

# THE EFFECT OF SIZE OF FIRM ON STRATEGIC MANAGEMENT OF TECHNOLOGY

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**Abstract:** The impact of changing technology in gaining sustainable competitive advantage is of interest and concern to organisations. Lately interest has grown in analysing the influence of strategic management of technology (STM) in the performance of firms. Studies so far have focused on the manufacturing sector and those too in the West. Studies on STM in the East are almost non-existent. A study was carried out in an Eastern country to exploit this gap and develop new variable which could be further developed. This paper is part of the big study and analyses the influence of the size of firm on the development and implementation of technology strategies at the firm level. It contributes to the literature in terms of overall effect of STM on firm performance.

**Keywords:** Technology Strategy, Technology Management, Strategic Technology Management, Size of firm.

## I. INTRODUCTION

The impact of changing technology in gaining sustainable competitive advantage is of interest and concern to organisations. To effectively manage the technology at the strategic level would require companies to re-evaluate their technological strategies and integrate them with the business strategy. Poor technological choices by management may severely affect firm performance [15,16]. The failure of the traditional techniques for exploiting technology like R&D has emphasised the need to address technology at a strategic level [3]. Almost invariably, all studies on Strategic Technology Management share common features, they generally employ different industry perspectives, research methodologies and study dimensions, which makes it difficult to make comparison among them [4]. There was a paucity of studies on STM in the manufacturing sector. Some studies (very few) were done to analyse the technology strategy types in high tech sector of the Western Countries. To address this gap, it was decided to explore the significance of STM issues in the East, consequently an in-depth research was carried out in an Eastern country which experienced tremendous growth. The results of the study have provided unique strategies applied by the firms in the high technology sector which contributed to their remarkable performance.

## II. LITERATURE REVIEW

East and South East Asian economies achieved high growth rates between the period 1965 and 1990. The manufacturing sector growth in the SE Asian countries have been impressive and contributed to their GDP increase. However “these figures do not tell us much about the actual nature and process of industrialization which requires a close scrutiny of the manufacturing sector .....”[7]. This study in part addresses this issue.

Jomo has stated that the rapid growth of East Asian NICs has brought our attention to the role of cultural factors in industrialisation [7]. “There is no denial of the fact that cultural practices (social relation, cooperation etc) in East Asia have been crucial for the development of business networks which do not rely on the state and have contributed towards capital accumulation” [7]. The technology strategies leading to success of the manufacturing sector in the West is well researched and documented, however the culture had an important impact in their evolution and implementation. The industrial policy instruments too in the West have been responsible for this success. So in the East, despite state interventions and selective policies (e.g. heavy industrialization in Malaysia in mid-1980s), the remarkable progress must have been influenced by similar strategies applied in a different cultural context or evolution of new strategies pertinent to the local culture [7]. This aspect was studied by the author and the results compared with those from the West.

#### A. STRATEGIC TECHNOLOGY MANAGEMENT

Clarke, Ford and Saren used the term technology management to refer to organizational issues and processes involved in developing and implementing a strategic approach to technology [1]. Through this approach, technology management issues can be operationalised and integrated into normal management activities of the firm. Strategic Technology Management (STM) did not emerge as a distinct area of managerial and academic interests until late 1980s. The key managers may initiate efforts to gain access to newer technologies, but the question is whether the approach they adopt is strategic or a series of ad hoc decisions [12]. STM is synonymous to Technology Policy in the context of this study and defined as developing technology strategies and then evolving methods to implement and manage them. Linstone highlights that the technological, organizational and personal perspectives are frequently used by scientists to analyze complex phenomenon [10]. The technological perspective is of interest in this study.

“Technology is recognized as potentially the single most important source of competitive advantage. A useful technology strategy must address the critical technologies vital for the attainment of strategic business objectives and the ways to achieve this domination” [11].

It is believed that adherence to strategic plans promotes firm sales growth rate [2]. Industrial development is a process of acquiring technological capabilities in the course of continuous technical change. Kim has proposed two frameworks—technology trajectory framework and technology strategy framework which can be used to analyze technology policies and strategies in developing countries [8]. Representation of technology strategies numerically is of concern to many authors. The subsequent judgment in such models is prone to errors.

### III. GAP AND THE OPPORTUNITY

These efforts by the author in undertaking an in-depth research in this field has been the guiding factor in undertaking this study to investigate the technology policies in the high-tech manufacturing sector of the country of interest. The objective is to identify the technology strategy “types” adopted by the firms which contributed to their success. Identification of such strategies would be a useful contribution to the field of strategic management application in a high-tech sector of the economy. The link between the strategy types and performance of the firms in the manufacturing sector would provide a useful result to determine the effect on economic development of the country.

Some work to explore strategies in the hi-tech industries in USA was done lately [14] but the study utilized published data from firms "prospectus". The study done by the author addressed the above limitations that existed in literature and in similar studies. These results will now be used to develop a survey questionnaire for exploring the Technology strategies in the country of interest.

### IV. PROPOSED FRAMEWORK

A hypothetical framework has been developed based on the results of the literature search in the West (Fig.1). The attributes will be tested to determine the suitability or otherwise of this model in the East.

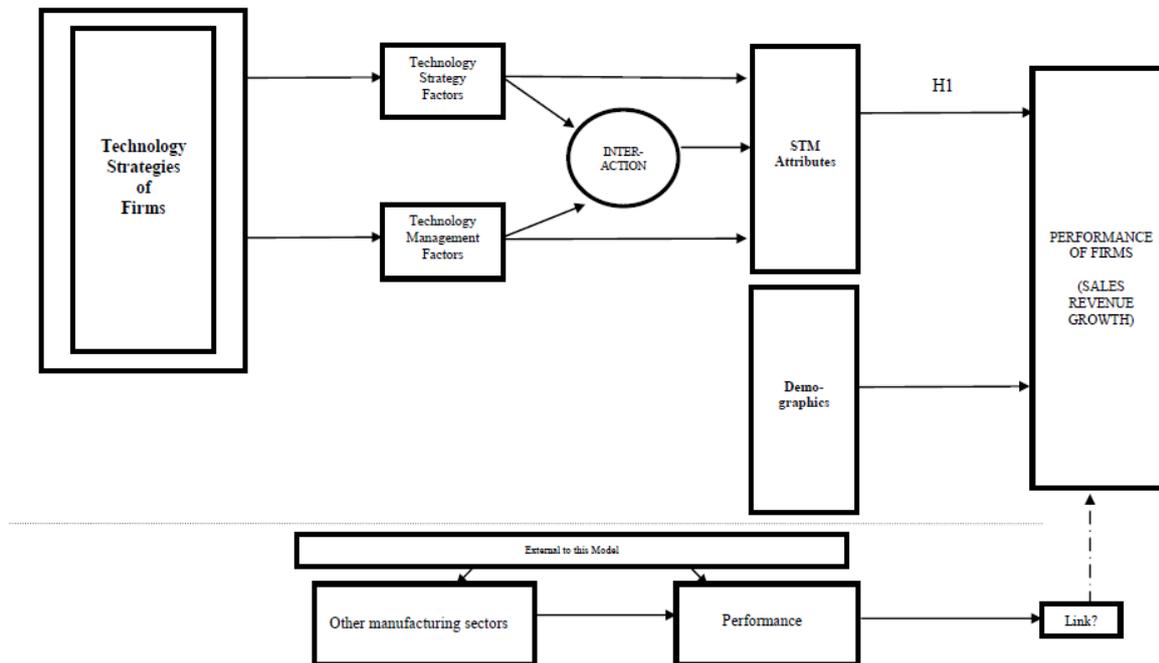


Figure 1: Conceptual framework (Research Model) of strategic technology management

Source: Developed for this paper from Sikander (2010)

## V. HYPOTHESES

Lee (2000, p.489) is of the view that small firms have played an important role in technological innovation and economic growth in developed countries. This innovating role has recently received increasing attention in NIEs, as they attempt to transform their industries from labour-intensive to technology-intensive.

Herman (1998, p.129) in his research on electronics industries in the USA concluded that certain TS-TM combinations are adopted by larger companies and avoided by smaller companies.

This expected relationship between the size of firm (LSI, MSI, SSI) and the acquisition of the successful STM factors (TS & TM) leads to the following hypothesis:

**H1: Larger E&E firms will have greater propensity to acquire successful STM factors.**

## VI. METHOD

The data for this study was obtained through a survey questionnaire. The questionnaire was developed in line with the objectives of the research and to maximize information extraction from the respondents [7].

Five types of data as suggested by Herman were gathered for the study [3]:

1. Individual's Profile Data
2. Organisation/Business Data
3. Competitive Environment Data
4. Technology (Strategy and Management) Data
5. Management Issues

Advantage was also taken of prior research results to select the dimension variables. The data on five strategy and five management dimensions is in line with that suggested by Herman [4]. Individual profile and Organisational data was used to check for response bias and content validity. The survey questionnaire was pre-tested in a pilot study to assess the clarity of its direction and the questionnaire items. The pilot study included face-to-face interviews with CEOs of selected companies. Based on the Pilot Study and CEOs responses, the questionnaire was revised to develop the final format. The results were entered into the SPSS software.

The Technology Strategy dimensions include the elements of: key positioning, leading in discovery of new technologies, introducing innovative products at the right time, and incorporation of new technologies in firm's plants and facilities, whereas Technology Management dimension employ: keeping abreast with emerging technologies, formal processes to plan and select technologies and in-country external acquisition of technology. Each of these elements are represented by items. A likert scale has been utilized to tap the items of interest to the respondents.

An acceptable response rate of 21% was ultimately achieved. Although 101 responses were received in total, only 62 of these contained usable data. This response rate of 21% is considered satisfactory since the researcher has lived in a culturally similar environment and observed that responding to mail questionnaires is not a widely accepted practice among firms in country investigated.

## VII. DATA ANALYSIS

The background variables were analysed after the data was entered in SPSS. Factor analysis was used to transform the variables into a new set of linear combinations called the principal components.

The extraction using PCA for the technology strategy variables revealed that three components accounted for 71.3% of the total variance. The factors were named as: *technology positioning*, *technology leadership* and *up-to-date plants and processes*. The extraction using PCA for the technology management variables revealed that four components accounted for 83.2% of the total variance. The factors were named as: *strategic R&D*, *technology consciousness*, *formal planning* and *external technology acquisition*. Correlation analysis revealed the association of performance with *strategic R&D* and *technology positioning factors*. The results indicate that *key positioning* and *strategic R&D* are positively correlated with the size of the firm ( $r=0.307$  and  $r=0.425$ ). They are also positively correlated with the capital investment made by the firm ( $r=0.37$  and  $0.49$  respectively). This supports the hypothesis that larger firms will have more propensity to acquire the successful STM factors.

## VIII. PROPOSED METHODOLOGY FOR THE NEW STUDY

It is proposed to use the results of the study to develop a new questionnaire incorporating dimensions and items relevant to the East. This will provide a more meaningful outcome. The survey questionnaire like done previously, will be developed and tested in a pilot study..

The questionnaire will be tested in a pilot study and interviews before being finally administered. The background variables will be analysed after the data is entered in SPSS. The data from the main survey instrument would also be utilized to perform multiple regression analysis to observe the influence of the items on the elements and dimensions. It will also be used to predict the differences in responses to selected dependent and independent variables and predict the magnitude of elements and responses of the different firms. Factor analysis will be used to transform the variables into a new set of linear combinations called the principal components. The proposed conceptual model for STM would then be statistically tested using the PCA. A new model would be subsequently developed after naming the new factors at the item level. The new dimensions of TM and TS will also be used to determine the relationship with firm size, firm type, R&D efforts and firm performance. The various hypotheses will be tested based on the above relationships.

## IX. CONCLUSIONS

As a result of the study seven new factors have been identified by this research and these all apply at the company level. These seven factors can be seen as falling into two dimensions: The Technology Strategy (TS) dimension, and the Technology Management (TM) dimension. The results revealed that there was a statistically significant correlation between the STM factors of *key positioning* and *strategic R&D* and the size of the firm

Through a detailed examination of this study, it is planned to develop a new instrument incorporating the results of the research and subsequently apply it to the country under study. The questionnaire will be piloted in order to improve its validity and before being administered in the final survey. A modified model will be evolved and it will be argued whether the Technology Strategies and their management relate to the size of firms in the manufacturing sector. It will also be argued if there is a difference in the strategies with respect to firm type.

#### X. LIMITATIONS OF THE STUDY

This study has contributed to the STM discipline by investigating the nature of technology strategies applied in the firms operating in an Eastern environment. This study uses variables from studies conducted in the West and so the questions were derived from that environment. This limitation would obviously be diluted once the new study as suggested above is carried out incorporating the factors developed as part of this study.

This study limits a firm's performance dimensions to its sales revenue growth. There could be other factors besides Strategic Technology Management that could contribute to performance. It is suggested that the proposed new study to include other performance dimensions as well.

The number of companies which responded was small; as such, it is difficult to generalise the results for the whole sector. The new study should aim at including a larger population and also different sectors.

To keep this study within the objectives set down, boundaries were placed around the problem. In determining the various factors on technology management, some exogenous (moderating) variables like culture, financial structure, training philosophy, human resource etc were omitted [6]. The proposed study could aim to include these moderating variables as well.

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I am a dynamic individual with local and international experience in engineering, entrepreneurship and innovation, strategic technology management, training, lecturing, business planning and H.R.M. I have a unique and rich combination of qualifications in engineering, business administration and education, holding a Master Degree in each. My PhD thesis relates to strategic management of technology and innovation (STM). I have led multidisciplinary teams and established effective networks. I can easily assimilate and disseminate wide ranging information to a variety of targeted audiences and work towards bringing disparate groups to consensus. I possess a research and teaching experience at the College and University levels and lectured/supervised both undergraduate and post graduate courses. This includes an assignment of about 12 years in VTEC sector of Brunei. I have lectured and lead teams at Polytechnic West VTE in Australia from 2004 to 2011. I have initiated and developed subject materials for various units at Murdoch University and UWA. I have lectured, coordinated and tutored many units at both these universities. I can lecture, supervise research and manage most Business programs in the areas of Human Resource Management, Strategic HRM, Organisational Behaviour, Operations management, Entrepreneurship and innovation, Strategic management, Strategic decision making, Strategic Technology management, Leadership and closely related areas. Human Resource Management and Management are my major specialist areas.