative industrial cluster, where firms simultaneously compete and collaborate whilst sharing infrastructural features in the broader institutional environment. Such networks were the final piece of Wedgwood's successful puzzle; he made new products in new ways to cater to new groups of consumers in a regional setting that proved supportive of inter-related innovations. As Dodgson and Gann succinctly note, "The way Wedgwood merged technological and market opportunities, art and manufacturing, creativity and commerce, is, perhaps, his most profound lesson for us".[16] Chapter 2 provides examples of the key innovations associated with industrial growth.

There are other important cases when a basic invention leads to innovation that is widely transformative, yet the impetus for change might lie in an

alternative direction. An individual might have the foresight to recognize the market potential of a product that serves an extant need but in ways that conventional thinking might not grasp. Such a person was Henry Ford. He developed a product and then set about convincing people that they should have it. He famously said that if he had asked people what they wanted at the beginning of the 20th century it would have been "a faster horse". And this despite the noise and dung of horse-drawn vehicles that filled the streets of the growing cities. Wedgwood was a pioneer in product design but also masterful in marketing; he understood what people might want and catered precisely to that desire. Ford meanwhile anticipated a desire for an entirely new product if he could bring it to consumers at an affordable price. He did this through an innovative production process as well as pioneering the use of a product that had been restricted to the wealthy and its use severely restricted by the lack of suitable roads.

Sometimes new technology emerges not because people want such a product but because an individual comes up with an innovative idea that he/she believes would be widely useful. Resistance to such innovation can be strong. Inertia is often pervasive amongst people even as they recognize certain inefficiencies but lack the vision to contemplate an entirely new way of doing something. The inventor presumes the potential benefit of the new or modified product even if the general population lacks such foresight. Henry Ford was a case in point.

When Ford started tinkering with his early cars, the technology behind the internal combustion engine was not new. In fact, there was a plethora of automobile companies making vehicles at the turn of century. However, they were expensive and thus more of a novelty than a mode of transportation. Ford's genius was to recognize that this technology when combined with process innovations and a new organizational framework, specifically the assembly line,[17] could simultaneously increase the volume of output and dramatically lower product costs. Such economies of scale led to costs savings that were passed on to consumers who hitherto would not have even thought of owning a car. Like Wedgwood, he was prescient in recognizing a potential customer base for his product. He was also taking advantage of growing prosperity at the turn of the century following sustained economic growth and industrial development. More material goods than ever before were available to a broader segment of the population and consumption habits were changing. People, especially in the United States, embraced consumerism as part of a heightened self confidence borne of a belief in the inevitability of progress. Rapidly disappearing was the ethic of frugality that was inevitable in an era of low

incomes and scarcity. Consumerism had become more *de rigueur* and was seen as not only as a mark of success but also normative for an aspiring middle-class citizen.

With his iconic Model T, Ford was able to shape public opinion away from extant products and embrace an innovative and eminently affordable concept. Furthermore, by paying his workers a higher than prevailing wage, often out of necessity to avoid high rates of absenteeism and turnover, he put money into the pockets of his potential customers. His process innovations transformed worker productivity and his high wages ensured a customer base for his final product. It was as if he simultaneously created the supply and demand for his product. The automobile was a technological product whose utility was magnified through innovations in the way things were made that dramatically lowered costs. It changed how work was structured and lessened the need for skilled workers. It also transformed the layout of urban areas, spawned suburban growth, enhanced leisure activities and gave people of most walks of life an opportunity for mobility that would expand their mental as well as geographic horizons. The automobile proved to have lasting cultural significance beyond that of a means of transportation. Culturally, this was revolutionary, and I will discuss this in more detail in Chapter 3.

Having the requisite demand for a product is crucial, with cost often being an initial impediment in many new product offerings. Throughout the early 20th century many new appliances were introduced but it often took time for them to be fully absorbed into households because of their initial expense. A more recent example of this imbalance was the microwave oven. Introduced in 1965, it did not become widely accepted until the 1980s when prices fell significantly. Its utility was never really questioned, but its affordability was an obstacle to its acceptance.

Another product whose introduction around simple functionality had less far-reaching but nonetheless significant cultural resonance was Levi Strauss's rivet. When Levi Strauss took out a patent on his rivet design called XX in 1873, his aim was to use copper rivets used in his horse blankets and transform them into a functionally efficient way of securing denim fabric for miners. His family's East Coast dry-goods business had been interested in expanding into West Coast markets with their blankets, cloth and hardy work pants. When he applied the rivets as an improved way of fastening pocket openings to his line of denim, he found an instant client base amongst miners and laborers who valued durability. Little did he know

that a hundred years later that same denim garment would become a fashion item for people who had never performed a day of paid manual labor.

His product was copied by numerous other manufacturers over the decades, and jeans eventually acquired a multi-purpose functionality that transcended their early usage. The crossover into fashion from utilitarian function was part of a gradual sartorial trend that encapsulated lifestyle changes and the adoption of more casual attire. Denim jeans went from durable work wear to an everyday fashion item, assuming almost iconic status from the 1960s onwards. No longer denoting manual occupations or lower socioeconomic status, jeans could now be worn at work and play even by the rich and famous.

The ultimate success of jeans centered on a variegated marketing strategy that at times invoked the glory of the American West and the hyper-masculinity of cowboys. When cultural changes rendered dresses less sartorially *de rigueur* for women, marketers soon switched their campaigns to a female audience to demonstrate how jeans could display overt sexuality and denim subsequently acquired *de facto* designer status. Jeans were also a counter cultural symbol as well as associated with American imperialism. In other words, they could cover a wide range of usages and symbolic values. They could allow you to be what you want to be by simply wearing a pair of jeans.[18] As historian James Sullivan aptly noted, the product has provoked outrage as well as adoration.[19] What started as a simple rivet fastening device eventually became ubiquitous in the garments it secured.

Yet even denim's time as a 'go to product' for young people waned in the last decade as synthetic materials known as leggings, initially designed as 'work-out' clothes for the gym, became an omnipresent item on college campuses and then elsewhere. Leggings are *de rigueur* for young fashionistas. Canadian sportswear company Lululemon built a successful brand around precisely such products: ultra-breathable, fast drying, stretchy fabrics that allowed you to be cool as well as look cool when exercising. Leggings were a technical breakthrough and a departure from the moisture absorbing cotton or the tyranny of much maligned polyester (in its earlier guises). Given their success as sporting attire, many people felt such outfits could be worn on many other occasions. Why restrict such clothing to the confines of sporting activity when their comfort and stylistic features permitted widespread everyday use? Like denim, leggings would transcend their initial functionality and find mainstream utility as an everyday clothing item. Adopted widely across socio-economic groups, their original utility became subsumed under the broader panoply of everyday fashion. As in the

past, a product developed for a specific use, crossed over to a more mainstream functionality. In doing so, it assumed a broad cultural significance that resonated beyond its technical specificity.

Consumer embrace of such a product is indicative of just how fashions change through appropriation and adoption as well as a result of informal and *de facto* 'influencers' pronouncements on their stylistic significance. As with many other clothing items, the referential success derives from the fluent identities that 21st century consumer's nurture.[20] Freed from the constraints of fixed statuses, the new consumer can create their own authentic identity and typically use clothing to maneuver the vicissitudes of daily social life. Functionality assumes many facets, the more so because of fashion's fickle collective persona. So called 'Fast Fashion' firms, the most notably of which today is the Spanish company Zara, have been adept at meeting and shaping this new consumer demand, introducing process changes that provide an almost constant supply of new styles at affordable prices.[21] As with Henry Ford a century earlier, whose process innovations lowered overall costs and fostered the growth of the automobile market, Zara repositioned stylish fashion as an attainable everyday product. By constantly tapping into the latest trends and then quickly bringing to market finished clothing that typified such trends, the company is at the forefront of affordable style—the epitome of fast fashion. Technological and organizational innovation, from design implementation to supply chain logistics, and rigorous control of overheads to keep costs down, transformed the way fashion could become accessible to the masses.

Is technological change necessarily good?

Technological innovation is for some seen as a paean for progress, wrapped up in the vertiginous ark of economic development. When looking back over history, it is easy to retrospectively identify key innovations that clearly transformed life. The steam engine, developed by Thomas Newcomen in 1715 for use in English coal mines as a way of pumping out water, was the cutting-edge technology of the day. Yet it was notoriously unreliable and consumed a prodigious amount of fuel.[22] James Watts' subsequent modification in the 1760s improved its pumping efficiency and was part of a broader effort to organize technological change by spreading the cost of experimentation amongst potential users.[23] This cooperation was crucial for managing R & D costs for what were expensive machines. When Watt partnered with Matthew Boulton to build rotary engines to power machinery in cotton mills, they assiduously courted mill owners and even invested in

the early steam powered factories such as the Albion Mill in Manchester in 1784, as a way of promoting their machinery.[24] Such technology soon passed to other establishments and by the late 1790s, mills such as Ancoats mill (pictured below) were renowned for their size and use of steam power. Built adjacent to the Rochdale canal – itself a technological innovation from the 1760s designed to transport goods more easily to the growing number of mills – Ancoats mill was part of a burgeoning industrial district central to Manchester's rapid commercial growth.

Fig. 1-3 Ancoats Mill, Manchester

Author's photograph

But these events are just part of the story of clothing which has often been at the forefront of change since early humans transitioned from the use of hides to fabric. Whether it was the introduction of labor-saving machines of the sort noted above which in part derived from the need for thread, to the origins of chemistry which developed following the search for more durable dies than those provided by vegetables, the story of textiles is, as historian Virginia Postrel argues, the story of human ingenuity.[25] Weaving and cloth making, developing new forms of fiber and organizing pattern making have all been crucial aspects of textile history. They enabled early humans to find protection against the elements as well as offering adornment that could

distinguish groups from each other. Along the way, innovations in spinning dramatically transformed otherwise labor-intensive activities. Again, as Postrel notes, "cloth making is a creative act, analogous to other creative acts. It is a sign of mastery and refinement."[26]

There is a tendency to somewhat privilege England and the industrial revolution as the arbiter of textile technology and innovation during the early industrial revolution. However, it is important to note that basic production changes such as new technology, standardization and worker control were present in Piedmontese silk mills in northern Italy in the late 1600s. Silk was a luxury item of clothing and finding ways to manufacture it in the quantities needed to satisfy a growing wealthy merchant class was the impetus behind experiments and then manufacturing innovation in this region. Prior to these changes, cottage industry production akin to that which existed in much of Europe, including England, was the norm. But it was in the Piedmont that water mills and skilled workers produced silk thread that was the vital part of increased output. Water powered machines filled up to a thousand spindles with the oversight of a mere 2 or 3 workers – quite a contrast to a single spindle of thread thrown by a worker working by hand in a 12-hour day.[27] Technology and work organizational transformations combined to revolutionize a niche industry. When similarly organized and powered factories developed in England a century later, they propelled the country into the industrial revolution but in this case with a commodity product of cotton.

As steam power replaced water to drive machinery, by the beginning of the 19th century, it not only transformed the productive efficiency of such factories but also radically changed the way work was structured and organized. Such innovations were eventually recognized as labor saving, but this very function cast some doubt over the desirability of technological change. As economic historian Joel Mokyr has argued, an implicit acceptance of technological progress had been contingent on the belief of its pervasive benevolence and a victory over the forces of inertia.[28] Yet if actual jobs were lost, it cast such optimism in a more skeptical light; what even David Ricardo saw as potentially "being injurious to the laboring classes".[29] This eventually proved a rallying cry for Romantics and socialists, plus the laboring Luddites, who not only worried about the displacement of skilled artisans by machines, but also the suffering of those workers who continued to work in smoky factories.

By the mid-nineteenth century in England, social, political, and technological upheavals associated with the Industrial Revolution had

resulted in overcrowded urban areas, soot filled air following factory growth and the burgeoning networks of railways, plus growing unrest amongst a working class whose already precarious socio-economic situation had become ever more fraught. In the United States, post-Civil War Reconstruction brought industrialization and urbanization plus waves of immigration. Dirt and disease in the overcrowded cities were often accompanied by increased crime. For many white Americans who were uneasy about the rapid changes, there was a longing for what they remembered as simpler times. Many yearned nostalgically for the Jeffersonian simplicity of artisanal craftwork and small-scale agriculture – both of which were seen as crucial components of the socio-political culture of an emerging nation. Similarly in England, industrialization confounded those who presumed an arc of progress would result in an overall improvement of life.

In both countries one can find in art an expression of these concerns. Winslow Homer painted tranquil rural scenes, evocative of a pre-industrial past. Rural serenity and an Arcadian simplicity captured the mood of many Americans who had feet in both worlds – agricultural and factory mills. The wages from the latter did not dissipate the nostalgia and longing for the past. In England meanwhile, JMW Turner determinedly revealed the contradictions inherent in a technologically transformed society – some landscapes overtly realistic and pastoral in their ethereal theme whilst other paintings displayed the confusion, uncertainty and moral ambiguity of a rapidly changing society. His latter impressionistic canvases harkened the brutalism of industrialism, albeit with a vivid brightness and celebration of light that almost mitigated the deleterious conditions. And fellow English artist John Martin added an apocalyptic vision of industrial societies' descent into a grim and tortured inferno. Across the channel in Paris, Impressionistic painters captured the malaise of city life, with depictions of alienation, loneliness, and anxiety.[30] Cities were clearly not nice places to live and for many they were the harbinger of the gloom and doom associated with industrialization. But they continued to draw people from rural areas in search of work opportunities and even excitement that was conspicuously absent in the countryside. Artists' more privileged position gave them license to interpret urban and industrial malaise; workers in turn would take to the streets to protest.

Other artists and writers in England were more cogent in their critique of what was increasingly seen as the degradation and dehumanization of factory work. William Morris was determined to restore not just craftsmanship but the dignified individualism that accompanied artisanal

labor. Albeit couched in a neo-romantic revival of aesthetic beauty, he wanted to show, as historian Lucy Hartley noted, "how the decorative arts can be promoted as the collective '*means*' of reforming the arts and why working are the individuals '*who*' must be rouse to desire beauty as both intellectual and creative property".[31] Morris was the prophet of craftsmanship which he saw as the means to restore the essentialism of decorative arts. Such a movement became the moral imperative to counter the material excesses of industrial life and the presumed degradation that accompanied a growing consumerism. Beauty and happiness would be the inevitable outcome of a rededication to the decorative arts, and a rediscovered individualism, the salve of working-class morals. His overt socialism placed emphasis on human agency; his Pre-Raphaelite contemporaries were less concerned with political rhetoric than a rediscovery of an Arcadian pre-industrial society replete with languid women floating down streams in almost mythic Arthurian landscapes. Other late nineteenth century writers such as John Ruskin held similar views about the need to unfetter culture from modern civilization by restoring beauty as the crucial counterpart to nobility and negating the alienating conditions of industrial capital.[32]

Art provides a window into the cultural contradictions that were seen by many as the insidious side effects of industrialism and capitalism and will be discussed extensively in Chapter 5. But several decades later, other artists embraced technology, occasionally even glorifying the presumed progress that it engendered. For many in the early twentieth century, the city and industrial society was viewed as a positive force for change; the embodiment of the beneficial aspects of progress. Speed, newness, mechanization, and efficiency were viewed as paragons of a new industrial age – a mechanistic utopia that confounded earlier critics. And then World War I unleashed the horrors of industrialized warfare, the mechanization of slaughter on an unprecedented scale. Artists, many of whom served in the trenches, found ways of expressing the futility of their experiences with visual depictions of what technology does to human bodies. It was a grim reminder of another type of efficiency that was far less beneficial to human progress.

I use artistic expression as a window into culture and the lens through which critics as well as apostles of change offer their differing perspectives on technology's impact on society. Throughout the ages artists have captured and reflected social trends. Some provide imagery designed to accentuate the consequences of socio-economic change; others seek to question dominant ideologies and conventions. Whatever the stance, they can tell us

much about how culturally groups in society are reacting to technological change. For some, change is seen in a sanguine light whilst for others there is less certainty. Such contradictory sentiments continue to this day following increased automation and the possibility that new technology can do both harm and good.

The long arc of historical progress

Notwithstanding the above reservations, there has always been a tendency to assume that progress is an inevitable part of societal evolution. Technology's role in this process has been part of a cultural framework in which rationality is crucial to human attempts to control their environment.[33] Humans have historically sought to organize, structure and improve their overall lot and used technology to augment this ongoing process. They have often done this in a purposive manner, attempting to objectively discern ways of analyzing problems and seek appropriate solutions. Certain societies have been more likely to embrace this analytical framework and not surprisingly it is those societies that have often been in the forefront of innovation and development. Such constant searching for ways of improving life institutionalized inventiveness and augmented a belief in the inevitability of progress. As Volti argues, "A society imbued with a rational ethos is dynamic and essentially optimistic, and it exhibits the confidence necessary to alter existing ways of doing things in order to gain particular benefits".[34]

Enlightenment thought eagerly and enthusiastically embraced the diffusion of ideas to combat superstition and the irrationalism of religious hegemony. Baconian science had elevated data and systematic investigation of empirical sources and an emerging culture of innovation had embraced the idea of rationality to test new ideas.[35] Competitive markets were seen as vehicles to facilitate economic development but also enable individual self-improvement. This implied that progress would be beneficial to all, or at least those willing to take control over their own destinies. Superstition was relegated to the back burner as a more optimistic view of human agency residing in an individual's own disposition meant people could take advantage of the changes that were occurring in the socio-economic realm. Self-improvement became the *sine qua non* of economic progress. Perhaps not surprisingly, when new factory jobs entailed what appeared to be a dehumanizing work environment or even resulted in job losses, the confidence in technological progress became more muted.

Absent the alacrity that accompanied some of these early innovations, the embrace of technology nonetheless proved too powerful for the naysayers to resist. Furthermore, political, and institutional developments typically formed the supportive context for inventions to become actual innovations. This is what was happening in 17th and 18th century England, where such a supportive environment sustained the cultural context for the germination of such technological developments.[36] It was there, and not China, that inventions gained widespread usage. In China, much earlier introduction of products such as gunpowder and the printing press had presaged what might have been a fundamental restructuring of society yet dissipated under the oppressive weight of a cautionary, insular, and authoritarian regime. In England reactionary forces held less sway. For it was in England that even religious leaders believed in a rational Deity that wanted people to advance economically and technological change was clearly a way that facilitated this.[37]

We see many of these changes emerging by mid nineteenth century England when mechanization enabled a more efficient use of muscle and brain power. Steam power had dramatically increased labor productivity in textile mills; between 1750 and 1800 a cotton spinner's productivity increased by 200 percent.[38] Other industries such as the railways and steam ships followed suit, eventually followed by electricity as both a light source and communication and then the electric motor. All of these involved a transformation in the way work was organized and, in many cases, a dramatic increase in the number of hours worked. Wage labor replaced self-employment. Work became a place where one went to at the start of the day (sometimes as early as 6 am until 6 pm, 6 days a week), laboring under established terms and conditions that were monitored, for a wage that was pre-determined and in an environment that lacked the intimacy and casualness of self-employment. Such changes built upon what many have referred to as an earlier *industrious revolution* – the growth of total household participation in work for pay that resulted in an increase in consumption. For example, historian Jan De Vries noted how many 17th century peasant families in northern Europe used women and children in the family to produce more food for sale, thus enabling more consumption.[39] This runs counter to arguments regarding peasant societies' desire to maximize leisure time and in many respects presages the growth of consumerism that accompanied wage labor. These developments constituted a significant cultural change within the family and marks the beginning of lifestyle changes that would be accentuated with industrialism. But industrialization went hand in hand with urbanization and the growth of