STUDY OF REASONS FOR THE ADOPTION OF LEAN PRODUCTION IN THE AUTOMOBILE INDUSTRY: QUESTIONS FOR THE AEC INDUSTRIES

Scott Featherston[1]

ABSTRACT

The primary intent of this paper is to raise questions concerning broader forces that, as advocates of lean construction, we should consider as we develop and refine our model of production for the AEC industries. The adoption of an alternative production system is a major strategic decision for any organisation, let alone one that might exist in the complicated and complex AEC industry. As advocates of an alternative to existing methods, it is incumbent upon us to understand the strategic imperatives which organisations face.

KEY WORDS

Lean production, strategic environment, lean construction

[1] Project Manager, Lend Lease, Level 7 Australia Square, Sydney 2000, Australia, +61 (2) 9518 8022, fax: +61 (2) 9518 8122, scott_featherstone@lendlease.com.au

INTRODUCTION

As exponents of the need for radical renewal in the AEC industries, particularly in that we advocate "lean construction" as the appropriate model for the future, we often cite the revolutionary gains that lean production brought to the car industry to support our arguments. What we often overlook however, are the forces that led car manufacturers to adopt lean production, and whether these same pressures exist in the AEC industries. Why for instance, did car manufacturers discard mass production, a system of production that had been remarkably successful since its inception in 1913, and invest billions of dollars in opting for an alternative? Were there pressures that gave automobile producers no option but to alter their methods of manufacture? If so, what were they? Were there other alternatives that car manufacturers might have considered?

The primary intent of this paper is to raise questions concerning broader forces that, as advocates of lean construction, we should consider as we develop and refine our model of production for the AEC industries. The adoption of an alternative production system is a major strategic decision for any organisation, let alone one that might exist in the complicated and complex AEC industry. As advocates of an alternative to existing methods, it is incumbent upon us to understand the strategic imperatives which organisations face. This is important for two reasons. First, change will not occur unless its implementation is seen as desirable - and desirability is often dictated by the surrounding strategic environment. And second, it is the impositions of that environment which often dictates the form and shape of that which is changed.

CURRENT DIVIDE

Before moving to look at the specifics of change in the car industry though, it is worth understanding the broader environment within which these changes have occurred. In the affairs of humanity, dramatic change has occurred over the past two decades, and continues apace today. These changes are so overarching, so pervasive, that their influence transcends borders, religions and industries.

A free and global economy is emerging. Knowledge has replaced tangible goods as the primary commodity of most economies. Ideology, in the political sense, is mostly dormant in the wake of the collapse of communism. The influence of government is diminishing. Developing economies are rapidly accumulating wealth. Women and minority groups are increasingly afforded equal status amongst Caucasian males. The value of the ecological environment is by and large appreciated and is starting to be treasured rather than exploited. And the list could go on.

It is not difficult to find literature that endeavours to capture the scope of these changes. Lipietz (1987) for example states: "This is a time for doubts and for questions, a time when schemas fall apart and when every apostasy can be justified." Wriston (1997) talks of "Great new forces at work in the world ... the world is changing dramatically and at unprecedented speed. We are in the midst of a revolution ... (causing) old power structures to crumble and

new ones to rise." And Mulgan (1997) ponders "There can't have been many times in human history when so many problems have demanded fresh ideas and new thinking."

In a broader sense, it seems to be widely accepted that current times represent a 'divide' between one form of societal framework and another. Very few disagree that the period "since the mid-1970s represents a transition from one distinct phase of capitalist development to a new phase" (Amin 1994). This notion is confirmed by the names given to the era into which we are said to be moving. Almost invariably, they are titled with the word 'post' as their prefix. 'Post-capitalist', 'post-industrial', post-modern', post-civilised', 'post-Marxist', 'post-Fordist' and 'post-Taylorist' are all common appellations (Gahan 1993). Each of these titles implies that the coming new era represents a break from the past - a break from the previous capitalist, industrial, modern, civilised, Marxist, Fordist or Taylorist structures. In the broader sweep of history, such 'divides' are not unprecedented.

> "Every few hundred years in Western history there occurs a sharp transformation. We cross ... a "divide". Within a few short decades, society rearranges itself - its world view; its basic values; its social and political structure; its arts; its key institutions. Fifty years later, there is a new world." (Drucker 1993)

One of the products of the current 'divide' period is that car producers have moved from mass to lean production as their preferred method of manufacture. But why has this been so?

SUMMARY OF REASONS FOR CHANGE IN THE CAR INDUSTRY

As Mathews (1994) points out, "an astonishing range and conjunction of forces have undermined the supremacy of the mass production system" But like change that occurs in any field of human endeavour, change must be both *desirable* in the first instance, and *possible* in the second, before it will occur. The lean production revolution that occurred in the automobile industry in the mid to late 1980s is no different. Broadly speaking, four reasons can be identified for the demise of mass production and the adoption of lean production in its place. The first three reasons represent forces that made a move from mass production desirable, while the fourth demonstrated that the change to lean production was possible.

So what were these forces? First, the environment in which mass producers operated became unstable. Stability was critical to the success of mass production. This instability forced vehicle producers to explore alternative, more flexible methods of manufacture better suited to an ever-changing environment. Second, markets became both saturated and fragmented. The mass market was subsequently destroyed. Mass production relied on long runs of a limited variety of vehicles for a steadily expanding marketplace with more or less homogeneous tastes. It was not able to cope with the demands of a stagnant but diversifying market. Third, productivity growth under the regime of mass production had reached its natural limits. Expanding economies of scale, vital to productivity improvement under mass production, were not possible in congested and unpredictable markets. In addition, every efficiency possible under the Taylorist model of work organisation had already been wrung from the system. Subsequently, productivity growth slowed. Wage and profit growth slowed with it.

Finally, the development of lean production and its success in adapting to the new realities provided a proven alternative to mass production. It gave mass producers a template upon which to model a competitive production system of their own. This assisted in lean production emerging as mass production's obvious successor.

Let us examine each of these reasons for change in more detail.

NEW ENVIRONMENT

The era which preceded the first world war was, as The Economist (1997) points out, in many ways more economically liberal than the global economy is today. But by 1945, this liberalism was perceived to be largely responsible for what Hobsbawm (1994) has dubbed "the age of catastrophe" - the era which delivered two world wars and The Great Depression. These perceptions, along with the apparent success of Russia's planned economy at the time, dramatically influenced the policies that most of the democratic nations of the world followed for the ensuing decades. These policies resulted in so-called "mixed" economies in which the role of government was dominant, although the market mechanism wasn't completely stifled.

Governments achieved this mixed economy by controlling and regulating key industries, through tariff control, capital flow supervision, currency regulation, direct or partial ownership, Keynesian economic policies, labour regulation, and a further raft of regulatory apparatus. The mixed economy required large expenditure by the state, bigger taxes to fund it and a sprawling bureaucracy to manage it. This model, together with some limited interaction through trade in commodities and some manufactured goods with other economic states, proved effective for the three decades that followed the second world war.

Mass production, "largely a rigid, linear process..." (Morales 1994) thrived in the mixed economy. The economic stability of this regime provided an environment in which homogeneous, mass markets could be created and maintained. Keynesian policies ensured economic constancy. Tariff controls reduced competition. Currency regulation generally ensured stable import prices. Labour regulations went some way to controlling labour costs, but coupled with the insular nature of the economy generally, allowed increased costs to be passed onto the consumer. Generous social welfare systems made even those without an earned income, able consumers.

Steadily growing, homogeneous mass markets were critical to mass production, and these markets are precisely what developed from the mixed economy and the conditions described above. From the mid-1940s to the mid-1970s, this was the environment that prevailed.

But since the recession of the 1970s this environment has altered. The enormously influential forces of globalisation and deregulation, two of the defining trends of the current "divide" period, have brought instability and uncertainty to most marketplaces.

Globalisation and deregulation are the result of a number of developments.

First, advances made in communication and transportation technologies of the past three decades have dramatically increased the ability of national economies to integrate. The global network of computers, telephones and televisions has increased its information carrying capacity one million fold in the past twenty years (The Economist 1996). The rapid decline in information processing costs and the costs of communicating have ensured the widespread use

of these technologies. As their use became more widespread, so their benefits more pervasive. Markets now work more efficiently due the speed of information exchange. Knowledge and information are more freely available and are diffused more rapidly. Goods and services are more tradeable as the need for direct contact between the producers and consumers is eliminated. Production and capital are more footloose as companies can base different parts of their organisation in different countries and link them by information technology.

Second, transportation technologies have reduced the costs associated with the movement of people and goods and so have encouraged international trade. The establishment of the shipping container especially "had huge consequences for world trade" (The Economist 1997). The costs of shipping fell dramatically, reliability increased and the capacity of international shipping exploded. Technological advancement in this field provided the capability for levels of trade in goods and commodities to increase dramatically.

Third, most nations now no longer seek to control the "commanding heights" of their economies. They are ideologically disposed toward a democratic, free-market political-economy and are rapidly removing themselves from ownership and regulation. A series of events, which Piore and Sabel (1984) have referred to as "external shocks", began to drive the move from Keynes-based economic policies to those founded in the liberal thinking of Austrian economist Freidrich van Hayek.

The oil crisis of 1973 was the first such "shock". It arrived after the Arab nations of the OPEC cartel jacked up oil prices in response to Western support for Israel in the Arab-Israeli conflict of 1973, and drove inflation in the developed economies to new heights. Many nations saw their foreign debt levels explode as they borrowed to purchase oil. Stagflation, a combination of economic stagnation and inflation ensued. Laden with debt, the promises of governments and the actual results they were able to achieve began to diverge. The confidence governments once held amongst its populace turned to cynicism, and the perception of the state as a panacea for all problems was diminished.

At the same time, the government in the United States used cash resources rather than raise taxes to fund its war in Vietnam. This was the second shock, and lead to a waning in the confidence in the strength of the US dollar. Under pressure, the government finally decided to float the dollar and free currency exchange controls. Other countries soon followed suite. This marked the collapse of the Bretton Woods system of currency controls, removed government from control of currency valuations, and established the basis for essentially unfettered capital movements across the globe.

Then in the early 1980s the decay of communism became increasingly evident. Its near total collapse in 1989 (Cuba, North Korea and some pockets of Russia are live examples of its resilience), and the success of the emerging liberal Asian economies, ensured that the ideological debate over planned versus open economies was all but over. The ideas of free-market economist Freidrich van Hayek emerged as preeminent and his ideology became pervasive.

Yergin and Stanislaw (1998) succinctly pull the strands of technological advancement and an ideological shift together in explaining the effects of globalisation and deregulation:

> "The end of the Soviet Union and communism has redrawn the map of world politics and subdued ideology as a dominating factor in international affairs. The growth of capital markets and the continued lowering of barriers to trade and investment are further tying markets together - and promoting a freer flow of ideas. The advent of emerging markets brings dynamism and opportunism on a massive scale to the international economy ... paralleling and facilitating much of this is a technological revolution of momentous but uncertain consequences. Information technology—through computers—is creating a "woven world" by promoting communication, coordination, integration, and contact at a pace and scale of change that far outrun the ability of any government to manage. The accelerating connections make national borders increasingly porous - and, in terms of some forms of control, increasingly irrelevant."

So what has been the impact of these three developments?

Domestic markets, through the implementation of freer trade policies, have been exposed to competition from abroad. Technology now allows capital and knowledge to be transported to developing countries where it combines with cheap labour to produce high quality goods at a low cost. Freer capital flows provide investors a broader choice in whom and where they invest. It also allows investors to change their place of investment more readily. Uncertain and ever changing macro-economic conditions make it more difficult for organisations to elect strategies for success. The growing integration of a world economy provides increased and more diverse markets within which opportunities exist. Surety and a limited array of choices have been replaced by uncertainty and a multitude of options. Decisions and options taken at one point in time may be totally unsuitable in another. Change is now constant.

In essence, car manufacturers now no longer operate in stable economic conditions. To adapt to the new, fluid environment, vehicle producers must be capable of flexibility in their investment of capital, the products they develop and manufacture, and in the deployment of their labour. Only this capability provides the agility needed to survive in an ever-changing environment.

SATURATED AND FRAGMENTED MARKETS

By the mid-1970s, consumer goods markets had become saturated. In the United States for example, by then, 99 percent of households had refrigerators, televisions, electric irons and radios. In the motor vehicle market, there was one car for every four residents in the early 1950s, but one for every two by 1979. This near-total penetration of the market ensured the cessation of the steady growth in annual demand experienced in the years prior to the 1970s.

Stagnation in domestic market growth forced producers to seek extensions of their markets elsewhere. This lead them to compete in the markets of other countries, and before long, the automobile producers of the industrialised countries began to compete with one another. This had the effect of introducing a diversity of product to markets previously accustomed to the vehicles produced by domestic producers only, and helped fragment the mass market.

This process was assisted by two other trends. First, disparities in the incomes earned by different sectors of society began to increase, and a "stratification of society" (Morales 1994) slowly emerged. This caused markets to fragment as the range of demands increased commensurately with ranging incomes. The second, as argued by Piore and Sabel (1984), rests on the notion of a hierarchy of needs and wants. This argument purports that so long as purchasing power is low, the market satisfies its basic needs by acquiring the cheapest available, mass produced goods, mainly regardless of their quality and style. But as disposable incomes rise, consumers are able to fulfil their individual wants, which are, almost inevitably, different from those of others. Thus there is a trend toward diversification of demand. But whatever the reasons for the change, there is no doubt that markets are fragmenting, as Womack et al. (1991) have demonstrated.

The stagnation and diversification of mass markets placed a "heavy emphasis on (producers) correctly identifying and targeting market segments through product differentiation" (Morales 1994). Blindly producing large quantities of a small range of products as mass producers did, was no longer good enough. Saturation of the markets put an end to profit growth through the dynamic of economies of scale and the trend toward diversification saw the abolishment of demand for homogenous goods. With these two blows, the mass market was destroyed.

SLOWING PRODUCTIVITY GROWTH

On the supply side of the production equation, mass production began to reach its limits insofar as productivity improvements were concerned by the mid-1970s.

Productivity growth under a mass production system relied in part on the notion of economies of scale. This source was destroyed along with the mass market as described above. But productivity growth was also undermined by inherent limitations in the system of mass production itself.

Taylorist work organisation principles ensured that the majority of producers had no control over their work. The activities of the few engineers who did have control was the only source of productivity improvement. Eventually, every efficiency that could be squeezed from the mass production process through improvements in time and motion related activities were realised.

These two attacks on productivity growth occurred whilst purchasing power, underpinned by a strong, united labour force, continued to rise. As labour costs grew relative to productivity improvement, profits were squeezed. Investment therefore slowed and productivity growth, whose only real source at the time was increased investment because of the exhaustion of other options, slowed with it.

Reduced investment levels lead to fewer jobs and higher unemployment. This increased pressure on the welfare state and its ability to pump prime the economy as it had done in the past. Demand therefore decreased and the economies of scale fundamental to the virtuous circle were further undermined. Productivity growth, and hence the ability to continually reduce the costs of manufactured goods, had ceased. Another pillar of the mass production system had been removed.

VIABLE ALTERNATIVE

The final nail in the coffin for mass production was the emergence of an alternative method of manufacture better adapted to the emerging environment. Without such an alternative, mass production could well have survived the attacks upon it, only in a much less prosperous form than that enjoyed by lean producers. But lean production altered the competitive landscape in automobile manufacture. It provided the most value at the lowest cost in the shortest period of time (Morales 1994) and recast the paradigm of competition, previously fundamentally based on cost-competitiveness alone. Mass producers had no option but to alter their method of manufacture to befit the environment at hand and to compete with those already capable.

The Japanese developed lean production, but the effects of globalisation and deregulation previously described were responsible for its diffusion. Lower tariff barriers and improved transportation techniques meant domestic producers in western countries had to compete with imports from Japan. Then, as western governments became more tolerant of foreign direct investment, the Japanese established manufacturing plants on western domestic soil and exposed domestic manufacturers to lean production in their own backyards.

In short, lean production provided a tried and proven alternative to companies stuck with the rigidities of mass production. It demonstrated that the unpredictable and diverse demands of the market could be successfully met. It provided a clear beacon, to those willing to look for it, showing a way ahead. "Average American performance - under unrelenting pressure from the Japanese transplants in North America - has improved dramatically" (Womack et al. 1991).

QUESTIONS FOR THE AEC INDUSTRIES

Two clear conclusions can be drawn from this examination of the lean production revolution in vehicle manufacture. First, change must be *desirable* before it will be implemented. There needs to exist either external pressures which dictate that an alternative is imperative, or perceived rewards which outweigh any investment that may be required, before organisations will implement change. Second, change must be technically and organisationally *possible*, and it must respond to the conditions that made it desirable in the first place.

Therefore, in determining whether lean construction is an appropriate model for the AEC industries into the future, it is important to first determine whether change is desirable. Employing the lessons of the automobile industry, it is possible to quickly shape pertinent questions that must be answered to determine if change in the AEC industries is desirable.

For example, what impact has globalisation and deregulation had? What has been the effect of international competition on the AEC industries? Have the lines on which organisations compete been altered as they were for car manufacturers? Are there market forces, like those that effected the car industry over recent years, which are making current construction methodology unsustainable or redundant? Is productivity improvement under current arrangements, and hence profit levels, so low that it is untenable to continue with the existing mode of construction? Is there an alternative model already being used in the AEC industry that is changing the competitive rules, as the Japanese did in the automobile sector?

In looking at the possibility of implementing lean construction, we need to ask: is it possible to implement the principles of lean production in the fragmented environment of construction? Is it possible to develop the skills required of the workforce to implement lean construction in such a transient industry? What impact does the everchanging nature of a construction site, as opposed to the static environment of a manufacturing facility, have on the viability of implementation. What technical capabilities do organisations need to develop to implement lean construction and will companies make this necessary investment? Will lean construction counter the forces that led to the perception that an alternative mode of construction was desirable in the first place?

These are the types of questions that need to be answered to determine whether lean construction is viable. To change the mode of production used more or less pervasively throughout an industry requires that change in the first instance, be seen as *desirable*. The experiences of the car industry proved this. Once desirable, the implementation of a particular mode of production must be *possible*, and must meet the demands that made the change desirable in the first place.

Whilst much work has been done in studying the possibilities of implementing lean construction, I would argue that we have not done enough in assessing the strategic environment of the industry to determine whether there is a genuine desirability for change. This is the challenge of those of us who advocate lean construction.

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