The Effect of Organisational Culture and Organisational Structure on Technology Commercialisation Performance: Conceptual Framework

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ABSTRACT
Commercialisation activities are crucial for technology based companies to make sure that there is income to support continuing R&D activities, pay back their investors, and make a profit. Technology commercialisation performance varies among companies. Some companies succeed in commercialising their technology, while some others fail. It is important to understand the drivers of technology commercialisation performance, in order to increase the success rate and reduce the failure rate. Among organisational factors, the culture and structure of the organisation are hypothesised to play an important role. Organisational culture represents the implicit aspect of the organisation, while organisational structure represents the explicit aspect of the organisation. This paper will develop a conceptual model which explores both of these factors and their impact on commercialisation performance.

Keywords:
Technology commercialisation performance, organisational culture, organisational structure

1. INTRODUCTION
The Importance of Technology Commercialisation
Every year the Australian government provides extensive funding to support R&D (research and development) activities. This funding is spent through the R&D activities of government laboratories and universities. Data from OECD (2007) shows that Australia’s expenditure on R&D in 2007 was around 1.8 % of its gross domestic product. This percentage is lower than expenditure in Japan, the United States, and Canada, but higher than expenditure in New Zealand.

However, it is believed that technology commercialisation activities in Australia lag behind R&D activities compared to the same activities in US. Australia has an excellent research capability, but the commercialisation of the research results is less than might be expected. While Jones (2007, p.1) stated that There is little doubt that Australia’s research capabilities are generally judged as world class on a global scale, he added that, However, the most frequently voiced problem is that too little of the research results in commercial products or services, or forms the foundation for the development of new dynamic growth firms. Data from OECD (2007) shows that Australia has a negative technology balance of payments and lags behind Japan, United Kingdom and the United States.
The performance of Australia’s technology commercialisation activities thus still requires improvement. This suggests that further research on Australian technology commercialisation could be important for improving technology commercialisation performance.

**Research Objective and Research Questions**

The objective of this paper is to build a conceptual model which shows relationship between organisational culture, organisational structure and technology commercialisation performance. Based on this research objective and a review of the literature, the research questions developed for this paper are:

a. Which organisational culture dimensions affect technology commercialisation performance and in what ways?

b. Which organisational structure dimensions influence technology commercialisation performance and in what ways?

**2. EXPECTED CONTRIBUTIONS**

This paper is expected to have both theoretical implications and practical implications including:

a. Theoretical. From a theoretical perspective, this research will attempt to answer the question: how do organisational culture and organisational structure affect the technology commercialisation performance of a company? After field work is done, the expected contribution of this research is validation of the theoretical model and hypotheses.

b. Practical. From a practical perspective, this research is expected to indicate ways to improve technology commercialisation performance, that is, to increase the success rate and reduce the failure rate of the technology commercialisation process in Australian technology based companies. After the field work is done, this research is expected to contribute to the development of recommendations and strategy guidelines for the CEOs and managers of technology based companies, taking into account the context of the company.
3. TECHNOLOGY COMMERCIALISATION

Organisational Success Factors in the Technology Commercialisation Process

Many organisational factors influence the technology commercialisation success including: hiring and training of skilled scientists, engineers, managers and production workers (Brown, 1997); the organisational culture, core group expertise, core group drive / motivation (Davidsson and Klofsten, 2003); team building processes, organisational structures, reward and penalty structures, human resources support (Large et al., 2000); putting someone in charge (Parker and Mainelli, 2001); excellent management in which a competent, balanced and motivated team of technical, commercial and management staff are assembled (Raine and Beukman, 2002); career experiences and research skills of inventors and the involvement of researchers in the process (Sharma et al., 2006); a skilled workforce (Singh, 2001); and high level of management support (Wonglimpiyarat, 2007).

From the many organisational factors above, organisational culture has been selected because it drives and motivates people in an organisation to have commitment and to work hard for developing innovative products and commercialising them. Organisational structure has also been selected because it relates to ways of organising the people in the organisation. Furthermore, it influences the flow of information sharing and the flow of decision-making in the organisation and influences the speed of decision-making as well as the scope of power, job description and resources (people) available. It also influences how people behave based on their positions as well as their job descriptions. Through organisational structure and culture, people become connected and cooperate to achieve their common goal.

Technology Commercialisation Behaviours

Organisational behaviour refers to organisational members' work-related activities (Olson et al., 2005). In this research, organisational behaviours that have the potential to create superior performance in technology commercialisation are examined below:

a. **Customer-oriented behaviours.** Customer orientation is defined as the degree to which a firm focuses on getting closer to its customers to identify their desires in order to provide higher levels of quality of service and products (Koufteros et al., 2007, p. 471). Companies with a strong customer orientation pursue competitive advantage by placing the highest priority on the creation
and maintenance of customer value to anticipate customer needs evolution and to respond to market change (Olson et al., 2005).

b. **Competitor-oriented behaviours.** Companies with a strong competitor orientation see competitive advantage as simply defeating the competition and their behavioural goal is to match, if not exceed, competitors' strengths (Olson et al., 2005).

c. **Innovation-oriented behaviours.** Deshpande and Farley (2004) defined innovativeness as being first to market, avoiding late entry and stable markets, and being at the cutting edge of technology. Companies with a strong innovation orientation build competitive advantage through radical or discontinuous innovations and enhance the likelihood of developing radically new products (Olson et al., 2005).

d. **Communication-oriented behaviours.** The “level of communication” is the degree to which vertical and horizontal communication is slow, difficult, and limited versus fast, easy, and abundant (Nahm et al., 2003, p. 287). Communication is important as organisational members need to communicate to accomplish their tasks effectively and efficiently (Koufteros et al., 2007).

**Technology Commercialisation Performance Measure**

Companies which have a good commercialisation capability behave differently compared to companies that have a lesser commercialisation capability. Nevens et al. (2000) determined four measures of a company’s capability to commercialise and to compete: time to market, range of markets (number of markets), number of products (number of market segments) and breadth of technologies (wider range of technologies).

In their research, Zahra and Nielsen (2002) measured technology commercialisation performance using the following measures: number of new products (frequency), technology commercialisation speed (speed), number of radically new products (radicalness) and number of patents (patents).

All of technology commercialisation measures noted above will be used in this research; however some of the measures will be combined since they have similar meaning. The number of new products launched will be used to represent the number of products, number of new products and number of radically new products. Time to market will be used to represent technology commercialisation speed and time to market.
4. RELATIONSHIP BETWEEN ORGANISATIONAL STRUCTURE AND PERFORMANCE

Organisational structure is the way responsibility and power are allocated, and work procedures are carried out among organisational members (Koufteros et al., 2007; Nahm et al., 2003; Ruekert et al., 1985). According to Meijaard et al. (1985), organisational structure concerns work division and coordination mechanisms. Much research has already been done on the relationship between organisational structure and corporate performance in which organisational structure is presented under three categories below:

a. **Organisational Structure Dimension.** Some papers (Jennings and Seaman (1994), Koufteros et al. (2007), Lin and Germain (2003), Meijaard et al. (2005), Nahm et al. (2003), Olson et al. (2005), Randolph et al. (1991)) discuss the relationship between structure at the organisational level and performance using various dimensions to represent organisational structure.

b. **Organisational Structure Typology.** Several papers (Ezzamel and Watson (1993), Ingham (1992), Weir (1995), Ivancevich and Donnelly (1975), Malone and Smith (1988), and Pleshko (2007)) have investigated the relationship between organisational structure and performance using different perspectives to represent organisational structure. They used organisational structure typology, instead of organisational structure dimension.

c. **Specific Aspects of Organisational Structure.** Several papers focus on the relationship between specific aspects of organisational structure and performance, as follows: matrix organisation structure (Kuprenas, 2003; Laslo and Goldberg, 2001), marketing organisation structure (Olson et al., 2005; Ruekert et al., 1985), and organisational communication structure (Visser, 2000).

The literature review above makes clear that there is a gap which no previous research has investigated namely, the relationship between organisational structure and technology commercialisation performance.

Organisational structure has multiple dimensions and various researchers have used somewhat different organisational structure dimensions in their research. Among this variety of dimensions for organisational structure, the six most commonly discussed and also deemed relevant to this study are described below. These dimensions have been selected since they may influence technology commercialisation behaviour and performance.
a. **Centralisation/decentralisation.** Centralisation refers to *whether decision authority is closely held by top managers or is delegated to middle and lower level managers* (Olson et al., 2005, p. 51). This definition aligns with Pleshko’s (2007, p. 54) definition in which he refers to centralisation as *the degree to which the right to make decisions and control activities is concentrated.*

b. **Coordination.** This dimension is selected based on Meijaard et al. (2005) who described coordination as the way companies organise day-to-day coordination between individuals and departments. They divided coordination mechanisms into personal coordination and impersonal coordination.

c. **Formalisation / standardisation.** Formalisation can be defined as *the extent to which an organisation uses rules and procedures to prescribe behaviour such as the details on how, where, and by whom tasks are to be performed* (Pleshko, 2007, p. 54). Contrary to above definitions, Koufteros et al. (2007, p. 475) and Nahm et al. (2003, p. 286) define the nature of formalisation as *the degree to which workers are provided with rules and procedures that deprive versus encourage creative, autonomous work and learning.*

d. **Integration.** Level of horizontal integration is *the degree to which departments and workers are functionally specialised (i.e., low level of horizontal integration) versus integrated in their work, skills, and training (i.e., high level of horizontal integration)* (Koufteros et al., 2007, p. 475; Nahm et al., 2003, p. 287). Highly integrated companies allow contacts between the experts within each department and also with top level decision-makers (Pleshko, 2007).

e. **Number of layers in the hierarchy.** Number of layers in the hierarchy is *the degree to which an organisation has many versus few levels of management* (Koufteros et al., 2007, p. 475; Nahm et al., 2003, p. 286).

f. **Specialisation.** Specialisation refers to *the degree to which tasks and activities are divided in the organisation and the degree to which workers have control in conducting those tasks* (Olson et al., 2005, p. 52). Meijaard et al. (2005) used specialisation to describe how tasks that involved task diversity and employee specialisation are distributed among company members.
5. RELATIONSHIP BETWEEN ORGANISATIONAL CULTURE AND PERFORMANCE

Schein (1999, p. 7) defines organisational culture as: *A pattern of shared basic assumptions that the group learned as it solved its problems of external adaptation and internal integration that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way you perceive, think, and feel in relation to those problems.* It has long been known that organisational culture impacts organisational performance and much of the literature has tried to analyse the relationship between organisational culture and performance. To investigate the relationship between organisational culture and performance, organisational culture has been organised into three categories:

a. **Organisational Culture Dimension.** In some previous research (Nahm et al. (2004), Koufteros et al. (2007), Gordon and Ditomaso (1992), Marcoulides and Heck (1993), Pothukuchi et al. (2002), Reynolds (1986), Tsamenyi (2002), Sengupta and Bushman (1998), Sin and Tse (2000)) the relationship between organisational culture dimensions and performance was investigated using a variety of organisational culture dimensions.


c. **Specific Aspects of Organisational Culture.** Various papers focused on the relationship between specific aspects of organisational culture and performance: organisational error management culture (Dyck et al., 2005), market-oriented organisational culture (Homburg and Pflesser, 2000), temporal elements of organisational culture (Onken, 1999), informal organisational culture (Pyoria, 2007), and organisational learning culture (Skerlavaj et al., 2007)

As can be seen from the literature review above, there is a gap that no previous research has investigated specifically, the relationship between organisational culture and technology commercialisation performance.
This research will use Denison’s organisational culture dimensions as presented in Denison and Mishra (1995) which uses four cultural traits to measure organisational culture (involvement, consistency, adaptability, and mission) with each trait consisting of three component indexes. The research will use two of these traits (involvement and adaptability), because they are applicable in a flexible environment which are necessary in the context of technology commercialisation. Involvement and adaptability are also indicators of change, flexibility, openness and responsiveness (Denison and Mishra, 1995). Table 1 shows Denison’s organisational culture traits, indexes and definitions.

### Table 1 Denison’s Model Traits, Indexes, and Definitions (based on Denison and Mishra, 1995)

<table>
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<tr>
<th>Trait / Index</th>
<th>Definition</th>
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<tr>
<td>Involvement</td>
<td>Employees are committed to their work, feel a sense of ownership, and have input.</td>
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<tr>
<td>Capability development</td>
<td>The organisation continually invests in the development of employees’ skills in order to stay competitive and meet ongoing business needs.</td>
</tr>
<tr>
<td>Team orientation</td>
<td>Value is placed on working cooperatively towards common goals to which all employees feel mutually accountable. The organisation relies on team effort to get work done.</td>
</tr>
<tr>
<td>Empowerment</td>
<td>Individuals have the authority, initiative, and ability to manage their own work. This creates a sense of ownership and responsibility towards the organisation.</td>
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<tr>
<td>Adaptability</td>
<td>Organisational capacity to change in response to external conditions.</td>
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<tr>
<td>Creating change</td>
<td>The organisation is able to create adaptive change. The organisation is able to read the business environment, quickly react to the current changes, and anticipate future changes.</td>
</tr>
<tr>
<td>Customer focus</td>
<td>The organisation understands and reacts to the customer, and anticipates their future needs. It reflects the degree to which the organisation is driven by a concern to satisfy the customer.</td>
</tr>
<tr>
<td>Organisational learning</td>
<td>The organisation receives, translates, and interprets signals from the environment into opportunities for encouraging innovation, gaining knowledge, and developing capabilities.</td>
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### 6. THEORETICAL AND CONCEPTUAL FRAMEWORK

In Figure 1 below, the conceptual framework which will be used in this research is described. Appropriate organisational culture and organisational structure dimensions are likely to influence technology commercialisation behaviours and technology commercialisation behaviours will affect technology commercialisation performance. To describe organisational culture and organisational structure, dimensions are selected rather than typologies. The reason for this is that organisational dimensions are likely to give a more detailed explanation about an organisation than organisational typologies. From the above conceptual model, some hypotheses can be drawn, which are:
1. Organisational Culture and Technology Commercialisation Behaviours

H1: Organisational culture can have an influence on technology commercialisation behaviours

This hypothesis can be explained as follows:

a. Empowerment. The empowered employees tend to work harder and have more commitment to the company. Employees in the R&D department will work harder to develop good products. Marketing department employees will put their best efforts into understanding the market and commercialising products that meet market needs.

b. Team Orientation. In a team-oriented culture, employees from across departments work as a team to achieve company goals. Team orientation will increase the exchange of information and communication among employees.

c. Capability Development. A company with a capability development culture views employee skills as an important factor in increasing the company’s performance. Employee skill development will increase employee capability to understand customers and to innovate.
d. **Creating Change.** A culture of creating change is required to anticipate market change and technology change. This culture will allow the company to handle customer and competitor change behaviour by adapting the products provided and the way the company runs its business.

e. **Customer Focus.** A company in which a customer-focused culture becomes its daily way of life will result in customer-oriented behaviour. In such a culture, most employees will believe that all business activities should to be conducted to satisfy the customer.

f. **Organisational Learning.** An organisational learning culture is important to increase the innovation capability of a company. Learning from failures and mistakes can improve a company’s innovation capability.

**II. Organisational Structure and Technology Commercialisation Behaviours**

H2: Organisational structure can have an influence on technology commercialisation behaviours.

This hypothesis is proposed based on the following explanation:

a. **Coordination.** Good coordination will lead to intense communication among employees. Good coordination will also make it easier for employees to share information and have the same level of information regarding markets, competitors and customers.

b. **Centralisation.** The innovation literature generally assumes that centralisation is negatively related to innovation (Damanpour, 1991). However, lines of communication and responsibilities which are relatively clear in centralised organisations generally cause implementation to be straightforward after the decision is made (Olson et al, 2005).

c. **Formalisation.** Companies with fewer formal procedures (organic companies) encourage horizontal and vertical communication and tend to have a rapid awareness of, and response to market changes (Olson et al, 2005). However Koufteros et al. (2007) who define nature of formalisation as the degree to which employees are provided with rules and procedures that encourage creative, autonomous work and learning, argue that formalisation can be conducive in adapting to customer requirements.

d. **Integration.** The level of horizontal integration has significant, direct and positive effects on the level of communication (Nahm et al., 2003). Horizontal integration will also increase information
sharing among employees regarding market. Collective and integrated actions by organisational members are suggested in order to respond to customer requirements, (Koufteros et al., 2007).

e. **Number of Layers in Hierarchy.** The number of layers in the hierarchy has significant, direct and positive effects on the level of communication (Nahm et al., 2003). Fewer numbers of layers in hierarchy improves responsiveness to market changes and makes the company react more effectively to customer change. Many companies would benefit by limiting the number of layers in the decision-making hierarchy to respond more flexibly to changing markets, and to provide value to customers (Koufteros et al., 2007).

f. **Specialisation.** Specialists, in complex environments, are typically given substantial authority to determine the best approach to complete their tasks, enabling the organisation to respond rapidly to changes in its environment (Olson et al., 2005). Specialised employee in the R&D department will be able to contribute to product ideas and find a way to realise these ideas. Specialisation is also needed in marketing department so that the commercialisation team can handle customers and monitor competitors.

### III. Commercialisation Behaviours and Technology Commercialisation Performance

H3: Commercialisation behaviours can affect technology commercialisation performance.

This hypothesis is proposed based on the following explanation:

a. **Competitor-Oriented Behaviours.** Knowing the competitor’s products will help a company to improve its own products and give customers better products than the competitors. Recognising the competitor’s patents will also help determine the direction of a company’s R&D, and determine the scope of a company’s patents.

b. **Customer-Oriented Behaviours.** Companies that build customer-oriented behaviour and stay close to their customers can benefit through improved market positioning and company performance (Koufteros et al., 2007). The company will be able to fulfil market demand and to provide appropriate products for the appropriate market segment.

c. **Innovation-Oriented Behaviours.** The impact of innovation on company performance has been of interest to experts for decades and innovation has been linked empirically to company performance in the US and in China (Deshpande and Farley, 2004). An innovative company can
provide new products for customers when the old product is obsolete and can also make the product first to market.

d. Communication-Oriented Behaviours. Communication among departments within a company (R&D, production, marketing) is very important for increasing the success of technology commercialisation and for developing marketable products as soon as possible. The level of communication has a significant, indirect and positive impact on plant performance (Nahm et al, 2003).

7. FURTHER RESEARCH

The further research is planned to be conducted within 2 years. This research will use a mixed method approach, a combination of quantitative methods and qualitative methods (Creswell, 2007). The questionnaires will be distributed to Australian technology-based companies in the biotechnology, nanotechnology, ICT and manufacturing industry sectors. SEM, structural equation modelling, (Byrne, 2001) will be employed to deduce a model. Interviews will be conducted with 4 selected companies (1 case study each from industrial sectors), to find explanations for the quantitative results. Brief case studies (Yin, 2003) will be written based on the interview results to gain a deeper understanding about the model.

8. LIMITATION

There are some possible limitations to this research:

a. This research only focuses on organisational culture and organisational structure and specifically uses only certain dimensions of organisational structure and organisational culture which may relate to technology commercialisation.

b. The unit of analysis of this research is technology commercialisation in companies, instead of universities or government laboratories.

c. This research discusses technology commercialisation from the business point-of-view and not from the technology/science point-of-view.
4. Byrne, B.M., 2001, Structural equation modelling with AMOS: basic concepts, applications, and programming