TRENDS IN PROCUREMENT AND IMPLICATIONS FOR INNOVATION AND COMPETITIVENESS OF AUSTRALIAN BUILDING AND CONSTRUCTION

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ABSTRACT

This paper investigates the relationship between the procurement methods used on building and construction projects, the opportunities for innovation and innovative solutions to client requirements, and the competitiveness of the Australian industry. The economic theory of innovation suggests that returns to innovators from research and development (R&D) and positive externalities drive the process. The argument is made that traditional tendering and procurement methods used by building industry clients works against these drivers of innovation in several important respects. This paper reviews trends in R&D in the Australian building and construction industry, and assesses the importance of these trends for the international competitiveness of the industry in the context of alternative procurement methods and a changing regulatory environment. The analysis of the implications of these trends in deregulation and procurement for the international competitiveness of the Australian industry finds that they will determine the competitiveness of Australian building and construction. The links between R&D and competitiveness is also discussed. The paper concludes that the ability of the Australian industry to lift R&D investment will be an important determinant of competitiveness over the coming decade, which will see significant structural change in both the domestic and international building and construction industry.

KEYWORDS:

innovation, building procurement, productivity, competitiveness

INTRODUCTION

The purpose of this paper is to look at the links between competitiveness in the construction industry and the R&D intensity and level of innovation that characterizes the industry, and relate these to the procurement systems and market structure in the industry. This discussion covers the relationship between R&D and procurement, R&D and deregulation under the Government Procurement Agreement, and the difficulty of achieving returns on R&D in an industry that is fragmented and highly dispersed. The implications of these factors for the Australian industry are discussed.

Innovation in the construction industry has been a focus of research for over a decade. By the commonly accepted measures of innovation, such as patents, technological research papers, introduction of new products or process improvements (Freeman and Soete 1997: 7-8), the construction industry has a record of very low identifiable innovation. This record is despite characteristics of the industry seen as favourable to innovation (Tatum 1986) and the importance of innovation for competitiveness in the industry (Flanagan 1999).

Tatum (1986) identified seven features of the construction industry as advantages for innovation. Construction projects create teams presented with high levels of necessity and challenge, which promotes innovation by forcing examination of new technologies for each project. Integration of engineering, design and construction can simplify the construction process and decrease cost. The low capital investment typical of construction firms allows high flexibility for the adoption of new technologies. A pool of technologically experienced personnel provides depth of knowledge. The strong emphasis on process limits barriers to imitation, because new processes can spread rapidly without patent restraints (but this may also discourage innovation). Lastly, construction production processes do not create rigid restraints.

Five characteristics of the construction industry were later identified by Tatum (1989) as being constraints to innovation. The low capital intensity of the industry limits its interest in investment for automation. If a firm has adequate market share and profitability then pressure to innovate is reduced. The institutional framework is not supportive of innovation (the number of firms, the legal incentives for technological inertia, regulatory influences, and craft organization of labour). Building cycle volatility affects capital investment and economies of scale, and suppliers have not created technological improvements in the equipment and tools used by construction.

Tatum's analysis is descriptive of the construction industry, but lacks a model of how innovation occurs in the industry. Technological change and innovation have become central to the economic analysis of development of individual industries, and economic growth in general. The state of any individual industry is seen as driven by and subject to the forces of competition, where competition is driven by changes in technological opportunities and appropriability of knowledge (Dumenil and Levi 1995). Firms typically are in a process of constant adjustment and selection, as industries adapt to entry and exit, and innovative projects or R&D are succeed or fail. Nelson and Winter (1982) were the first to compare this to the biological concept of natural selection in evolution. Verspagen (1998) suggests that economic systems adapt over time but do not necessarily produce optimal outcomes, as suggested by the work of Arthur (1988) or David (1985). In the analysis of economic growth, this line of thinking led to the development of new growth theory, where investment in R&D leads to positive externalities and increasing returns to scale at the macro level (Romer 1990).

Inter-firm differences in R&D and innovation accounts for differing rates of increase in productivity, improvements in the quality, and differentiation of products within industries. The Canther and Pyka (1998) model sees firms engaging in R&D and what they describe as search and experimental activities, in pursuit of profits. They also see technological development as cumulative, as industries develop along specific technological trajectories, with decreasing exploitable technological opportunities. The benefits of new technology depends on how easy it is for new ideas and knowledge to be transferred to other firms in the same industry.

So far there is no good explanation of the construction industry’s record of innovation, grounded in the broader theories of innovation available. This paper develops a model of construction innovation in a revised framework, using procurement methods and market deregulation as potential drivers of innovation. The argument is on two levels. Firstly, at the level of industry structure, the relationship between innovation and concentration is discussed. The issue here is whether the research intensity of construction is an outcome of industry competition rather than a requirement, as in high research intensity industries. Secondly, the issues of appropriability of research and innovation revenues and treatment of knowledge externalities are considered in the context of procurement methods used.

The discussion uses recent developments in two fields. From the theory of industrial organization, Sutton’s (1991, 1999) theory of endogenous sunk costs and its application to fragmented, low research intensity industries is discussed. Then, using the innovation paradigm from evolutionary economics, the effects on R&D from increased international competition are highlighted. Finally, the paper includes the role of procurement methods used for building and construction projects as a determinant of the level of innovation in the industry.

AUSTRALIAN INDUSTRY R&D

It is rare for an Australian construction firm to have a R&D budget. If R&D generates new ways of doing things, including improved construction methods and materials, then the industry's non-funding of R&D is a cause of the low productivity growth rate found in the Australian industry (for productivity estimates see Productivity Commission 1999). Much of the R&D done by the construction industry is more in the nature of problem solving, and is specific to a particular project or a new technology imported from the materials or equipment manufacturers (Table 2 below shows the level of construction R&D expenditure by industry). Because of the nature of this work it is not recognized as R&D, however in building and construction this may be the most important component of research and innovation. Because it is difficult to collect data on this type of activity the real level of R&D in the construction industry is probably significantly understated.

Research has shown that the level of R&D within building and construction in Australia is at the lower end of the scale when compared to other industry sectors. A report by Building Research and Development Review Committee (BRDAC 1987) found R&D in relation to value added in 1986-87 was 3.9% for agriculture, 3% for manufacturing, 1% for mining and 0.13% for construction. A report from the Department of Industry, Science and Resources found little change a decade later, stating the industry "does not spend enough on R&D. The nature of the industry also influences it to continue to use traditional methods of construction, rather than take the risk of innovating." (DISR 1999: 52).

The BRDAC report described the construction industry as having a negative attitude towards R&D at an enterprise level. The reasons for this were said to be the predominance of small businesses, low capitalisation, low operating surpluses and low productivity. The industry's sensitivity to cyclic variations in the economy and the transient nature of various groups within the industry were also identified as factors contributing to the low level of R&D. These factors still operate to create an environment which deters building and construction companies from investing in innovation without a clear short-term return. In Australia, around 60% of construction R&D is funded by the public sector, shown in Table 1, and the business spend on construction R&D is concentrated in the manufacturing industries, as shown in Table 2. Contractor spending in 1996-97 was 0.11% of income.

Table 1. R&D Expenditure on Construction, 1992-93 to 1996-97 (A$ million)

Expenditure by:	1992-93	1994-95	1996-97	Person years 1996-97
Business	25.7	34.0	45.1	384
Government (Commonwealth)	28.5	24.3	28.9	264
Government (State)	10.2	6.8	7.0	50
Higher education	38.5	27.7	32.3	648
Private non-profit organisations	0.3	1.3	0.7	9
Total	103.3	94.0	113.9	1,355

Source: AEGIS, 1999: 153

Table 2. R&D Expenditures across Building and Construction Product System, 1996-97 (A$million)

Industry Segment	R&D expenditure ($m)	R&D expenditure as a % of income
On-site Services (Trade Services)	0.65	0.003
Client Services (Engineering, Technical, etc.)	2.91	0.034
Building and Construction	3.80	0.011
Materials and Products Supplies	31.87	0.077
Machinery and Equipment Supplies	4.74	1.110
Total	44.0	0.040

Source: AEGIS, 1999:62.

RESEARCH INTENSITY

There are major differences between industries in rates of both technological progress and productivity growth. Efforts have been made to find both theoretical and empirical explanations of the factors that drive these differences, and the variables that can be applied to inter-industry differences in technology and productivity growth. One explanation for differences among industries in technology and productivity growth is R&D intensity, or the degree of innovation that is found in the industry, and the differences between the R&D and innovative activity in one industry compared to another. Research intensity is typically measured by R&D as a percentage of sales or income.

R&D intensity in an industry is determined by two key variables. One is "technological opportunity", which determines the productivity of R&D and the opportunities that are available for innovation. The other is the ability of innovating firms to "appropriate" a significant share of the economic value created by innovation, or to capture the externalities created through new knowledge. However, although both these variables influence R&D intensity of firms in an industry, only technological opportunity will affect the rate of technological advance in an industry in the long-run, even if both opportunity and appropriability influence R&D intensity.

“Differences across industries in their R&D intensities tend to be quite durable. This suggests that, to the extent that these are the major determining variables, differences across industries and technological opportunities and inappropriability conditions tend to be persistent.” (Nelson and Wolff 1997: 207). Nelson and Wolff propose cross industry differences in technological opportunities are due to R&D opportunities differing between industries. In turn, differences between industries in technological progress will be driven by differences in R&D intensity, appropriability and opportunity that are available. Their theory is that industries with high R&D intensity and technological opportunity must be receiving a high rate of flow of new technological opportunities to make up for those that are being exhausted.

In the industrial organization or industry economics literature, industries are usually seen in terms of a number of firms which advance along a single technological trajectory, and these firms compete in enhancing the quality of their individual versions of the same basic product (homogeneity of product). In this case, firms make decisions on how much R&D to finance, and apply that R&D to product development. This view fits some industries well, however many industries encompass several groups of products rather than a large number of versions of a single product. The products may be close substitutes in consumption, but embody different technologies, so R&D projects that enhance products in one group may generate huge spillovers for products in other groups.

Such complex overlapping patterns of substitutability have bedevilled industrial organization analysis for decades, since Chamberlin (1932) first developed the definition of an industry as limited by the chain of substitution, where industries were defined by their product. If industries are broken into separate sub-industries in order to address this problem, the choice in R&D spending can be between any number of technologies for the development of different groups of products. The products may be close or distant substitutes for products of firms on other technological trajectories. Both of these linkages operate on the demand side. When the linkages are strong they reflect the presence of scope economies in R&D; where the linkages are weak these scope economies will be absent and there will be a low degree of substitution across sub-markets.

Applying this discussion of sub-markets to the building and construction industry raises a number of interesting issues. The first is, of course, the general lack of specialisation of firms in the construction industry in terms of their product. The answer to the question "What does the industry produce?" is varied; some believe that the industry provides services (management, coordination, finance), others believe the industry delivers products (buildings and structures). The former group argues that the main task of the industry is one of coordinating site processes while the latter are more concerned with the building itself. The building and construction industry is typically broken into the engineering, non-residential, and residential building sectors, and there are some firms that cross all of these areas, however, typically firms work in either the residential or the non-residential sectors. Many of the larger firms cover both engineering and non-residential building in their activities. Within the non-residential building sector, there are ten or twelve different sub-markets, divided into offices, retail, factories, health, and so on. Some firms specialize in building particular types of buildings, in Australia Grocon specialises in high-rise office buildings and Westfield specialises in shopping centres, however more commonly a building contractor will apply their management skills to a range of building types, and not limit themselves to specific sub-markets. In this case, for the construction industry, sub-markets are difficult to identify because firms can be highly specialized in one area, or they can be highly generalized and put up a wide range of buildings and structures.

R&D AND MARKET STRUCTURE

The degree of monopoly power exercised by the largest firms in an industry is expressed in the concentration ratio, which is the degree to which an industry is dominated by the largest firms. Typically the concentration ratio uses the largest four firms in an industry, ranked by market share or sales as a percentage of total industry sales. The definition of the concentration ratio is the percentage of industry total sales (other measures are capacity, output, employment or value added) accounted for by the largest firms. The extent of control over prices is determined by the intensity of competition in a market, which is, in turn, determined by the number of firms and type of product.

Sutton (1999) in his development of the theory of market structure and concentration, suggests the effect of R&D spending on the technological trajectory of industries is crucial. Where the degree of substitutability across products associated with different R&D trajectories is high, concentration will necessarily be high, because if all firms have a low market share an increase in R&D spending will be profitable, and the high spending firm can capture sales from low spending rivals on its own trajectory and on others. Sutton shows that under these circumstances, the number of trajectories along which firms will operate is small, since low spending firms are vulnerable to increases in R&D spending by rivals. On the other hand, if the degree of substitution across products is low, then in spite of the effectiveness of R&D spending, concentration may be low. "This can only happen if there are many product groups, associated with different independent R&D trajectories.....Here, escalation yields poor returns, since outspending rivals can lead only to the capture of sales from products in a single, small product group" (Sutton 1999: 13).

In Sutton's analysis it turns out that industries or sub-industries with a low R&D to sales ratio, can have a low level of concentration, and this can continue indefinitely. The industries where there are a large number of firms in an increasing market, characterized by buyers who place different relative weights on different aspects of technical performance (product attributes), and many alternative technologies are available for those products, leads to a market where there is an indefinite number of firms, each with a small market share. For this type of industry with low R&D spending, Sutton's theory predicts that the concentration ratio will be low and that the level of concentration will decrease as the size of the market increases. The characteristics of such industry are compared to industries where the R&D to sales ratio exceeds a high threshold value, and Sutton's theory predicts that concentration will increase as the spending on R&D increases. In a low R&D intensity industry, the market share of the largest firm will be relatively small, in a high R&D intensity industry the market share of the largest firm can be very high (Sutton 1999: 14-16).

The importance of industry structure lies in the way that structure is the most important determinant of competition, and the form that competition takes, in an industry. Related issues are the way the process of competition affects prices and profits, the ease of entry of new firms into or frequency of exit from an industry, the impact of demand shocks (i.e. the business cycle) and the effects of new technologies, such as e-business and e-commerce. However, for the building and construction industry the methods used for tendering and procurement of projects are important determinants of the level and form of competition in the industry, and distinguish the industry from many others where competition is through marketing campaigns, new products and so on.

PROCUREMENT AND INNOVATION

Owners and clients are increasingly using a variety of alternative procurement methods aimed at reducing cost, achieving time schedules and milestones, shortening duration, reducing claims, and improving constructability and innovation. The overall trend is toward versions of design and build and turnkey construction because of the advantages of a project delivery system that combines designers, builders, and sometimes suppliers into a single entity (de Valence and Huon 1999). Many surveys have established that clients perceive the design and build (D&B) approach as providing better value for money, and giving rise to less disputes than other procurement methods, also that an experienced client with a clear brief can use it satisfactorily with most project sizes (Songer and Molenaar 1996, Ndekugri and Turner 1994, Akintoye 1994).

The move away from traditional procurement systems will have significant effects on innovation. Because the traditional design-bid-build method does not allow for capture of intellectual property and knowledge externalities by contractors in their tenders, there was a perverse disincentive to innovate. With the increased use of non-traditional procurement methods such as design and construct (D&C), D&B, build, own, operate (BOO), and build and maintain (B&M), this disincentive is removed and firms can appropriate the benefits of innovation and R&D

Craig (1997a) discusses innovation in D&C procurement systems, where the contractor bears single point responsibility for the complete product, like any other manufacturer. However, unlike deciding which car to buy a building is purchased through the tender process, which must not only evaluate design, but also production capability, time and price, and on a competitive basis. Procurement of projects through the tendering process appears to limit the successful tenderer's scope to be innovative. This paper concludes tendering rules or codes have been developed to maintain the integrity of the bidding process, not to encourage innovation. Craig (1997b) argues that ‘alternative tenders’ are potentially valuable to both clients and contractors, and to society at large. Contractors can make novel proposals to owners., and society benefits from such innovation. Tenderers can put forward more efficient and cost effective methods of construction, however there is not yet sufficient established custom and practice for modification of the existing ‘tendering contract’.

Craig (2000) develops these issues and asks three questions on procurement and innovation. The first is: do tendering processes encourage innovation? The essential basis of the tendering code is that all tenderers are to be treated equally and fairly, that contract award criteria are established in advance and known by all parties, thus creating a transparent award process. Tendering rules produce direct price competition for a specified product. The question then becomes: can traditional tendering processes permit innovation? The answer is that a successful tenderer's scope to be innovative is very limited. There is opportunity to find novel ways of organising work to achieve maximum profits within the tender price. Opportunity exists for 'bid shopping' to drive down subcontract prices. One tender might seek competitive advantage by offering to the owner a contract term more favourable than any from a competitor. Craig asks: what scope is there, at tender stage, to offer the client novel design (which is the bidder's intellectual property) at a saving on the original design? Bidders are not asked to put forward design suggestions, there are no criteria for evaluation of novel proposals, tenderers cannot be treated equally and fairly if one is preferred on an 'alternative' tender, which is a non-conforming tender in terms of the original invitation.

Finally, Craig (2000) asks: does D&B or D&C as a procurement system more easily permit innovation? The point is made above that using the tender process to competitively evaluate design, capability, time and cost is not easy. “Competitive design is not easy to evaluate in the context of tendering. Traditionally it has been done by a two-stage process …a design competition … and production competition. Wrap this up in a single stage process and the objectivity appears to be replaced by subjectivity in picking the winner, and the apparent integrity of the bidding process is lost, unless very clear integrity criteria are established at the outset for evaluation of competing designs." (Craig 2000:33). Craig concludes that the traditional tendering process for building works does not encourage design innovation by tenderers, but it has always been possible for tenderers to seek competitive advantage through novel construction methods.

REGULATORY ENVIRONMENT

The construction industry fits into the category of a fragmented, low research intensity industry. As such it is responsible for few new products and much process innovation is in response to developments in other industries, particularly materials manufacturers and the information technology and communications (ICT) industries. Sutton's theory predicts that this type of industry typically undergoes a significant increase in concentration as national markets are deregulated and opened up. This is what the Government Procurement Agreement (GPA) reached through the World Trade Organization is doing, by opening member countries public sector construction projects to international competition. Therefore the GPA might lead to a few large contractors dominating each national market, probably with a different mix of national and international firms in each market. The rise of these large firms might then be an important element in increasing R&D and innovation in the industry.

Governments in many countries have made changes in their policies and regulations on procurement under the regulations formulated by the World Trade Organisation (Korman 1997, Ashenfelter et al. 1997, Mattoo 1996, Ichniowski 1995). Reforms are underway in the bidding and contractual systems used for public projects in Australia, Japan, South Korea, Europe and the US. These countries are opening their construction markets to contractors from foreign countries, often with less discriminatory and more competitive forms of tendering (Gransberg and Ellicott 1996, Spacek 1996, Reich 1997). Reform of the bidding and contractual system used for public projects in Japan, and government policies on further opening of the construction market to foreign countries, is discussed by Kunishima et al. (1995). Japan's 1995 'Action Plan' provided for open and competitive bidding procedures to be used by public agencies, for procurement of construction, design, and consulting work that are valued at or above the WTO government procurement thresholds (Dunn 1995).

Legislative changes in the US are allowing public owners the opportunity to use design-build as a project delivery option (Krizan 1996, Loulakis and Cregger 1996). Changes in the US federal government's procurement system to allow federal agencies to use a limited form of design-build construction contracts has led to the establishment of procedures for agencies to follow when they enter into a design-build project. To combat the problems inherent with traditional low-bid procurement, many states are following the example of the federal government by enacting procurement options to allow and encourage alternative methods (Charles 1996).

The experience of other industries after deregulation has been a significant increase in competition for domestic companies as new entrants, often large established international firms, come into their home markets. The larger the firm, the more likely it is to engage in R&D and innovation. Therefore, the expansion of international contractors into new markets could lead to an increase in both the size of the largest contractors and their ability to undertake R&D spending.

COMPETITIVENESS

Competitiveness drives the economic performance of countries and industries exposed to international competition. The competitiveness of nations in the global economy lies in the four broad attributes of a nation described by Porter (1990), attributes that individually and as a system constitute Porter's 'diamond of national advantage'. This is the playing field that each nation establishes and operates for its industries. These attributes are:

1. Factor conditions - the nation's position in factors of production, such as skilled labour or infrastructure, necessary to compete in a given industry.
2. Demand conditions - the nature of home-market demand for the industry's product or service.
3. Related and supporting industries - the presence or absence in the nation of supplier industries and other related industries that are internationally competitive.
4. Firm strategy, structure, and rivalry - the conditions in the nation governing how companies are create, organized, and managed, as well as the nature of domestic rivalry. (Porter 1990: 139)

The Porter diamond identifies the determinants of industry competitiveness:

> These determinants create the national environment in which companies are born and learn how to compete. Each point on the diamond - and the diamond as a system - affects essential ingredients for achieving international competitive success: the availability of resources and skills necessary for competitive advantage in an industry; the information that shapes the opportunities that companies perceive and the directions in which they deploy their resources and skills; the goals of the owners, managers, and individuals in companies; and most important, the pressures on companies to invest and innovate.
>
> When a national environment permits and supports the most rapid accumulation of specialized assets and skills - sometimes simply because of greater effort and commitment - companies gain a competitive advantage. When a national environment affords better ongoing information and insight into product and process needs, companies gain a competitive advantage. Finally, when the national environment pressures companies to innovate and invest, companies both gain a competitive advantage and upgrade those advantages over time. (Porter 1990: 140)

With deregulation and the opening of national markets for public sector projects, as in Australia, contractors will be subject to increasing competition. This will make the ability to enhance competitiveness a crucial factor in the long-term prospects of Australian construction companies.

CONCLUSION

The importance of competitiveness is increasing as the global economy develops as both a market for Australian firms and as a source of new competitors. The ‘diamond’ of factors that determine an industry’s competitiveness are affected by government policies and attitudes. The GPA will increase openness to trade, capital and technology movements in building and construction, and this openness increases opportunities for greater economies of scale and scope and specialisation of firms, two important sources of competitiveness.

The alternative methods and systems of procurement and delivery being increasingly used by clients will emphasise innovative design solutions in order to lower ownership or occupancy costs. As major projects become part of an international, globalised market with deregulation of public sector procurement. Australian contractors will be competing against aggressive new entrants from other countries into their market, who will use the increasing diversity and complexity of procurement methods to win a share of the market. Also, the clients who have major projects are typically experienced, long-term investors with considerable expertise in alternative procurement methods. The traditional tendering and procurement process for building works is not amenable to innovation by tenderers. Craig (2000) suggests there are processes available for procurement of design services which allow competition on innovative design, in which design/ technical matters of the tenders are evaluated separately from price and could be used for D&C procurement.

The influence of procurement methods has been a determining factor in the level of innovation in the industry, and the significance of increased use of alternative forms of procurement is their providing incentives for increased R&D and innovation. When combined with deregulation the effect will be to move the industry toward more R&D. In the past, the level of innovation may have been an outcome of industry structure, not a determinant, however a more R&D intensive industry would tend toward having structure determined by research intensity. As R&D expenditure increases the potential level of concentration in the industry also rises, and the interplay between these factors will determine the eventual number of large firms in the industry.

Finally, the pace of development in technologies related to building and construction (particularly in automation, software integration and general ICT) makes it possible that traditional methods and processes could be swept away in a technological revolution that rapidly makes many of the craft-based traditions in the industry obsolete. This has happened in many other industries, such as automobiles in the early 1900s and steel making at the end of the century.

Technological change is significantly changing the competitive environment in the building and construction industry. Therefore, the level of technology used by the construction industry in Australia is important. The building technologies and methods used by the industry do not appear to significantly lag those in similar countries. In the design work that utilises new materials and principles Australia is clearly competitive. By any reasonable list of technology indicators that includes the major developments of the past two decades, the Australian industry cannot be seen to have been slow at adopting and adapting overseas developments. However, the level of investment in R&D and innovation by the Australian industry is low, and this threatens the future competitiveness of the industry with the increasing international competitive challenge to Australian contractors. With global economic competition the importance of creating a high value adding, high productivity growth industry increases.

The necessary conditions for competitiveness include strong and sustained levels of productivity growth, an openness to innovation and new technology, and a commitment to delivering value for clients' money. In the light of these conditions the Australian construction industry undoubtedly has the potential to achieve international standards of on time, on cost high quality projects. On their own these conditions are not sufficient however, other factors that relate to the attitudes of industry participants to R&D and innovation and the level of investment in R&D by the industry. These will determine the eventual level of competitiveness of the Australian industry.

REFERENCES

AEGIS, 1999. *Mapping the Building and Construction Product System in Australia*, Australian Expert Group in Industry Studies, DISR, Canberra

Akintoye, A., 1994. “Design and Build: A Survey of Construction Contractors' Views”. *Construction Management & Economics*. 12(2).

Arthur, B., 1988. “Competing Technologies, Increasing Returns and ‘Lock-In’ by Small Historical Events”. *Economic Journal*. March.

Ashenfelter, O., Ashmore, D. and Filer, R., 1997. “Contract Form and Procurement Costs: The Impact Of Compulsory Multiple Contractor Laws In Construction”. *Rand Journal of Economics*. 28.

BRDAC, 1987. *Priorities for Future Building Research*, Building Research and Development Review Committee, Canberra

Canther, U. and Pyka, A., 1999. "Technological Evolution - An Analysis within the Knowledge-Based Approach". *Structural Change and Economic Dynamics*. 9(1) 85-107.

Chamberlin, E. H., 1932. *The Theory of Monopolistic Competition*, 1st Ed Cambridge, Massachusetts, Harvard University Press, Massachusetts.

Charles, M., 1996. “Congress Approves New Design-Build Law”. *Civil Engineering*. 66(3).

Craig, R., 2000. "Competitive Advantage Through tendering Innovation". *Australian Construction Law Newsletter*. 70 March-April, UTS Faculty of Design, Architecture and Building.

Craig, R., 1997a. "Competitive Advantage Through Tendering Innovation". *CII Australia, Fourth Annual Conference*. Melbourne.

Craig, R., 1997b. "The ‘Tendering Contract’: Fairness, Equality and Innovation" in Davidson, C. and Mequid, T. A. A. (eds) *Procurement – A key to Innovation*. CIB W92 Publication 203, 91-100.

David, P. A., 1985. "Clio and the Economics of QWERTY", *American Economic Review* 75(2) 332-7.

de Valence, G. and Huon, N,. 1999. “Procurement Strategies” in Best and de Valence (Eds.) *Building in Value: Pre Design Issues*, Edward Arnold Publishers, London

DISR, 1999. *Building for Growth: An Analysis of the Australian Building and Construction Industries,* Department of Industry, Science and Resources, Canberra.

Dumenil, G. and Levy, D., 1995. "Structural Change and Prices of Production". *Structural Change and Economic Dynamics*. 6(4) 397-434.

Dunn, E., 1995. “The 1994 Public Works Agreement”. *Business America.* 116(11).

Flanagan, R., 1999. "Winning Projects and Satisfying Customers Through Innovation". CIB W55/W65 Triennial Conference, Capetown. Published in proceedings.

Freeman, C. and Soete, L., 1997. *Economics of Industrial Innovation*. Cambridge, Mass., MIT Press.

Gransberg, D. D. and Ellicott, M. A., 1996. "Best Value Contracting: Breaking the Low-Bid Paradigm". *40th Annual Meeting of AACE International*. Vancouver, Canada.

Ichniowski, T., 1995. “Reform Advances on Procurement”. *Engineering News Record*, 235(6).

Krizan, W. G., 1996. “Design-Build Faces Legal Hurdle”. *Engineering News Record*. 237(7).

Korman, R., 1997. “Reforms Worry Industry Groups”. *Engineering News Record*. 238(5).

Kunishima, M., Fukuda, M., Saito, T., Shimizu, H. and Sabase, Y., 1994. "Changes and Reforms of Bidding and Contracting Systems in Japanese Public Projects", *Construction Congress*. ASCE.

Loulakis, M. C. and Cregger, W. L., 1996. “Federal Legislation Will Increase Design-Build Opportunities”. *Civil Engineering*. 66(7).

Mattoo, A., 1996. “The Government Procurement Agreement - Implications Of Economic Theory”. *World Economy*. 19(6) November, 695-720.

Ndekugri, I. and Turner, A., 1994. “Building Procurement by Design and Build Approach”. *Journal of Construction Engineering & Management-ASCE*. 120(2) June.

Nelson, R. R. and Winter, S. G., 1982. *An Evolutionary Theory of Economic Change*. Cambridge, Massachusetts, Harvard University Press.

Nelson, R. R. and Wolff, E, N., 1997. "Factors Behind Cross-Industry Differences in Technical Progress". *Structural Change and Economic Dynamics.* 8(2) 205-220.

Porter, M. E., 1990. *The Competitive Advantage of Nations*. Free Press, New York.

Productivity Commission, 1999. *Update of Productivity Estimates - 1998-99*, Canberra.

Reich, A., 1997. “The New GATT Agreement on Government Procurement-The Pitfalls Of Plurilateralism and Strict Reciprocity". *Journal of World Trade* 31(2).

Romer, P. M., 1990. "Endogenous Technological Change". *Journal of Political Economy*. 98 71-102.

Songer, A. D. and Molenaar, K. R., 1996. “Selecting Design-Build: Public and Private Sector Owner Attitudes”. *Journal of Management in Engineering*. 12(6) November-December.

Spacek, J., 1996. “New Law Passed to Allow Design-Build Method of Project Delivery”. *Water-Engineering & Management*. 143(7).

Sutton, J., 1999. *Technology and Market Structure*. Cambridge, Massachusetts, MIT Press.

Sutton, J., 1991. *Sunk Costs and Market Structure*. Cambridge, Massachusetts, MIT Press.

Tatum, C.B., 1986. “Potential Mechanisms for Construction Innovation.” *Journal of Construction Engineering and Management*, ASCE, Vol. 112, No. 2.

Tatum, C.B., 1989. "Organising to Increase Innovation in Construction Firms”. *Journal of Construction Engineering and Management*, ASCE, Vol. 115, No. 4.

Verspagen, B., 1998. "Introduction". *Structural Change and Economic Dynamics*. 9(1) 1-3 Special Issue on the Evolutionary Analysis of Innovation.