

# MARKET STRUCTURES IN AIR CONDITIONING MAINTENANCE ACTIVITY

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It is questionable whether activities like construction, including maintenance and repair, can be considered a single entity or industry – on the basis that different sectors of construction/maintenance use fundamentally distinct resource and skill bases. This creates a number of issues including the development of competition and reform policy. de Valence deployed the Structure-Conduct-Performance model (SCP) to delineate sectors of new/installation construction activity and, in doing so, proposes that there exists multiple market structures in a given project. The purpose of this paper is to apply the SCP model to a different sector of construction activity, that is air conditioning maintenance and test de Valence's proposition concerning the existence of multiple market structures in a supply chain but this time to a built facility. The research method combines secondary data concerning the "Structure" component of the SCP model and primary data with regard to the "Conduct" and "Performance" parts of the SCP model. The results provide further support (beyond de Valence's analysis of new/installation activity) that a sector system approach using the SCP model is a more effective way to analyse market structures in construction activity. This paper also supports de Valence's proposition concerning the existence of multiple market structures in a supply chain to a project/facility.

Keywords: maintenance, market structures.

## INTRODUCTION

The Structure-Conduct-Performance (SCP) approach developed by Bain (1968) and Mason (1939) is a general theoretical model from industrial organisation economics that can be used to classify an industry in terms of its market structure, as summarised in Table 1. Along with duopoly (a special case of monopoly comprising two firms), the market structures in Table 1 represent a range a price competition, from reacting to intense price competition (perfect competition) to the power to set prices (monopoly). On the basis that the market structure represents stereotypical points in a continuum of pricing possibilities, the match between the SCP attributes and the industry's market structure is far from exact. Moreover, the SCP model represents a static/non-evolutionary approach. Rather, the application of the SCP model allows some important characteristics from an industry to be revealed and, in overall terms, suggests that an industry may have a current tendency towards a particular market structure.

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*Table 1: SCP pertaining to different types of market structure (Source: Based on Barney 2002: 77)*

<b>Structure</b>	<b>Conduct</b>	<b>Performance</b>	<b>Market Structure</b>
One firm	Use of market power to set prices	Above normal	Monopoly
Costly entry Small number of competing firms Homogenous or heterogeneous products	Collusion	Above normal	Oligopoly
Costly entry and exit Large number of competing firms Heterogeneous products	Cost leadership Product differentiation	Above normal	Monopolistic competition
Low cost entry and exit Large number of competing firms Homogenous products Low cost entry and exit	Price taking	Normal	Perfect competition

It is questionable whether activities like construction, including maintenance and repair, can be considered a single entity or industry – on the basis that different sectors of construction/maintenance use fundamentally distinct resource and skill bases (Eccles 1981; Groák 1994). Indeed, the CIB W55 and W65 (Carassus, 2004) have adopted the focus on sectors, as opposed to one industry, as an approach to analysing the operation and function of construction activity (including maintenance and repair). Furthermore, within different sectors of construction activity, it is possible to identify sub-sectors of firms that specialise in parts of a sector. For example, applying the SCP model to Australian new/installation construction activity, de Valence (2003) classifies two main sectors (main contractors and subcontractors) and their sub-sectors (different sizes of main contractors and varying levels of specialisation amongst subcontractors) and each in terms of their stereotypical market structures. Here, de Valence notes that “one of the interesting aspects of this analysis is that on any given construction project, there will be a range of market structures in existence, with various different forms of competitive behaviour overlapping these” (2003: 823). The purpose of this paper is to apply the SCP model to a different sector of construction activity. That is, air conditioning maintenance and, in doing so, test de Valence’s proposition concerning the existence of multiple market structures in a supply chain to a project/facility.

## RESEARCH METHODS

The research methods combine secondary data concerning the “Structure” component of the SCP model and primary data with regard to the “Conduct” and “Performance” parts of the SCP model. The secondary data pertaining to the “Structure” component is sourced from various public directories of Mechanical Services Contractors (MSCs) and subject to a qualitative interpretation to identify pools of firms whose production and pricing decisions affect each other. On the other hand, the primary data relating to the “Conduct” and “Performance” component is generated from a structured questionnaire completed by three MSCs in Brisbane that were randomly selected. The analysis of the questionnaire data comprised an assessment of the answers in terms of the extent to which these answers correspond with a particular market structure.

## RESULTS

A summary of the results is provided in Table 2.

This shows some similarity with de Valance's assessment of sectors and sub-sectors in new/installation construction activity. That is, two primary sectors comprising mainstream MSCs, with further sub-sectors relating to size of operations, and a specialised sector of MSCs that carry their own proprietary Direct Digital Controls (DDC) system. The justification of these two sectors and the sub-sectors is given in the remainder of this section.

*Table 2: Summary of results market structures in air conditioning maintenance activity - initial assignments based on "Structure" component (Source: Air Conditioning and Mechanical Contractors' Association 2004 and Yellow Pages.com.au 2004)<sup>2</sup>*

Market Structure	Primary Sector 1 (with two sub-sectors) Preventive Maintenance: Main MSCs	Primary Sector 2 Specific DDC maintenance: Either as a subcontractor supplying maintenance to own specific system or as part of main MSC contract supplying both preventive maintenance and maintenance to own specific system
Monopoly	None	None
Oligopoly	None	Large MSCs with own specific DDC maintenance capability Nationally (5 firms) - All C&I Brisbane/SEQ (5 firms) - All C&I
Monopolistic competition	Large MSCs Nationally (11 firms) - All C&I only Brisbane/SEQ (4 firms) - All C&I	
Perfect competition	Small and Medium-sized MSCs Nationally (735 firms) - C&I only (354 firms) - C&I and Home (79 firms) - Home only (302 firms) Brisbane/SEQ (129 firms) - C&I only (56 firms) - C&I and Home (23 firms) - Home only (50 firms)	

Key: SEQ = South East Queensland / C&I = Commercial and Industrial

## Structure

As mentioned, in order to establish a sector, it is necessary to identify a pool of firms whose production and pricing decisions affect each other. Besanko *et al.* (2000) summaries an approach to identifying competitors based on the extent to which competitors' good/services are substitutes. The factors that affect goods' or services' substitutability comprise their performance characteristics, occasions for use and geographical market. Applying the "Structure" component only and employing the

<sup>2</sup> In terms of the ACMA directory, firms operating in more than one state were counted once and those firms that occur in the ACMA directory and Yellow Pages are again only counted once. With regard to the Yellow Pages, firms listed under "Air Conditioning" - "Commercial & Industrial" were searched under "Service", "Maintenance", "Repairs" and "Warranty". Also firms listed under "Installation and Service" were searched under "Commercial and Industrial". Firms appearing in more than one list were counted once. A similar search was applied to firms listed under "Air Conditioning" - "Home", with the exception that under "Installation and Service" firms were searched using "Home Residential Domestic". Firms were counted once in terms of whether they provided either commercial/industrial services only, or commercial/industrial and home services, or home services only.

secondary data used in Table 2, it can be said that the 751 firms providing mechanical services maintenance are not all competing against one another. More specifically, two primary sectors and one sub-sector within one of these primary sectors – each with different stereotypical market structures, can be identified.

The first primary sector relating to mainstream preventive maintenance comprises 11 large MSC firms that only maintain commercial and industrial facilities and each of these firms operate in more than one state in Australia (as a separate subsidiary or licensed firm with unique Australian Business Number for taxation purposes and consistent with an autonomous profit centre) and 735 small to medium-sized firms. The larger firms are able to differentiate their service, in so far as, they have enough technical staff to provide a non-interrupted and sufficiently responsive operation to larger facilities. These firms can also generate economies of scale (and choose to pass on some or all of these economies to clients) by offering their service across a number of facilities. In contrast to the large MSCs, the small to medium-sized MSCs maintain smaller facilities and are located within one state only. Here, the size of the firm appears to be an important factor in determining the performance characteristics of MSCs. Once a facility reaches an important threshold point that makes it more appropriate to use chillers and chilled water, then this generally promotes the larger MSCs in terms of their capabilities in meeting the scope/range or scale of maintenance tasks involved. Beyond this, differences in the maintenance of facilities arise mainly due to the size, complexity and age of the facility, as well as its maintenance policy. Notwithstanding this, these differences have little effect on the scope/range of tasks required on common alternative air conditioning systems, but rather have a greater effect on the extent/scale (or time) that each task takes. This reinforces the position that this sector is differentiated mainly based on the size of firms, in terms of the extent to which firms can meet the extent/scale of work in different type/sizes of retail centre. The geographical scope of operations also seems important in terms of dispersing competition amongst the MSCs in this market sector. The fact that MSCs face a cost in transporting their resources to an immobile facility, means that the small-to-medium sized MSCs compete on a local/regional basis only. Overall, the substitutability of the product provided by MSCs seems to create two broad levels of service on an interstate and intrastate basis. Given that the nature/scope of preventive maintenance requirements to alternative office, retail and industrial facilities appears to be relatively narrow, then there is greater homogeneity of the product in the MSC market sector in smaller facilities. Furthermore, barriers to entry for small-to-medium sized MSCs seem relatively modest. However, there may well be some significant investment involved in recruiting, training and retaining the scale of technical staff required by the larger MSCs, in order that these firms can maintain larger and more complex facilities.

As such, the 11 large MSCs in this sector are initially assigned to a monopolistic market structure and which is consistent with de Valence (2003: 824) classification of new HVAC installation/construction. Whereas, the 735 small-medium sized MSCs are assigned to perfect competition. Furthermore, given the influence of geographical scope of operations on competition, and using Brisbane/SEQ as an example, there would be 4 large MSCs (assigned to a monopolistic market structure) and 129 small to medium-sized MSC (assigned to perfect competition) in this locality.

The other primary sector concerns DDC systems. There are nine firms that cover practically the entire sector in Australia and that are capable of at least the

manufacture and installation of their own proprietary DDC system(s). These firms are able to provide a level of maintenance / support to their DDC system throughout all states and territories in Australia and so geographical constraints do not disperse the competition in this market sector. However, and in addition to the already small number of firms in this sector, the performance characteristics and occasions for use of this product operate to subdivide this sector and significantly further reduce the extent of competition in terms of the maintenance of highly specific DDC systems. First, in terms of performance characteristics, these DDC systems differ mainly in the extent to which the system can be accessed (in particular the software) by firms other than the firm that designed the system. Such that, the five firms noted under the specific DDC maintenance column in Table 2 are the only firms that can fully maintain their firm's own specific DDC system. In contrast, all of the MSCs undertaking Commercial and Industrial work could readily develop the capability to maintain generic DDC systems designed and installed by the other four DDC firms. Second, and in relation to occasions for use, the specific and generic DDC systems differ in respect to the extent to which they are appropriate to buildings of alternative sizes and varying levels of complexity. Here, the specific systems tend to be deployed in larger facilities and the generic DDC systems in smaller facilities. From this analysis of the numbers of competitors in this sector, it is evident that this market is highly concentrated and heterogeneous. Moreover, there is substantial investment in research and development involved by all the firms in this sector, including the time involved in their technicians' learning-by-doing and updating their skills to suit new software and hardware developments. This creates significant barriers to new firms wanting to enter this sector. Accordingly, this sector is assigned to an oligopoly market structure and which is consistent with de Valence (2003: 824) classification of new Building Automation installation/construction. If these initial assignments are accurate, then MSCs selected from each of the three market structures are expected to display different attributes pertaining to the "Conduct" and "Performance" components of the SCP model.

### Conduct and Performance

As mentioned, primary data concerning the "Conduct" and "Performance" items is sourced from a structured questionnaire completed by three MSCs randomly selected to represent each of the three market structures shown in Table 2. A brief profile of the three contractors is given in Table 3.

*Table 3: Brief profile of MSCs*

<b>Brief Profile</b>	<b>MSC 1 from Primary Sector: Preventive Maintenance/Sub-Sector: Large firm</b>	<b>MSC 2 from Primary Sector: Preventive Maintenance/Sub-Sector: Small to Medium-sized firm</b>	<b>MSC 3 from Primary Sector: MSC with own specific DDC system</b>
Year Established	1999 (Queensland)	1989	1980
Type of work	Commercial & Industrial (100%)	Commercial & Industrial (100%)	Commercial & Industrial (100%)
Staff	Management (8)/ Administrative (2)/ Technical (27)/Other (1)	Management (2)/Administrative (1)/Technical (1)	Management (10) /Administrative (10) /Technical (50)/Other 2
Work subcontracted	General Air conditioning Systems (20%)/DDC Specific Systems (80%)	General Air conditioning Systems (90%)	General Air conditioning Systems (0%) /DDC Own Specific System (0%)
Turnover	Between \$10-30million	Up to \$1,000,000	Between \$10-30million

*Table 4: Summary of results from data concerning “Conduct” and “Performance” components*

<b>Conduct Items (1-9) and Performance Item (10)</b>	<b>MSC 1 from Primary Sector: Preventive Maintenance/Sub-Sector: Large firm (Initially Assigned to: Monopolistic Competition)</b>	<b>MSC 2 from Primary Sector: Preventive Maintenance/Sub-Sector: Small to Medium-sized (Initially Assigned to: Perfect Competition)</b>	<b>MSC 3 from Primary Sector: MSC with own specific DDC system (Initially Assigned to: Oligopoly Competition)</b>
Item 1: Type of contract: Preventive /Comprehensive/Other	Preventive (100%)	Preventive (100%)	Preventive (83%) Comprehensive (17%)
Item 2: Typical duration of contracts	5 Years	3 Years	1 year
Item 3: 30 day termination clause normally included in contract	Yes	Yes	Yes
Item 4: Obtaining new work: Open Competition/Competition with selected list of rivals/Negotiation as only contractor/Other	Open (30%)/List (60%)/Negotiation (10%)	List (“Majority”)	List (50%) Negotiation (50%)
Item 5: Authorship of terms and conditions in contracts: Client/Your Firm (MSC)/Standard Form/Other	Clients (“mostly”)	Not Answered	Clients (20%) MSC (80%)
Item 6: Hourly rates specified for breakdown work	Yes	Yes	Yes
Item 7: Current number of clients and contracts	80 (Clients)/600 (Contracts)	31(Clients)/10 (Contracts)	400(Clients) 560 (Contracts)
Item 8: Large percentage of work with few clients	Yes	Not Answered	No
Item 9: In last two years, contracts renewed	50% plus	“More than 50%”	90%
Item 10: Profitability	Above Average	About Average	Above Average

A summary of the three contractors’ responses is shown in Table 4. The results given by the three MSCs indicate a broad hierarchy in market power associated with the three market structures in which they were initially assigned, with MSC 3 showing the greatest level of market power. For example, MSC 3 is the only contractor to take-on the higher risk-based type of comprehensive contract (17%) and negotiates by far the highest level of their contracts as the only contractor (50%). Moreover, MSC 3 authors the vast majority of their contracts (80%). The positions of the three MSCs relative to the “Conduct” attributes are consistent with the positions of the three MSCs in terms of their “Performance” item or profitability. That is, both MSC3 and MSC2 attain above average profitability and MSC 2 achieves at about average profitability. The responses for the typical durations of the contracts might also be explained by the extent of market power. It could be that clients are more comfortable to enter into longer term contracts with firms with a greater number of rivals (and mindful of the ability to employ the 30 day termination clause). Whereas, in terms of MSC 3’s clients, it might be that a shorter contract is a mechanism to counter balance this firm’s near monopoly power. In the end though, this may only amount to a weak threat - in particular in respect of facilities in which the MSC’s own specific DDC system installed. That is, in these facilities MSC 3 attains practically monopoly power as it enjoys a significant competitive advantage over rivals by virtue of unique access to knowledge concerning software to its own DDC system (given the intimate relationship between the functioning of the DDC system and the general air

conditioning system). The client of such a facility faces a substantial switching cost if it were to replace the DDC system or possibly a greater threat of hold-up (Williamson 1985) if it were to have MSC 3 relegated to a DDC subcontractor to an alternative mainstream MSC contractor. In support of the suggestion that MSC 3's shorter contracts represent a weak threat on behalf of their clients, MSC 3 achieves a significantly higher rate of contract renewal than the other two MSCs.

## CONCLUSIONS

Returning to the question concerning the extent to which construction activity, including maintenance and repair, can be considered a single entry or industry, this paper provides further support (beyond de Valance's analysis of new/installation activity) that a sector system approach using the SCP model is a more effective way to analyse market structures in construction activity. In doing so, this paper also supports de Valance's proposition concerning the existence of multiple market structures in a supply chain to a project/facility. That is, MSC 1 (assigned along with the other 10 large MSCs to a monopolistic market structure in Table 2) has, at some point, subcontracted DDC maintenance to mostly all of the specialised large MSCs (assigned to oligopoly in Table 2). This paper also presents a method for undertaking a sector analysis in terms of the initial delineation of market structures combining secondary data and Besanko's approach to identifying competitors based on the extent to which competitors' goods/services are substitutes and in conjunction with primary data concerning the "Conduct" and "Performance" attributes. In terms of future research, the "Conduct" and "Performance" aspect of this paper could be addressed using a far larger data set to generate statistically significant relationships. The fragmented nature of construction activity in developed economies and its complex market structures that form the basis of de Valance's (2003) proposition, and which is now supported by this paper, surfaces challenges that de Valance (2003) has also anticipated in terms of governments developing reform and competition policy. That is, unless a comprehensive picture of sectors and sub-sectors, along with their market structure can be generated, then it seems quite possible that there will be a disconnect between any general reform/competition policy and the firms involved.

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