Taiwanese Engineering Process Survey Results – A Preliminary Study

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Abstract. The authors have administered a survey to explore certain issues in the management of engineering processes in Taiwan. The results of the survey are reported in this paper along with indications of future research which are suggested by the results obtained. The survey was developed in order to explore the manner in which engineering work is organized and led in Taiwan. The immediate goal of the work is to explore the interaction of Chinese culture and engineering process. The purpose of the work is to develop an understanding of the interaction of Chinese culture and engineering processes in order to provide a foundation to develop a culturally sensitive approach to the management of engineering work that is appropriate in the Chinese context. The survey explores a number of issues around the effect of corporate and project governance and the kinds of management processes used. The survey was developed with closed form questions to enable data analysis independent of language and to provide data which can be analyzed quickly in the development of sufficient empirical understanding to develop future research approaches. The survey deliberately used common language to describe the issues about which questions were asked to avoid any difficulty with alienating respondents who do not overtly practice or use the technical vocabulary of systems engineering. The results we obtained show that systems level issues are important in most of the companies surveyed.

Keywords: Engineering management – Taiwan, Engineering processes – Taiwan

Introduction

The authors have previously published work concerning the relationships between systems engineering process and ethnic culture, both as a generic matter (Ferris 2006; Ferris 2007; Ferris 2008) and in the specific inter-relation of systems engineering process and the Taiwanese form of Chinese culture (Ferris, Wang et al. 2007). In the generic study Ferris argued that a strength of ISO/IEC 15288 (2002) is that it identifies the matters for which processes are required, but does not provide detailed process specification. Although there is discussion in the systems engineering community, and even among the ISO/IEC 15288 authorship, suggesting this feature of ISO/IEC 15288 to be a weakness, Ferris argued that the abstraction of the standard is one of its distinctive contributions. This structure of ISO 15288 releases systems engineering from being a set of procedures and therefore consequent potential for conflict with ethnic cultures. Ferris *et al* (2007) demonstrate that the different conceptualizations of leadership in Chinese and US cultures result in it being inappropriate to blindly apply the US systems engineering processes in a Chinese cultural context. The results achieved may be different than expected, quite probably to the disadvantage of the project.

Culture is difficult to define (Ford, Connelly et al. 2003), but was defined, usefully, by Margaret Mead as “shared patterns of behavior” (Davison and Martinsons 2003). Our work, investigating the inter-relation of ethnic culture and professional practice, is of a kind which has been little investigated because it is professionally risky: the questions and methodology do not fit well with the research paradigms of any professional area (Martinsons and Davison 2003) and the specificity conflicts with the desire for generalizable knowledge and there is a general concern related to political correctness.

The work described above was conceptual. This paper describes empirical results of a survey conducted in Taiwan. The survey was planned as the first stage of a larger project seeking to identify the impact of Chinese culture on engineering practice in Taiwan, and therefore sought to obtain data which would enable the development of further research questions for later work. The longer term purpose of the work is to develop a culturally appropriate form of systems engineering process for use in Taiwan. Since the majority of Taiwanese industry works primarily in the commercial domain the work may also have broader benefit in the application of systems engineering in commercial industry, although this is not our primary purpose, and issues related to the situatedness of the work would need to be considered before generalization. We chose to create a survey instrument that would enable exploration of issues, rather than hypothesis testing, because of the current exploratory phase of our work, and our long-term purpose of engineering rather than science.

Background

Rouse (2005) observes that it is common in systems engineering to think of the system as being the technical product and the operators, but argues that it is important to think of organizations as purposive systems too. This is true of the organization in which the product system is deployed and also of the organization which does the development work.

The authors are concerned with developing two major, long-term, outcomes:

1. Appropriate systems engineering processes for the Taiwanese context; and
2. Educational curricula that will effectively prepare graduates for the systems engineering task in Taiwanese industry.

To date no-one has established findings which enable justified unequivocal statements about either of these outcomes. The works reviewed here have investigated development of systems engineers in a US context and reported empirical findings about engineering management in Chinese and Taiwanese contexts, although most of that work has addressed only parts of the systems engineering sphere of concern.

Arnold and Lawson (2004) argue that any well integrated organization must link the various enterprise management, project management, systems engineering and engineering specialization processes seamlessly. Hwang and Park (2006), writing out of a Korean context, have considered the relationship between the Korean systems engineering process and ISO 15288 and concluded that care is needed to avoid very rigid processes because they will inhibit creativity. This point would appear to be of general applicability. The linkage of processes requires development of a suitable process framework and suitable staff skills and behaviors. Davidz (2006) and Frank (2006) have explored the characteristics required of engineers to contribute effectively to the system conceptualization process. It is untested whether this work is generalizable or culturally specific.

The systems engineering task differs from most industrial processes in that in systems engineering the process performed is the development of a system, something done once, in contrast to most industrial work, which pertains to repeated processes, usually aiming to combine efficiency and effectiveness (Browning, Fricke et al. 2006). A consequence of development project uniqueness is the need for a theory of how projects are done in order to develop better processes (Sauser 2006). The uniqueness of systems engineering work also makes empirical research into processes difficult because the situation does not conform to the underlying assumptions of most scientific investigation, such as the idea of repeatability of observations.

Many others have investigated aspects of the impact of ethnic culture on teamwork. Lynn

(1991; 1999; 2002) studied the contrast between US and Japanese engineering environments concluding that simplistic arguments about cultural differences are ineffective and that perception of process efficiency is culturally relative. These reports support the authors' decision to not follow Hofstede's (1984) analysis of culture (Ferris, Wang et al. 2007).

A common cause of project failure is that the reporting from the lower ranks about difficulties often disguises problems until the problems are plainly evident and inescapable (Snow and Keil 2001; Snow and Keil 2002; Tan, Smith et al. 2003; Du, Keil et al. 2006). These papers indicate that the prevalence and nature of project progress problems are associated with reporting biases in particular ethnic cultures. However, the attribution of problems to particular characteristics of the ethnic cultures discussed is very brief. These studies did not investigate the deep seated nature of the problems confronted.

There have been many studies of the interaction of ethnic culture and technologies related to engineering teamwork including the adoption of telecommunication tools by distributed teams (Shin, Higa et al. 1999; Sosa, Eppinger et al. 2002; Weisinger and Trauth 2003) and the response to internet based technologies (Loch, Straub et al. 2003; Rose, Evaristo et al. 2003). However, these studies have focused on issues at the interface of culture and technology affecting the use of the technology, not the behavior of the engineering team developing the technology.

Teamwork has been a common theme for research with findings including the important place of tacit knowledge (Lawson 2005; Tiwana and Bush 2005). Hsu, Wu and Yeh (2007) studied knowledge sharing in a Chinese context concluding that information sharing is restrained unless the team captures the sense of *guanxi* through emphasizing the affective tie between the team members. Hsu *et al*'s approach relies on specific aspects of Chinese culture. This contrasts with Hofstede's (1984) categorization of ethnic cultures according to four, and later five, dimensions (Hofstede 1994). Hofstede's work is expedient as a framework associated with instruction about cultural sensitivity, and to provide 'broad-brush' presentations of cultural characteristics, but is not useful for identifying the behaviors to be encouraged. The latter requires immersion in the culture which is a time consuming, expensive and culturally specific process (Ford, Connelly et al. 2003). Wang *et al* (1996) assert that concurrent engineering works well in Japan but note that hierarchical relationships present a particular challenge in concurrent engineering. Hierarchical relationships are a feature of Chinese culture discussed in Ferris *et al* (2007) as important in the application of systems engineering processes.

The Taiwanese authors Lin and Chen (2004) describe four dimensions of social networks, which will have particular character resulting from the ethnic cultural context: relations, ties, multiplexity and composition. The Taiwanese industrial setting has the significant pattern, with many cultural and historical causes, of a high proportion of Small to Medium size Enterprises, SMEs, making the formation of inter-enterprise alliances and networks critical to the success of all the participants (Rosenblatt and Perry 1994).

Survey Administration

We developed a survey instrument, to be administered as an anonymous internet survey, described in (Ferris, Peng et al. 2008)[1]. The authors met to discuss the work to progress from their previous work, Ferris *et al* (2007) with a view to understanding the engineering management and systems engineering approaches in use in Taiwan. In this meeting, questions were developed to explore the range of issues of interest, mostly asking indirectly about issues such as the kind of people who would be considered desirable employees, and management and leadership processes. The questions were prompted by our reading of the literature in the

[1] The survey received ethics approval through University of South Australia, project P001/08.

references and our construction on those ideas.

The survey participants were invited by email, including a link to the survey, and could answer or omit any questions at their discretion. The survey was administered during July to September 2008. Invitations to participate were sent to a wide variety of Taiwanese businesses, the majority being SMEs, but the responses that contained data were from only twelve large businesses, employing more than 200 staff. We had a total of 35 responses to the survey. That is, the survey database created 35 records of participation, but only 12 responses containing respondent inserted data, all of which contained answers for most or all of the questions. The remaining responses were made by people who ended their participation without submitting and saving their responses. The results obtained are described in this paper.

The number of responses was very small compared with the number of invitations to participate which were sent, 700. Therefore it is not possible for us to make statistically significant conclusions, and this paper does not make claims for statistical significance of the results reported. The limitation of the valid responses to large businesses prevents us from exploring the relationship of business size and responses to any of the questions. This lack of information about SMEs is particularly disappointing to the authors because our conjectures about the cultural effects suggest to us that the most pronounced effects would have been found in SMEs.

The invitations to participate were sent to businesses doing engineering work with no filter applied for businesses who say that they use systems engineering or a systems engineering derived method of work, nor for the industry sector in which those businesses operate. Therefore the majority of invitations were sent to businesses operating in the commercial sector, not in the defense and aerospace sectors usually associated with systems engineering. Both these industry sectors are present in Taiwan, and have a record of significant achievement. The plan to invite a broad range of participants led to our choice to avoid specific systems engineering vocabulary, and rather to ask questions about the issues rather than the terminology.

Our interest in this approach was prompted by our view that the fundamentals of the systems engineering approach to engineering are valuable to industry in general and that the major issue for the Taiwanese context is to develop a method of engineering which achieves the desirable outcomes of the systems engineering approach to projects through addressing the major issues addressed in systems engineering. However, our work is predicated on the anecdotal and reasoned finding replication of systems engineering processes, in detail, from elsewhere is neither important nor likely to be successful.

Survey Results

Part 1: Business Context. The first group of questions concerned the business context. These were included in order to provide general information about the business because we reasoned that the governance of the engineering activity of the business is likely to be influenced by the general corporate governance structure and the kind of activities done by the business. These results are shown in Table 1.

This section shows that the companies that responded were large companies, of over 200 people, and that the majority were listed on a stock exchange, indicating the necessity of corporate governance processes that would satisfy the listing rules. Consistent with the size it was found that the companies were all over 12 years old. However, most of the companies were led by either the founder or a close relative of the founder, and most companies were established to exploit the particular knowledge of the founder. More specifically related to the kinds of engineering work performed, most companies manufacture primarily for corporate customers, in distinction with manufacture for the retail market or government, and some perform design in addition to manufacture. The majority of the companies have more than one work site, separated by a significant distance but, whilst there is significant working across sites, most projects are done primarily at one site.

This combination of responses is suggestive of a set of respondents representing fairly mature enterprises which should have developed sound processes for performing work in order to satisfy governance requirements and to have grown to their current size.

Section 2 of the survey investigated the expectations of the capabilities of engineers in the company at two levels; the new or graduate engineer seeking entry to the company and the senior engineer to be appointed to a leadership role in the engineering activities of the company. Results are presented in Table 2.

The questions of section 2 were in the form of a 5-point Likert scale, ranging from "marginal importance" to "very important". The mean and standard deviation results for both classifications of engineer are displayed, and calculated using equations (1) and (2).

Table 1 - Understanding the company context (Section 1)

Does your company:		Number
a	Only design products or services	1
b	Design and produce products or services	4
c	Design products or services under contract to other organisations	3
d	Manufacture products under contract to other organisations (no design)	3

Is your company's major market:		Number
a	The public at large	3
b	Other companies	4
c	Government acquisition	0
d	Other companies and government	3

How large is your company:		Number
a	0-20 employees	0
b	21-50 employees	0
c	51-100 employees	0
d	101-200 employees	0
e	More than 200 employees	11

Is your company:		Number
a	Listed on a stock exchange	7
b	A private company (limited number of share holders)	2
c	Owned by a family group	0
d	Owned by a few partners	1

Is the company leadership (top management personnel)		Number
a	The company founder or owner	6
b	A close relative of the founder or owner (such as the founder's children)	2
c	Professional management not related to the founder or owners	2

How long has your company been operating		Number
a	Less than one year	0
b	Between 1 year and five years	0
c	Between 5 years and 12 years	0
d	Over 12 years	11

Did the company begin to apply the knowledge and skills of the founder(s)	Number
Yes	8
No	2

At how many sites does your company operate:		Number
a	1 site	0
b	2 or more sites within easy commuting distance	1
c	2 or more sites separated by more than 2 hours travel time	9

Only show question below with * if either b or c is answered above) *Do staff travel between sites frequently?	Number
Yes	7
No	3

*Are there some staff who spend a large proportion of their work time at each of more than one site?	Number
Yes	5
No	4

Are projects normally arranged to be done at one site?	Number
Yes	7
No	3

$$Mean = \frac{\sum_{i=1}^{5} n_i . i}{\sum_{i=1}^{5} n_i} \quad (1)$$

$$StdDev = \sqrt{\frac{\sum_{i=1}^{5}\left(\sum_{j=1}^{n_i}(j - Mean)^2\right)}{\left(\left(\sum_{i=1}^{5} n_i\right) - 1\right)}} \quad (2)$$

where n_i is the number of response i

i is response number : 1 = marginal importance, 3 = moderately important, 5 = very important

j is a count of the number of each response

Equations (3) and (4) were used to calculate the entries in the comparison columns.

Table 2 - Expectations of the capabilities of new or graduate engineers and of engineers to be appointed to a senior engineering role (Section 2)

Attribute	New/Graduate Engineer		Senior Engineer		Comparison of new and senior engineer expectations	
	Mean	Standard Deviation	Mean	Standard Deviation	Difference of Mean	Difference Standard Deviation
Academic results in degree studies	3.182	0.751	3.100	0.994	-0.082	0.244
Detailed technical knowledge of the field	3.091	0.539	4.375	0.518	1.284	-0.022
Technical knowledge of other fields	2.636	0.505	3.500	0.707	0.864	0.203
Competence with generic software tools – e.g. Word, Excel …	3.400	0.699	3.600	0.699	0.200	0.000
Competence with software tools (specialist for your area of work)	3.273	0.786	4.000	0.817	0.727	0.030
Competence in making things (related to laboratory and experimental development)	2.818	0.874	3.700	0.675	0.882	-0.199
Able to take a 'whole of product' perspective	2.909	1.136	4.100	0.876	1.191	-0.266
Interested in the application situation of the product	3.091	1.044	4.000	0.817	0.909	-0.228
Ability to learn new knowledge and skills using books, journals and internet	3.455	0.820	4.200	0.632	0.745	-0.188
Willingness to try new activities when necessary	3.727	1.009	4.000	0.667	0.273	-0.342
Curiosity to learn more about their field of technology	4.091	0.831	4.100	0.568	0.009	-0.264
Ability to create new product ideas	3.615	1.044	4.100	0.738	0.485	-0.306
Ability to present new product ideas to others in the company	3.182	1.168	3.800	1.033	0.618	-0.135
Ability to ask insightful questions related to their work	3.727	0.905	4.333	0.707	0.606	-0.197
Good interpersonal skills	3.455	1.036	4.100	0.738	0.645	-0.298
Good communication skills	3.727	0.786	4.300	0.675	0.573	-0.111
Good in team work	4.182	0.874	4.500	0.527	0.318	-0.347
Ability as a leader of others or a team	3.091	0.831	4.600	0.516	1.509	-0.315
Ability to develop a work plan	3.455	0.688	4.500	0.850	1.045	0.163
Ability to monitor progress and compliance to a work plan	3.364	0.809	4.500	0.527	1.136	-0.282
Ability to take remedial action to deal with deficient progress in a work plan	3.818	0.982	4.333	0.707	0.515	-0.275
Ability to define boundaries of responsibility for work	3.636	1.027	4.333	0.707	0.697	-0.320
Ability to consider non-engineering factors affecting a project	2.889	0.601	3.750	0.463	0.861	-0.138
Ability to define the scope of problems	3.273	0.905	4.444	0.726	1.172	-0.178
Ability to comprehend the breadth of issues affecting problems	3.091	0.539	4.111	0.601	1.020	0.062
Ability to take action which effectively addresses the whole of problems	3.182	0.751	4.222	0.833	1.040	0.083
Ability to recognise the ethical issues associated with their work	3.300	0.675	3.750	0.707	0.450	0.032
Ability to satisfactorily resolve ethical tensions in their work	2.900	0.738	3.750	0.707	0.850	-0.031
Ability to understand the international issues in the industry	3.091	1.136	4.000	0.866	0.909	-0.270
Ability to make reasonable decisions when faced with incomplete information	2.818	0.405	4.333	0.707	1.515	0.303
Ability to decide on reasonable action in ambiguous situations	3.000	0.775	4.111	0.782	1.111	0.007
Ability to adapt to new situations	3.455	0.934	4.000	0.707	0.545	-0.227

$$Difference\_of\_Means = Mean_{Senior\_Engineer} - Mean_{New\_Engineer} \quad (3)$$

$$Difference\_of\_Std\_Devs = Std\_Dev_{Senior\_Engineer} - Std\_Dev_{New\_Engineer} \quad (4)$$

In the results we observe that for new graduates most of the mean scores are a little higher than three, the scale value corresponding to moderately important, indicating that all of the categories investigated are considered reasonably important but the only two questions scoring higher than four were for curiosity about the field of practice and teamwork. This suggests that these two matters are a focus of attention in the appointment of new engineers. We speculate that this may be because, in comparison to the other matters, these qualities are less well developed and become desirable distinguishing points for employment decisions. The speculation that the questions rated as of 'high importance' indicates some deficiency in the average graduate with respect to those matters then suggests that for the remainder of the topics the education system provides at least adequate results, or levels of attainment which the employers accept as being as good as they are going to obtain.

The other interesting columns are the comparison between the desirable characteristics of new engineers and senior engineers. The only negative score in comparison of means was for academic qualifications, indicating that in the appointment of senior engineers professional track record is more important than academic results.

Ten questions had an increase in importance of greater than one scale point for senior engineers, being detailed technical knowledge of the field; ability to take a 'whole of product' perspective; ability to lead teams; ability to develop a work plan; ability to monitor compliance with a plan; ability to define the scope of problems; ability to comprehend the breadth of problems; ability to address the breadth of problems; ability to make decisions with incomplete information; and ability to take reasonable action in ambiguous situations. These questions indicate a concern for the ability of senior engineers to take responsible leadership at a level very much greater than the level expected of new engineers. These capabilities are consistent with expectations based on general practices in engineering organizations, and reflect engineering leaders having roles with responsibility consistent with seniority.

These questions also show a concern by the employers for the engineer's capacity to think and work at the whole of product system level in order to make system type contributions, particularly at the senior engineer appointment level.

Section 3 of the survey contained a series of questions concerning the engineering management processes used in the company. Table 3 contains the results of the Likert scale type questions, with mean and standard deviation calculated using equations (1) and (2).

The results in Table 3 show high to very high scores of importance reported for all the questions except for surveying the market about the product concept. The questions that have scored highly primarily concern the processes of teamwork, including the contribution of creative product concepts, progress monitoring processes and the solution of difficulties. The recognition of these types of issues as very important by many of the respondents suggests that current experience makes those respondents acutely aware of difficulties with respect to these matters. This speculation cannot be proven, given the limitations of our data, but seems consistent with the general position that people place explicit importance on matters which they have difficulty addressing and do not focus attention on matters which are adequately addressed in the current situation.

Table 4 provides the responses to the multiple choice and yes/no answer questions related to engineering management processes. Only one response to each question was possible.

The results presented in Table 4 provide some reasonably clear trends. In particular, the companies have clearly defined product development documentation processes which tend towards the full documentation of every detail of the project, even where the ideas have not been incorporated into the final, deliverable, version of the product.

Table 3 - Engineering Management processes, Likert scale questions (Section 3)

Attribute	Mean	Standard Deviation
Getting the product concept right	4.571	0.787
Consulting the user about the product concept	4.143	0.690
Surveying the market about the product concept	3.429	1.272
Consulting the customer about the product concept	4.143	0.900
The creative design contributions of the leading engineer	4.143	0.900
The creative design contribution of the junior engineer	4.000	0.816
Accurate reporting of progress by junior engineers	4.429	0.787
Accurate observation of progress by the lead engineer	4.571	0.535
Maintaining harmony between members of the design team	4.000	1.000
Communicating complete product information within the design team	4.143	0.690
Sharing information within the design team to develop solutions to problems	4.286	0.951
Design team members sharing difficulties they face within the team	4.286	0.488
Design team members assisting each other in finding solutions to difficulties	4.571	0.787
Design team members sharing difficulties they face with their supervisor/manager	4.571	0.535
The supervisor/manager assisting design team members in finding solutions to difficulties	4.714	0.488

The companies have defined approaches and practice for the development of project plans and estimates. The majority of the companies use the inputs of the project managers, and in some cases staff who are likely to be involved in the project, so there is clearly devolution of the detail planning and estimation process to those responsible for implementation. We did not attempt to investigate the accuracy of estimates nor the quality of planning.

We found that a spread of methods are used to ensure that the product matches the market need, probably reflecting the range of company contexts faced by the companies represented in the survey, see Table 1. However, we also found that the engineering manager is expected to make a significant contribution to the formulation of the product concept, with very high 'yes' counts for each of the final three questions. This observation suggests a weighting of responsibility towards the engineering manager and away from other members of the team.

We found that the interaction between managers and staff working on projects involves the use of significant numbers of meetings and that meetings are a major tool of the management and supervision role. The responses indicate some range in the nature and purpose of the meetings, including formal and informal events, some of which have planned agendas. It is interesting that approximately equal numbers indicated that their companies have policies which guide the frequency and agenda of meetings and indicated the contrary. This finding suggests a matter for further investigation, of the kind of policies and guidance imposed by the companies in relation to meeting frequency and business. Our results indicate the presence of meetings which address a range of matters to be expected, from a Western setting, but have not given any clear indication of the dynamic processes of the meetings. Further work to explore the nature of the dynamic processes within meetings would be valuable, since it is a fact of experience that the form of a meeting can be used in a wide variety ways, ranging from the extremes of bottom-up democracy to a venue for the declaration of leadership decisions.

We also found that the manner of managers providing instructions to staff tends to be the discrete form of one-to-one communication, whether written or spoken, rather than communication in the public space.

The majority of the questions in Table 5 received a moderate to high importance rating. This importance rating indicates some, but not particularly strong, interest to ensure that the products or services designed and developed will provide good, balanced contributions in their field of deployment. There is some evidence of the need to address the design and development process in a manner that achieved the goal of overall balanced system perspectives. It is likely

Table 4 - Engineering Management multiple choice and yes/no questions (Section 3)

In your product or service development do you:		Number
a	Document in detail all the ideas, technical data and decisions including what is decided against	4
b	Document in detail the ideas, technical data and decisions that are incorporated into the product or service design	3
c	Document the minimum information judged necessary to help later design or product support work	1
d	Document only what is required by law	1

Does your company have a clearly defined policy about what product design information will be documented	Number
Yes	6
No	1

Does your company have a standardised approach to the development of project plans	Number
Yes	6
No	1

Who provides the project planning estimates for the amount of work and other resources required in order to do work		Number
a	Members of central company management	1
b	The project manager for the particular project	4
c	The staff who will actually do the work	2

Who prepares the project plan for design and development projects		Number
a	Members of central company management	0
b	The project manager for the particular project	5
c	The staff who will actually do the work	2

Does your company update project plans in response to progress and changes which happen during project execution	Number
Yes	7
No	0

How does your company ensure that the product design matches the market need		Number
a	The engineers designing the product are responsible to explore and meet the need	0
b	An external party/customer provides a technical description/specification of the product they want	2
c	A central manager of your company is responsible for the product concept development	1
d	The project manager is responsible for product concept development	1
e	Your company employs people specifically to develop the product concept to match the market need	0
f	Your company uses a combination of the above	3

Which of the options below is the main method engineering managers in your company supervise their subordinates:		Number
a	Frequent visits to the work area (several times per day) and/or frequent phone calls (several times per day) to each engineer	1
b	Waiting for contact from the engineer when the engineer has something to report or seeks instruction	1
c	Individual supervisory meetings on a scheduled or appointment basis	0
d	Team meetings on a scheduled or appointment basis	4
e	Written reports and written instructions for action	0

Are all contacts between the engineering manager and their staff normally documented	Number
Yes	3
No	4

Do project teams conduct informal meetings about project matters, for example in the work space or the lunch-room	Number
Yes	7
No	0

Do any informal meetings about projects normally include:		Number
a	The staff who are involved in resolving difficulties or potential difficulties	4
b	The friendship network of staff members	3

Do informal meetings about projects often include the manager responsible for the group	Number
Yes	5
No	2

Do projects in your company normally use official meetings to discuss and/or resolve issues in the project.	Number
Yes	7
No	0

The major purpose of meetings in your company is to:		Number
a	Make decisions about action to be taken or designs to be followed	3
b	Discuss issues and provide a report enabling a decision maker to make the decision	2
c	To report information so that all parties understand the current status of the project	2

Does your company have a policy for the frequency and kind of business to be addressed in project related meetings	Number
Yes	3
No	4

Does your company have a policy which strongly guides the agenda in project related meetings	Number
Yes	3
No	4

Are the majority of project related meetings in your company comprised of:		Number
a	Leaders or managers of particular areas of concern	4
b	Supervisors and the staff who report to them	3
c	The subordinate staff meeting without their manager	0

In your company do managers normally give instructions to their staff		Number
a	In writing, in a one-to-one communication	2
b	In writing, in a document which will be seen by other staff	1
c	Verbally, in a one-to-one setting	3
d	Verbally, in a setting including the subordinate's peer co-workers	1

In your company is the engineering manager expected to provide detailed technical knowledge and insight influencing the product design	Number
Yes	6
No	0

In your company does the engineering manager make a significant contribution to identifying the need to be addressed by the product	Number
Yes	6
No	1

In your company does the engineering manager make a significant contribution to the product design concept	Number
Yes	6
No	1

that the mix of results to these questions relates to whether the major market is finished products sold to the public or intermediate products, sold to other businesses, who in turn take responsibility for the whole system.

Table 5 - Emphasis on product attributes (Section 4)

Attribute	Mean	Standard Deviation
Designing your product to fit in well with a set of other products and services which are not part of the project	3.000	1.000
Designing your product or service to incorporate existing products or services	3.286	1.254
Designing your product or service to provide good value for all stakeholders	3.714	1.254
Designing your product or service using good environmental practice	3.286	0.951
Designing your product or service to provide a low whole of life cost to the owner	2.857	1.069
Designing your product or service to allow future expansion or adaptation to other needs	3.714	0.756
Designing your product or service to provide a balanced solution to the needs of all stakeholders	3.714	1.496
Designing your product or service to satisfy the functional and technical needs of the customer	4.857	0.378
Designing your product or service to provide enjoyment or status to its users	3.714	1.113
Does your company aim to compete primarily on product cost/price	4.286	0.756
Does your company aim to compete primarily on product quality	4.714	0.488
Does your company aim to compete primarily on intangible benefits to customers	4.125	1.126

The questions that received relatively low scores, including one lower than 'moderate importance', were 'design to fit with other products or services', 'design to incorporate existing products or services', 'design for the environment' and 'design for whole of life cost'. The responses to these particular questions may be influenced by the industry sector and customers of the respondents, because the results in section 1 indicated that most of the respondents were working in the business-to-business supply chain environment rather than designing finished products for distribution to end users. This particular focus is likely to explain the pattern of results reported in Table 5.

Conclusions

Our survey attracted a very small number of responses, but all the responses were from larger companies, and therefore the results reflect, at least, practice in larger companies in Taiwan. The low response rate has prevented any exploration of the issues raised by Lin and Chen (2004) and Rosenblatt and Perry (1994).

Our questions, whilst avoiding language which overtly refers to systems and systems engineering but uses common language to express systems related concepts, have identified an interest in achieving balanced systemic types of outcomes.

We have identified areas of interest for further research in the dynamics of meetings used in the project management process in order to understand the relationship between the leading managers and the staff. Research in this area would enable testing of the conceptualizations expressed in our earlier work (Ferris, Wang et al. 2007).

In the discussion of Table 2 we identified several areas of concern which were rated as 'very important' and speculated that these areas of concern may be so rated because of difficulty finding people with the requisite characteristics and abilities. Our speculation is based on an apparent differences between the results reported, common views about Chinese culture and the more detailed, theoretical, work about Chinese culture and engineering process which we reported (Ferris, Wang et al. 2007).

Our survey, whilst being so poorly responded to as to make the results of no value for statistical analysis do provide indications of fields for further research. Our experience with the running of this survey has led us to conclude that further progress is most likely to be made through an interview related process rather than an anonymous survey. The advantages of an interview include the ability to obtain richer understanding of the situation and to follow certain paths of investigation subject to interviewee provided information. Interviews also provide the advantage of being conducted in a direct personal relational setting. The interview process also overcomes the problems associated with attempting to explore rich information using closed form questions.

Our reason for using a survey for this study was to obtain data which would be amenable to numerical processing. This stage of the project was intended as the means to draw a broadly based picture of the situation in order to enable development of further research questions which would be explored using interviews. We are currently evaluating the appropriate kind of interview structure in order to obtain useful findings. In particular we need to consider the balance of questions with closed and open form answers.

References

Arnold, S. and H. W. Lawson (2004). "Viewing systems from a business management perspective: the ISO/IEC 15288 standard." Systems engineering 7(3): 229-242.

Browning, T. R., E. Fricke, et al. (2006). "Key concepts in modeling product development processes." Systems engineering 9(2): 104-128.

Davidz, H. L. (2006). Enabling systems thinking to accelerate the development of senior systems engineers. Engineering systems division, Massachusetts Institute of Technology. PhD.

Davison, R. and M. Martinsons (2003). "Guest editorial cultural issues and IT management: Past and present." IEEE transactions on engineering management 50(1): 3-7.

Du, S., M. Keil, et al. (2006). The role of perceived control and expertise in IT project risk assessment. Proceedings of the 39th Hawaii international conference on systems sciences. 8: 1-10.

Ferris, T. L. J. (2006). Cross-cultural issues associated with the application of ISO/IEC 15288 standard. 16th annual international symposium systems engineering: shining light on the tough issues. Orlando, Florida, International Council on Systems Engineering: paper 5.1.2.

Ferris, T. L. J. (2007). Engineering Practice and National Cultural Context. Proceedings of the 2006 International Engineering Management Conference IEMC 2006 Engineering Management: The Human Technology Interface. Bahia, Brazil: 32-36.

Ferris, T. L. J. (2008). Systems engineering process standardization and cultural diversity. 19th International Engineering Management Conference Managing Creativity … the Rise of the Creative Class. Austin, Texas, IEEE.

Ferris, T. L. J., W. Y. S. Peng, et al. (2008). Method for comparative study of engineering process in Taiwan and Australia. APCOSE 2008 Systems engineering: Wisdom for global harmony. Yokohama, Japan, Keio University: 12pp.

Ferris, T. L. J., T. J. Wang, et al. (2007). The interface of Chinese culture and systems engineering process. Proceedings of the Asia Pacific systems engineering conference. Singapore.

Ford, D. P., C. E. Connelly, et al. (2003). "Information systems research and Hofstede's *Culture's Consequences*: An uneasy and incomplete partnership." IEEE transactions on engineering management 50(1): 8-25.

Frank, M. (2006). "Knowledge, abilities, cognitive characteristics and behavioral competences of engineers with high capacity for engineering systems thinking (CEST)." Systems engineering 9(2): 91-103.

Hofstede, G. (1984). Culture's consequences international differences in work-related values.

Newbury Park, Sage Publications.
Hofstede, G. (1994). Cultural constraints in management theories. International review of strategic management. D. E. Hussey. Chichester, John Wiley. 5: 27-48.
Hsu, B.-F., W.-L. Wu, et al. (2007). Personality composition, affective tie and knowledge sharing: A team level analysis. PICMET proceedings. Portland, Oregon: pp 2583-2592.
Hwang, Y. H. and J.-G. Park (2006). "Approaches and requirements to develop and improve the standard processes for a research and development organization." Systems engineering 9(1): 35-44.
ISO/IEC (2002). ISO 15288 systems engineering - system life cycle processes, ISO/IEC.
Lawson, E. C. (2005). An examination of social systems of engineering projects. Adelaide, University of South Australia. PhD: 275.
Lin, F.-r. and C.-h. Chen (2004). Developing and evaluating the social network analysis system for virtual teams in cyber communities. Proceedings of the 37th Hawaii international conference on system sciences: 1-8.
Loch, K. D., D. W. Straub, et al. (2003). "Diffusing the internet in the Arab world: The role of social norms and technological culturation." IEEE transactions on engineering management 50(1): 45-63.
Lynn, L. H. (1991). Cultural differences and the management of engineering in U.S.-Japanese joint ventures. Technology management: the new international language. D. F. Kocaoglu and K. Niwa. Portland, Oregon, IEEE: 473-475.
Lynn, L. H. (1999). Engineers and engineering in the U.S. and Japan: What have we learned from comparative studies. Portland international conference on Management of Engineering and Technology, PICMET'99. Portland, Ohio, IEEE. 2: 304-308.
Lynn, L. H. (2002). "Engineers and engineering in the U.S. and Japan: A critical review of the literature and suggestions for a new research agenda." IEEE transactions on engineering management 49(1): 95-106.
Martinsons, M. G. and R. Davison (2003). "Guest editorial cultural issues and IT management: Looking ahead." IEEE transactions on engineering management 50(1): 113-117.
Rose, G. M., R. Evaristo, et al. (2003). "Culture and consumer responses to web download time: A four continent study of mono and polychronism." IEEE transactions on engineering management 50(1): 31-44.
Rosenblatt, A. and T. S. Perry (1994). "How countries compete: teamwork on a national scale." IEEE spectrum: 49-62.
Rouse, W. B. (2005). "Enterprises as systems: essential challenges and approaches to transformation." Systems engineering 8(2): 138-150.
Sauser, B. (2006). "Toward mission assurance: a framework for systems engineering management." Systems engineering 9(3): 213-227.
Shin, B., K. Higa, et al. (1999). "Analyzing the media usage behavior of telework groups: A contingency approach." IEEE transactions on systems, man, and cybernetics - Part C: applications and reviews 29(1): 127-139.
Snow, A. P. and M. Keil (2001). The challenge of accurate software project status reporting: A two-stage model incorporating status errors and reporting bias. Proceedings of the 34th Hawaii international conference on systems science: 1-10.
Snow, A. P. and M. Keil (2002). "The challenge of accurate software project status reporting: A two-stage model incorporating status errors and reporting bias." IEEE transactions on engineering management 49(4): 491-504.
Sosa, M. E., S. D. Eppinger, et al. (2002). "Factors that influence technical communication in distributed product development: An empirical study in the telecommunications industry." IEEE transactions on engineering management 49(1): 45-58.
Tan, B. C. Y., H. J. Smith, et al. (2003). "Reporting bad news about software projects: Impact

of organizational climate and information asymmetry in an individualistic and collectivistic culture." IEEE transactions on engineering management 50(1): 64-77.
Tiwana, A. and A. A. Bush (2005). "Continuance in expertise - sharing networks: A social perspective." IEEE transactions on engineering management 52(1): 85-101.
Wang, H., Q. Wu, et al. (1996). Research on teamwork-based organization environment and enterprise cultures for concurrent engineering. Proceedings on the IEEE international conference on industrial technology: 339-342.
Weisinger, J. Y. and E. M. Trauth (2003). "The importance of situating culture in cross-cultural IT management." IEEE transactions on engineering management 50(1): 26-30.

Biography

Willy Y.S. Peng has been appointed as Vice President of Overseas Chinese Institute of Technology in Taiwan. He is also the Chairman of the INCOSE Taiwan Chapter. In addition to his current jobs, he devotes most of his time to promote systems engineering education by proposing a systems engineering stream of studies in engineering college. Prior to joining the academic field, he worked in the Taiwan aerospace industry for more than 30 years and participated in two large scale systems engineering development projects from commencement to operation with internationally recognized contribution. He received both his MS and PhD degrees in Aerospace Engineering from University of Arizona in 1969 and 1973 respectively.

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