COVER SHEET

THE USE OF FUNCTION ANALYSIS AS THE BASIS OF VALUE MANAGEMENT IN THE AUSTRALIAN CONSTRUCTION INDUSTRY

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Conclusions	371
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THE USE OF FUNCTION ANALYSIS AS THE BASIS OF VALUE MANAGEMENT IN THE AUSTRALIAN CONSTRUCTION INDUSTRY

ABSTRACT

Function Analysis (FA) is considered to be at the core of Value Management (VM). However, research in the construction industry in the United States and Hong Kong indicates that this fundamental process is sometimes abbreviated or omitted from the VM process. In examining this situation in the Australian construction industry context, the research described in this paper aimed to gather a cross-sectional view of the role of FA in VM in the Australian construction industry by means of a postal questionnaire survey. The results confirm that FA is not always used in the VM process in Australia. Moreover, the functional hierarchy is preferred to the Function Analysis Systems Techniques (FAST) diagram when FA is implemented. It is also found that the greater the knowledge the participants have of FA, the more likely FA would be used in the VM process; while the greater the difficulty in implementing FA, the lesser is the commitment to use FA. In addition it is found that, in many ways, the use of FA and VM in general in Australia mirrors that of its operation (difficulty in applying FA, lack of expert facilitators, etc.) in other countries around the world. Exceptions to this include the length of time VM has been used in Australia and the duration of the VM workshops, both of which are shorter than in most countries.

Keywords

Australian Construction Industry, Function Analysis, Value Management, Functional Hierarchy

INTRODUCTION

Born out of the manufacturing industry in the 1940s, Value Management (VM) aims to achieve value for money by producing a quality product at a reduced cost (McGeorge and Palmer, 1997: 12-13; Green and Popper, 1990: 2). It has developed very quickly and spread across many industries and countries (Fong and Ashworth, 1997: 6, 10), experience showing that quality is frequently increased as a result (Dell'Isola 1982: 2).

However, VM has "little research base or market testing" (Fong and Ashworth, 1997: 6, 10) and, in particular, its core activity, Function Analysis (FA) is increasingly misused or avoided (Fowler 1997: 92). This is said to be due to: the lack of knowledge of VM itself (eg., Fong 1998: V7; Shen 1997: 261; Green and Popper 1990: iii, ix; McGeorge and Palmer 1997: 4; Clark 2000: 7; Fong and Ashworth 1997: 7; Angelo 2002: 71; Barton, 1991: 138; Neasbey et al, 1999: 232; Mansour, 1999: PM16.1; Gough 2000: 1); FA not being easy enough to perform (Smith 1999: 170; Adam and Lenzer (1997: 11; McGeorge and Palmer 1997: 26, 30; Palmer et al 1996: 326, 328); and the lack of experience and training of potential facilitators (eg., Kelly

and Male 2002: 82; Fong 1998: V6; Davis and Yeomans 1998: 14; Shen and Brandon 1991: 168; Fong 1999: 452; Miles 1972: 271-272).

With very few exceptions (eg., Chan et al 1996; McGeorge and Palmer 1997: 4; Clark 2000: 7; Neasbey et al 1999: 232-240; Davis and Yeomans 1998: 14; Chan et al 1996) little has been written on the use of VM in Australia and Chan et al (1996) seems to comprise the sole empirical contribution . Thus motivated, and bearing in mind the reported problems associated with VM in general, and the central role of FA, the main question adopted for the research was *How appropriate is FA as the basis of VM in the Australian construction industry*? From this, three sub-questions were developed, comprising:

1. What is the extent of use of FA in the Australian construction industry?
2. What is the relationship between the lack of knowledge concerning FA and the extent to which FA is used in the process of VM?
3. What is the relationship between the difficulty of implementing FA and the extent to which FA is used in the process of VM?

To answer these questions, a questionnaire survey was conducted in 2003 of a stratified sample of 55 project Clients, VM Facilitators, other VM Participants and Academics throughout Australia, the findings of which are provided in this paper. In short, these confirm that FA is not always used in the VM process in Australia; the greater the knowledge the participants have of FA, the more likely FA would be used in the VM process; the greater the difficulty in implementing FA, the lesser is the commitment to use FA; and that, in many ways, the use of FA and VM in general in Australia mirrors that of its operation (difficulty in applying FA, lack of expert

facilitators, etc.) in other countries around the world. In the first section of this paper, however, a more detailed background to the work is provided. Later, the results of the survey are summarised and examined in relation to the general literature on the topic.

HISTORY OF VM

Value Management (VM) was first introduced to the USA manufacturing industry by Lawrence D. Miles during World War II. The war resulted in a general scarcity of resources, and as an employee with the General Electric Corporation (GEC), Miles was assigned the task of finding a way of reducing the cost of manufacturing without sacrificing either function or quality. As a result, Miles developed a system in 1947 he termed Value Analysis (VA) (Smith, 1998: 297). By 1954, the USA Department of Defence had adopted VA for its procurement services and by the mid-1960s, VA had spread to many federal states, and local government agencies (Dell'Isola, 1982: 1). It was then that the term Value Engineering (VE) was coined to reflect the engineering emphasis of the approach (Miles, 1972: xvii; Dell'Isola, 1982: 1).

The VE concept was introduced to the USA construction industry in 1963 (Dell'Isola, 1982: 1), and it was around that time that the UK construction industry also began to show interest in the concept (McGeorge and Palmer, 1997: 6). While adapting the USA system of Value Engineering to the construction industry in the UK, Miles' work was revisited and a new version of Value Analysis was developed under the name of Value Management[1] (VM) (McGeorge and Palmer, 1997: 16).

[1] The term VM is used in the remainder of this paper to be synonymous with VA and VE.

VM was formally recognized in Australia with the incorporation of the Institute of Value Engineers, Australia (later renamed Institute of Value Management Australia, IVMA) on the 8th November 1977 (IVMA 2003). By the mid-1990s, the New South Wales Department of Public Works and Services (DPWS) made it a 'mandatory requirement' that the VM be used on all major projects (McGeorge and Palmer, 1997: 3).

FUNCTION ANALYSIS

Miles (1972) always emphasised that VM has one specific purpose - the identification and elimination of unnecessary cost. FA, or Value Method as it is sometimes called, is the systematic process of identifying functions and their associated costs, and assessing the necessity of those functions based on established criteria for the product or service. Although the term FA was never used by Miles, the concept of FA is clearly fundamental to the process of VM. In fact, FA is regarded as being so important to VM that it has been described as setting VM apart from other systems and processes (Barton 1991:139; Davis and Yeomans 1998: 13; Zackrison 1997: 32; Mansour 1999, PM16.2). However, despite the acknowledged importance of FA in VM, the observation from VM practices worldwide seem to suggest that this aspect has not always been completely adhered to in the VM process.

The use of FA in the USA

This phenomenon seems to be particularly prevalent within the USA context, where the area of FA appears to have "broken down completely" (Palmer et al 1996: 328). Likewise, it has been observed that "over time, the processes of function identification and depiction have been abridged or, in some cases, omitted from [VM] construction workshops" (Adam and Lenzer 1997: 10). Even Fowler (1997: 92), who was trained by Miles himself in 1955, agrees that since the mid-1980s an "unfortunate tendency" has developed in the practice of VM, chiefly in the construction industry, for the focus in VM to shift from FA to teamwork and reporting.

The use of FA in the UK, British Columbia and Hong Kong

The situation is similar in the UK, where FA is described as being *only a stage* in the VM process rather than *the* core activity (Kelly and Male 2002: 80) and hence VM is thought of in terms of several factors being needed for a successful outcome (Palmer et al, 1996: 328). In British Columbia, VM is said to be more of an independent review of projects, not including FA (McConachy and Baker 1997: 34), while in Hong Kong, there seems to be a greater variety of approaches, with "its application at the present time varying widely from organization to organization, industry to industry" (Fong 1997: 82).

The use of FA in Australia

In Australia, VM is a "relatively new cost engineering concept" (Chan et al 1996: 9) with the single empirical research study to date showing "very limited application of [the] techniques advocated in the USA" (Chan et al 1996: 9). Moreover, the Australian Standard for VM, AS/NZS 4183:1994, states the methodology of the job plan, the commitment of the team members and the facilitations, to be the success factors; while describing FA as just one of the techniques available.

REASONS FOR THE LACK OF USE OF FA

The lack of use of FA in VM is mostly attributable to the lack of knowledge of VM in general and the difficulties of carrying out FA in practice. As Table 1 indicates, VM is a relatively new concept in the construction industry and this, together with the wide variety of current definitions of VM, the inherent difficulties in grasping the concept and lack of guidance, contributes to the lack of knowledge of VM. As a result it has been said that there is often insufficient knowledge for VM implementation due to it being misunderstood and ambiguity about the concept, with FA sometimes not being the main focus of VM, VM being regarded as a purely cost cutting exercise or incorrectly associated with life cycle costing, networking, brainstorming and teamwork.

The difficulties in carrying out FA can be traced to the need to develop a consensus through the arrangement and rearrangement of function relationships; the importance

of building on experience, and that the process takes a lot of time, effort and expertise. Mandatory training is needed for participants in addition to quality facilitation.

This latter aspect is of particular concern as "poor" facilitation has been suggested as one of the obstacles to the development of VM in general (Davis and Yeomans 1998: 14) due to unskilled facilitators increasing the "risk of improper application" of the methodology (Neasbey et al 1999: 238). However, skilled facilitators are not always available. In the UK, for example, the "scarcity of qualified facilitators and improper methodologies" has been found to inhibit the implementation of VM (Shen and Brandon 1991: 168), while Kelly and Male's (2002: 82) case study research, found a "high degree of concurrence" on the use of untrained and inexperienced facilitators in the VM process. Likewise, in Hong Kong, Fong's (1998: V6) research found there to be a "shortage" of VM facilitators, leading to the conclusion that "more trained VM specialists are needed".

In the Australian context, Chan et al's (1996) case studies found an instance of an architect facilitator who had only attended 2 short courses prior to facilitating the workshop. Clearly, this reflects a very low level of competence in FA relative to the Miles' "years of training" requirement for facilitators.

METHODOLOGY

A sectioned questionnaire was designed based on the works of both Palmer *et al* (1996) and Fong and Shen (1999) and utilising a mixture of scales of measurement. Section A was concerned with grouping the respondents into nominal categories for

comparison purposes. For Section B, a mixture of scales was applied to ascertain the source of exposure and the extent of the exposure to VM. For Section C, a fixed sum ordinal scale and semantic differential interval scale was also used to measure the magnitude of the respondents' agreement or disagreement to a list of statements relating to the use of FAST diagrams, functional hierarchy, the role of VM and FA, ease of application and the sufficiency of associated knowledge, expertise, time and confidence. For Section D and E, a mixture of scales and open-ended questions were used to ascertain the respondents' exposure to, and perception of, FA. Section F comprised an open-ended question for any other remarks respondents might want to add.

To obtain an accurate view of the industry toward the subject matter, it was necessary that the sample population for the research include a variety of VM practitioners and construction professionals from all over Australia. However, due to time and resource constraints, it was not possible to include every construction professional group from every State of Australia. Therefore, while endeavouring to include as wide a spectrum of sample population as possible, certain assumptions and limitations were established:

- A stratified strategy was adopted to include professionals from every State in Australia. However, it is recognised that the collected responses may not reflect a balanced representation from each State. Nevertheless, it was assumed that the collected data would reflect the view of professionals across Australia generally.
- Relating to the sample population of VM practitioners, it was assumed that the population is relatively small, hence as many VM practitioners as possible would be approached for inclusion in the sampling.

- Relating to developers and construction professionals, companies within each of the following categories were randomly selected for inclusion in the sample population without regard to size or specific expertise:
    - Major developers, including government agencies where possible.
    - Architects
    - Engineers, including construction and services engineers
    - Quantity Surveyors
    - Construction contractors

Following pilot studies, a sample population of 150 representatives from various professional groups was selected. A number of questionnaires were sent to companies within each professional group in each State and Territory depending on the size of the group listed in the Yellow Pages. The only exception was that of the Professional VM facilitators, where due to the small number of advertised VM facilitators available, all 22 registered VM facilitators from all over Australia were included in the survey. Table 2 lists the professional group and the number of questionnaires sent out to each group for the collection of raw data:

RESULTS

Of the 150 questionnaires dispatched, 55 (37%) valid responses were received. Of these, 6 respondents (11%) identified themselves as Clients, 27 (48%) as VM Facilitators (although it is not known how many of these are registered VM

facilitators), 19 (35%) as VM Participants and the remaining 3 respondents (6%) as Academics.

The mean year when the respondents first heard of VM and first experienced VM are similar for all the respondent groups, with the Academics to be the first to hear of VM in 1988, followed by the Facilitators in 1989, the Participants in 1992 and Clients in 1993. In all cases, the first participation in the VM process happened around one year on average after hearing about VM.

The majority of respondents first heard about VM at VM workshops or from colleagues. The second highest sources of contact are through university courses (16%) and others (16%), including learning through work requirements. Clients predominantly learn about VM from colleagues (67%), while Participants learn about VM from VM workshops (37%). The Facilitators' exposure was more varied, touching all sources, with the majority (22%) learning about VM from a university, while the Academics learnt about VM predominantly from literature, training courses or personal experience.

The majority of respondents (91%) have participated in the VM process (Fig 1) – with the duration of the VM workshop being predominantly 2 days followed by 1 day for Clients and Facilitators; 1 day followed by 2 days for Participants; and the length for Academics depending on the value and complexity of the project, number of participants, extent of preparation and purpose of the process.

Significantly, only 24% of respondents reported FAST diagrams always being used, while 43% reported functional hierarchy always being used – with the same being said for their usefulness (Table3).

The most popular form of VM training is from workshops. The next most popular is: in-house training for Clients; private training for Facilitators; university training for Academics; and both in-house and university training for Participants.

Overall, although 91% of respondents had participated in the VM process, only 84% had heard of FA. Of these, Facilitators are the most familiar with FA with Clients being the least familiar.

Fig 2 indicates that Clients predominantly received their first exposure to FA from workshops, with Participants receiving their exposure predominantly from a university course and Academics from the literature and colleagues. Facilitators received their information from a university course and also as part of their work exposure.

Most respondents are aware of the difference between VM and cost reduction and agree that FA is essential in the VM process (Table 3). Significantly, however, the Facilitators strongly agree that there is sufficient knowledge available to implement FA while the Participators think this is not the case.

The main reasons cited generally for conducting VM are the elimination of unnecessary cost, achieving value for money and to arrive at a more effective design

(Fig 3). The Participants, however, also consider cutting costs to be a major reason, while the Academics consider creative thinking to be more important.

- The most important elements in VM are considered to be brainstorming, FA and teamwork (Fig 4). It is interesting to note that while 23% perceived FA to be important, only 2% perceived the FAST diagram to be important.

Of the 84% that have heard of FA, 29% of the Participants, Clients and Academics believe FA is not necessary in VM, while slightly less (22%) of the Facilitators believe this to be the case. Those who feel FA is necessary commented that: identification of function is foundational to obtaining best value; FA is what separates VM from other processes; and just one of the processes to be considered. Those who feel FA is unnecessary on the other hand commented that: FA is very difficult; not always possible to apply; expensive; inaccurate; and too time-consuming. Some also commented that FA is separate to VM, and is not critical since experience is sufficient to achieve the same result. Moreover, it was perceived that it is the project objective that determines the approach to the workshop, and should therefore not be restricted to FA.

The results suggest that the level of knowledge about FA is related to its essentiality in VM. Testing this statistically, a Pearson correlation coefficient of 0.78 ($p<0.05$) was found between the variables representing perceived level of knowledge about FA and its essentiality in VM. Similarly, there is a significant correlation (0.90) between the perceived level of knowledge about FA and the use of FA as compared to traditional cost savings.

A significant correlation (0.85) was also found between the readiness of the Australian construction industry for FA and the perception that FA is more adequate than traditional cost saving methods. Similarly, there is a very strong correlation (0.91) between the readiness of the construction industry for FA and the perception that the VM process is not an interruption to normal work.

Table 3 includes the responses to a series of questions concerning the relationship between the difficulty of implementing FA and the extent to which FA is used in VM. As can be seen, opinions are divided on all the issues raised. Of the respondent groupings, the Facilitators provided the most contrary answers, in generally believing that briefings are adequate and disagreeing most strongly that the VM process is an interruption to normal work. The Clients, however, tended to agree that there is not enough confidence in FA to introduce it to clients, while the Participants remained neutral.

There is a very strong correlation (0.97) between the perceived availability of specialists in Australia and the use of functional hierarchy, suggesting that the more specialists are available the more functional hierarchy is used. Similarly, there is a strong correlation (0.87) between the perceived difficulty of implementing FA and knowing that VM is different to cost reduction.

CONCLUSIONS

Although FA is considered by many to be at the core of VM, research in the construction industry in the United States and Hong Kong indicates that this fundamental process is sometimes abbreviated or omitted from the VM process. In examining this situation in the Australian construction industry context, the survey results confirm that FA is not always used in the VM process in Australia either. What appears to be the case from the sample surveyed is that many potential participants simply have insufficient knowledge to use FA in the VM process or perceive the difficulties in implementing FA to be too great. In this respect, therefore, the use of FA in Australia mirrors the use of VM in general (difficulty in application, lack of expertise, etc.) although some obvious exceptions to this are the relatively short length of time VM has been used in Australia (less than 30 years compared with 40 years in the USA); the duration of the VM workshops (2 days compared with 40 hours in USA); and a preference for function hierarchy (in contrast with the predominance of FAST in the USA).

A worrying possible implication of this that the difficulty in implementing both FA within VM and VM itself is that VM, as adumbrated by Miles for the manufacturing industry, is not as easily transferable to the construction industry as originally imagined. As has been suggested on many occasions, the construction industry has special features that make it fundamentally different from other industries, even service industries. The bespoke, complex and often uncertain, nature of construction projects may undermine the relatively lengthy investment required in the full VM process in terms of the opportunity costs involves. As a result, FA may be impractical

or, as evidenced by the survey, clients (who may not necessarily be aware of FA) may simply not have sufficient confidence to commission the use of FA.

Of significance in this study, however, is the finding that 67% of respondents indicate that FA is essential in VM. Insofar as this research shows that this is attributable in part to a lack of knowledge concerning FA then there appears to be an opportunity to further develop FA and VM in general in Australia.

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CAPTIONS TO FIGURES AND TABLES

Figure	Caption
1	Duration of VM workshop
2	Where respondents first heard of FA
3	Main reasons for carrying out VM
4	Important elements in VM

Table	Caption
1	Reasons for the lack of use of FA
2	Distribution of questionnaires
3	Responses to questions

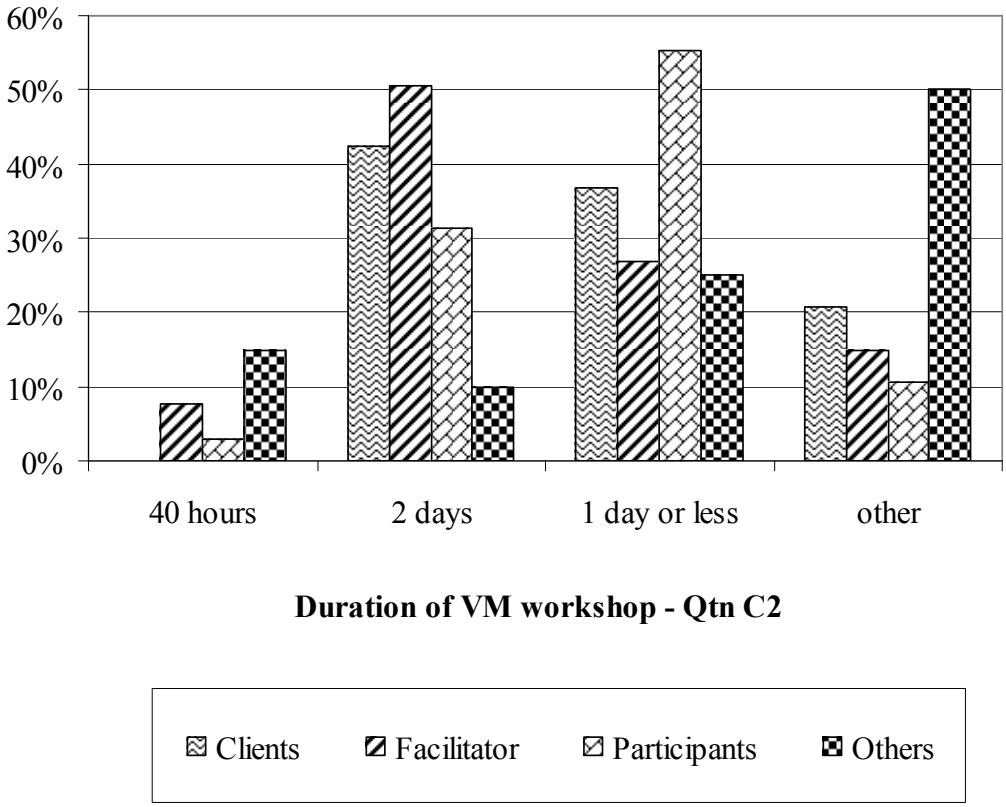

Fig 1: Duration of VM workshop

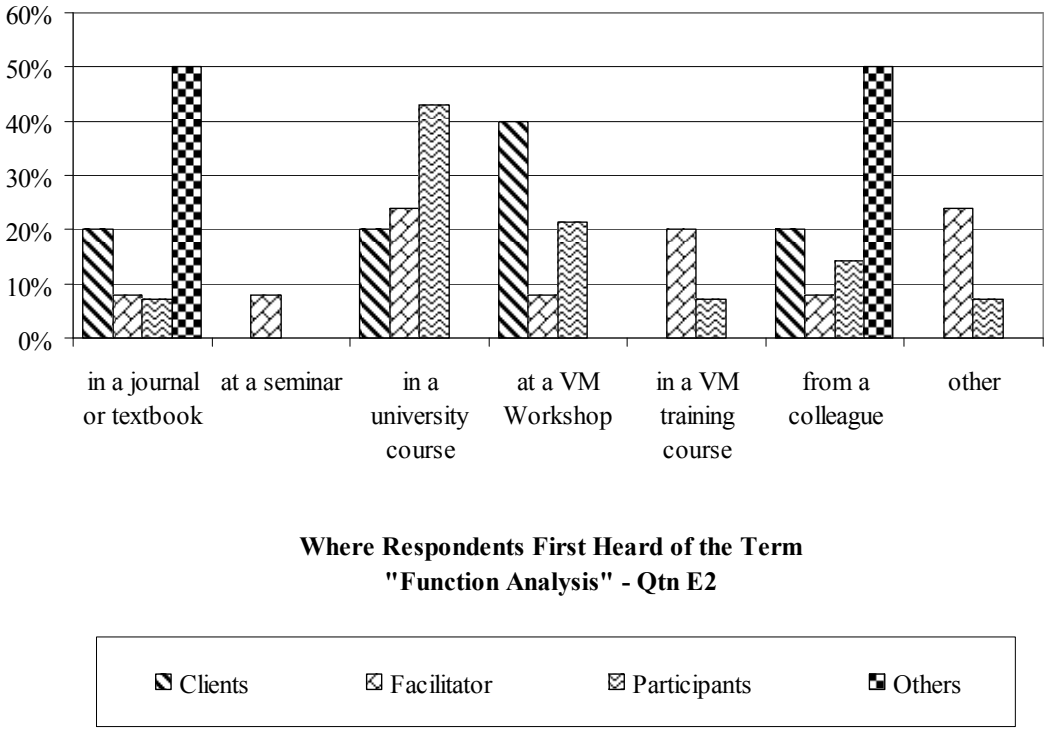

Fig 2: Where respondents first heard of FA

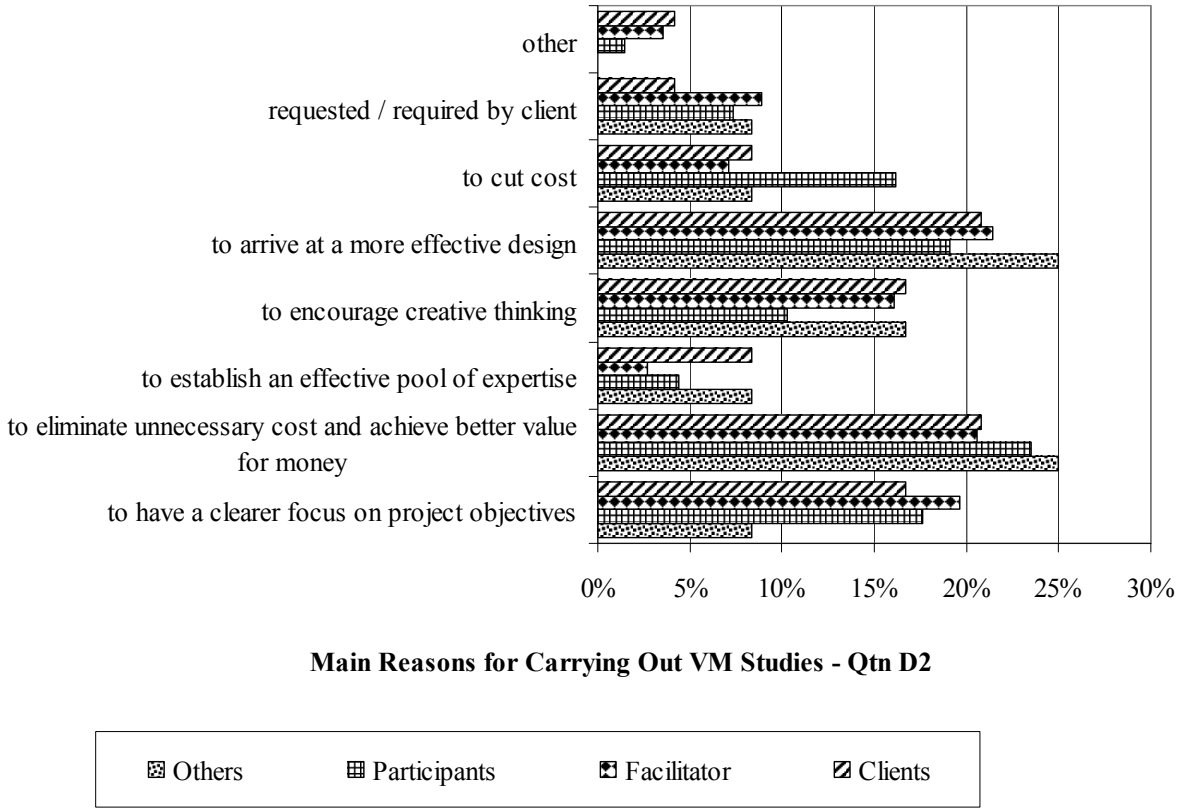

Fig 3: Main reasons for carrying out VM

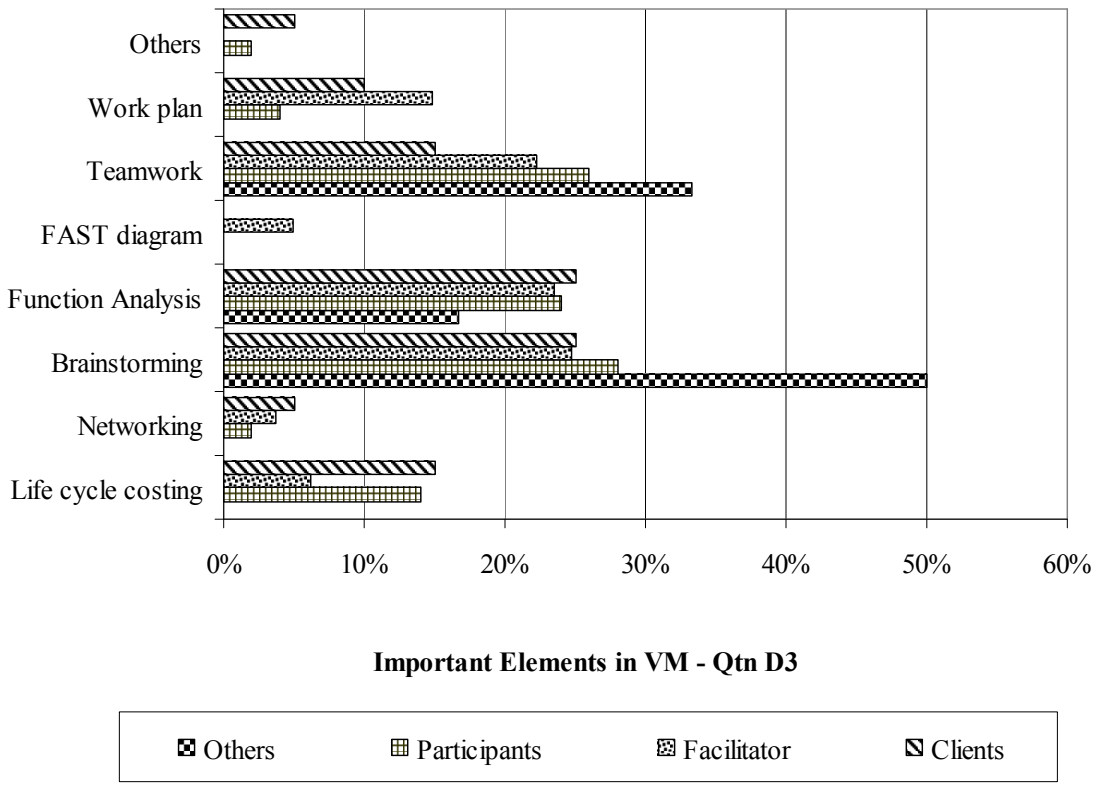

Fig 4: Important elements in VM

THEME	SOURCE
Lack of knowledge of VM	
Causes:	
New concept	Chan et al (1996); McGeorge and Palmer (1997)
Variety of definitions	Barton (1991); Palmer et al (1996); Smith (1998); Kelly and Male (2002); Clark (2000); McGeorge and Palmer (1997); Fong and Ashworth (1997)
Concept is hard to grasp	Gough (2000)
Lack of guidance	McGeorge and Palmer (1997)
Effects:	
Insufficient knowledge for implementation	Shen (1997); Fong (1998); Ma(1991)
VM is misunderstood	Fong (1999); Green and Popper (1990)
Ambiguity about the concept	McGeorge and Palmer (1997)
FA not the main focus	Clark (2000); AS/NZS 4183 (1994); Dell'Isola (1982); Neasbey et al (1999); Kelly and Male (2002)
VM is cost cutting	Herbert (199); Shen (1997); Angelo (2002)
VM associated with life cycle costing	Barton (1991)
VM associated with networking, brainstorming and teamwork	Neasbey et al (1999); Mansour (1999)
FA is difficult to carry out	
Cause:	
Requires the development of a consensus through the arrangement and rearrangement of function relationships	Adam and Lenzer (1997)
Involves building on experience	McGeorge and Palmer (1997)
Takes a lot of time, effort and expertise	Palmer et al (1996); Adam and Lenzer (1997)
Effect:	
Mandatory training is needed	Miles (1972)
Quality facilitation is needed	Miles (1972); Davis and Yeomans (1998); Neasbey et al (1999); Shen and Brandon (1991); Kelly and Male (1998); Fong (1998); Chan et al (1996)

Table 1: Reasons for the lack of use of FA

Professional Groups	*No. of Questionnaires Sent*	*Percentage of Total Questionnaire sent*
Professional VM facilitators	22	15%
Architects	24	15%
Engineers	19	13%
Project Initiators (eg, developers, govt agencies, etc)	30	20%
Quantity Surveyors	30	20%
Contractors	25	17%
Total	*150*	*100%*

Table 2: Distribution of questionnaires

Question	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
FAST diagram is never used	7	8	26	10	3
Functional hierarchy is never used	0	10	21	15	8
FAST diagram is useful	3	10	26	8	7
Functional hierarchy is useful	8	15	21	10	0
VM is the same as cost reduction	0	2	4	28	21
FA is essential in VM?	13	24	15	3	0
There is usually not enough knowledge to implement FA in a project	1	9	12	16	8
There are inadequate briefings at the start of the VM process	3	22	8	17	4
There is adequate time in VM workshops to achieve the workshop objectives	7	26	11	10	0
There is a general lack of VM specialists in Australia	2	18	21	8	5
The VM process is an interruption to normal work	1	6	10	22	15
VM is easy to implement	3	10	13	23	6
There is not enough time to implement FA in a project	0	11	11	14	10
The construction industry is not ready for FA	1	5	14	20	6
There is not enough confidence in FA to introduce it to clients	1	7	13	18	7

Table 3: Responses to questions