PERFORMANCE-DRIVEN RESOURCE ALLOCATION FOR TECHNOLOGY-EXPLOITING VENTURES: EXPLORATION OF OPTIMAL CAPITAL COMMITMENT STRATEGY FOR SUSTAINABLE GROWTH

By

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ABSTRACT

The purpose of this research was principally to explore the growth and development experience of technology-exploiting ventures (TEVs) with the objective to examine factors that augmented their performance from an interdisciplinary perspective building on the traditional resource-based view and the contemporary studies on intellectual capital. Based on a holistic approach, a literature review was completed to cover interdisciplinary research studies in the areas of performance measurement, resource-based view, intellectual capital, technology management, and other pertinent management studies, particularly managerial accounting and corporate governance. A framework of resource flow integrated with a performance measurement system in connection with issues of venture governance was developed to exemplify critical factors that could augment optimal resource allocation and growth of TEVs. Research questions were introduced to investigate current discrepancies in the relevant knowledge. Focusing on the two defined stages of early-growth and expansion, this research adopted the triangulation methodology to investigate the opinions of equity stakeholders and to explore the patterns and variations in resource utilisation among cases of TEVs under the two different stages. Both in-depth case analysis and longitudinal disclosures analysis were engaged to explore the underlying relationship between significant components of intellectual capital and performance of TEVs. The results revealed the differentiating reliance on resources at the two prescribed stages of development and the implications to performance measurement system of TEVs.

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PREFACE

The resource-based view of the firm has long emphasised the importance of management of resources for the growth and development of a firm. These resources should essentially be composed of a management's knowledge and experience, effective execution and coordination, organisational systems and appropriate infrastructure. With an increasing demand for technological innovation in various industries, management and measurement of intellectual capital - an increasingly critical resource - has become an area of growing business research interests. Among the knowledge-based economies, researchers have focused on exploring effective measurement of intellectual capital and understanding the key components within the structure of intellectual capital. Researchers seek to investigate business performance in relation to intellectual capital management and how to effectively allocate resources for sustainable growth in light of immense competition in the marketplace. Nevertheless, contemporary research has been centred on the interrelationship between components of intellectual capital, which is largely intangible, but there seems to be less exploration of its interaction with other types of resources, such as financial capital and infrastructure. The interrelationship between these types of resources and the timing of allocation might have considerable implications to the growth and development of technology-exploiting companies.

Venture financing of technology-exploiting companies is considered to carry significant risks, as business failures among early-stage development companies have been demonstrated to be high. While economic resources available to these start-ups are limited, insignificant revenues generated from early operations raise concern about sustainability among the stakeholders. As a result, equity stakeholders are eager to effectively measure and monitor performance of technology-exploiting companies during their early growth and development in order to mitigate the risks involved with investments of venture capitalists and private equity firms. The resource-based view approach is unique in explaining the utilisation of resources, which is crucial to sustainable growth and development of such ventures; contemporary management research continues to make references to the theory published by Edith Penrose in 1959.

This study aims to focus on the growth and development experience of technology-exploiting ventures ("TEVs") that exploit emerging technologies in pursuit of new business opportunities. These opportunities arise in industries where delivery of products and services can be enhanced with application and integration of emerging technologies whose reliance on intellectual capital is inevitably high, namely computing technology, information technology, internetworking technology as well as wireless communication applications. This research does not aim to limit its study on certain technology sectors, but to explore particular characteristics among TEVs in effecting technological innovation during their early years of growth and development. It attempts to explore three key management questions related to issues among technology exploiting ventures:

(a) It is critical for the equity stakeholders to review the effectiveness of executing a particular business plan by an early-stage technology-exploiting company and to consider their economic returns. How can the growth and development of new TEVs be effectively monitored in order to mitigate the risks of equity stakeholders' investments as the primary source of financial capital? The common key performance indicators among TEVs and their implications for resource allocation need to be investigated.

(b) Human capital is considered the primary element for the initial growth and development of TEVs, namely entrepreneurial as well as research and development capabilities in technological innovation. However, human capital alone seems insufficient for continual growth and development. The literature suggests that continual growth and development of ventures need to be complemented by strategic resource allocation of financial capital into critical areas, such as organisational and structural capital, innovation capital, technological infrastructure, and customer capital development. To support the growth and development of these young TEVs, what should be the proper mix of resources in the growth and development process of new ventures?

(c) It appears that the values of TEVs could only be sustained when adequate resources are supplied. Nevertheless, how can such resource allocation of external capital converted into various components of intellectual capital be made effective for the growth of the ventures over time? How can the timing of allocation of such resources affect the growth and business performance of such new ventures?

It follows that an evolving management issue is the quest to optimise the allocation of capital resources in an emerging TEV. The dilemma is between turning the ventures into self-sustainable, high-growth operations during their early stage of growth and development and conserving for the limited availability of initial resources. How should financial capital and other initial resources be allocated to the suitable components of intellectual capital in order to drive toward performance at particular stages of development of TEVs?

In addition to the resource-based view school of thought, the literature review was focused on four main areas of thoughts, namely performance measurement, intellectual capital, business venturing and technology management. Such research provides the foundation of knowledge in this research study. The initial objective was to evaluate the essence of contemporary research on the mounting attention on managing and measuring intellectual capital within organisations in view of the concerns for performance-driven management. Specific research was targeted towards the characteristics of TEVs and particularly development aspects of ventures that exploited technological innovation for organic growth.

Explicit research queries in this thesis were made through examination of the growth and development experience of TEVs with reference to the resource-based view based on the triangulation approach. This particular research design aimed to embrace the advantage of adopting a process approach to explore different cases of TEVs. The focus was on their growth and development processes throughout their early-stage development, as well as the expansion stage subsequent to substantial amount of capital being raised from the capital market. The evidence collected was composed of multiple sources among the selected samples.

A framework of intellectual capital flow was designed based on integrative knowledge from the literature review. In this evolving framework, financial capital resources were optimally allocated to various components of intellectual capital at various stages of development. Corresponding performance indicators (PIs) were utilised to measure the degree of success that signals achievement of predetermined targets in performance. Since PIs might vary in different stages of development, requirements for capital resources would have to be adjusted, and consequently the internal plan for the mix of resource allocation adjusted. PIs were meant to provide useful signals for the providers of financial capital - namely venture capitalists, private equity and other equity stakeholders - in monitoring performance of TEVs as well as reviewing relevant information about the effectiveness of resource coordination in light of subsequent financial decisions.

It is important to clarify that PI is the common term used to define measurable outputs. However, two more specific terms for PI were used for specific performance measurement. First of all, performance driver (PD) could be adopted for identification of certain characteristics and requirements that would drive performance output. For instance, these could include training and development activities and technological know-how that improve business processes, coordination of resources and execution of strategy and operations. Secondly, performance enablers (PE) were associated with new resources, such as information systems, research and development facilities and additional human capital. These PEs provided the necessary tools and facilities for delivery of performance and results.

Sources of evidence proposed for application in this research methodology, comprising qualitative and quantitative elements, were further rearranged into three main corresponding areas as follows:

(i) Focusing on the preset indicators and required resources, points of view were collected from the equity stakeholders of the TEVs with respect to the linkage between PIs and required resources during early-stage and subsequent expansion-stage of development. The aim was to receive insights and opinion of equity stakeholders who were directly involved in monitoring performances and decision making for utilisation of capital among these selected cases. A survey with structured questions was launched and supplementary interviews were arranged. Supplementary interviews were made to further explore certain opinions in-depth.

(ii) PIs for TEVs at various stages of development were developed based on prior research of the key components of intellectual capital, including human capital, innovation capital, structural capital and customer capital, with a theory-laden approach. In this part of the research, four relevant cases were investigated - two from the wireless communication application and the other two from the semiconductor and related integrated device industry. Through interviews, observation and ethnographic approach, two companies from each sector were selected for investigating the characteristics of their requirements in intellectual capital, actual utilisation of capital resources during their early growth and development, and the relevant key performance indicators. Cross-analysis between these companies was also performed. To complement the analysis, the prescribed survey with equity stakeholders contained questions about their opinion towards the importance of particular PIs.

(iii) Retrospective review of resources utilisation within the two additional groups of technology-exploiting enterprises at the expansion-stage (12 companies in total; six from each of the two identified technology sectors) took place in reviewing their effectiveness in resource allocation for growth. These selected samples had successfully gone through the milestone of Initial Public Offering (IPO) in raising significant financial capital for the next stage of business expansion. Longitudinal disclosures analysis was adopted to examine inherent patterns of the composition of the components of intellectual capital based on the same proposed framework.

While obtaining evidence for subsequent analysis of results, this research embraced the advantage of combining both qualitative and quantitative methods through triangulation, in which complementary analyses were contained to serve their respective advantages.

Independent points of observation, on the other hand, enabled this research to improve the reliability and objectivity of evidence and measurement.

The key findings obtained in this research were supported by independent sources summarised herewith. Firstly, through the survey, it was observed that current practice in performance management and control by venture capital and private equities tended to adopt traditional methods, such as reported financial statements and meetings with senior management. However, they were willing to attempt the implementation of a performance management system, such as the Balanced Scorecard as an alternative to improve the current practice. Balanced scorecard, a more structured way in reviewing performance, could be adopted as a tool to monitor performance more effectively than current traditional approach. These equity stakeholders on the other hand expressed their views about the importance of various performance drivers and enablers for the TEVs and reflected significant difference in their importance to intellectual capital during the two stages of development.

In exploring the four cases with in-depth analysis, the research looked into the growth and development experience of two wireless communication application and two semiconductor companies. The study examined the resource availability and utilisation among these companies during their early years of development. Their respective success and failure experiences were also revealed. These four cases provided evidence about the significance of human capital, incremental requirements in structural capital and the continuous demands on innovation capital.

For the 12 cases under longitudinal analysis, the study was able to examine the composition of the intellectual capital components in light of the growth of these TEVs. Through disclosures analysis, it demonstrated that human capital remained the core resource for facilitating growth. On the other hand, the two other components -- innovation capital and structural capital acted as the complementary elements that complemented organic growth for these TEVs. Growth required the combination of heterogeneous resources in face of vigorous market competitions. Unique resources in terms of human capital, technological know-how, and infrastructure did not seem to work effectively alone. Acquisitions of unique equipment and facilities were made subsequent to successful development of technological innovation and new products.

In search of an optimal resource allocation for growth, the stakeholders needed to explore the performance characteristics within a TEV, which in turn dealt with a number of dynamic factors. According to the results of the studies, human capital of in-depth industry and network experience remained the necessary core resource. As a TEV grew, incremental resources were required to provide the necessary infrastructure for a platform of internal business activities and the supporting systems to enhance delivery of products and services. Continuous resource allocation into research and development activities that substantiated innovation capital was unavoidable under a technology sector that underwent rapid advancement and disruptive changes. Above all, a TEV needed to assess the level of financial resources available for various allocation requirements as there were constant constraints on such external resource. Research and development expenditures however might not produce immediate positive impact on initial growth but longer term effect on performance.

Successful TEVs tended to have a stepwise approach in allocating resources. While time and responsiveness to market were considered a key success factor, these firms had to rationalise the priority of resource allocation in order to deal with unexpected disruption from the marketplace itself. Innovation capital alone was insufficient by itself to sustain growth but required to be combined with the necessary technological infrastructure. A stepwise approach enabled focus on near term performance while seeking the long-term value creation. Without notable business performance that delivered signals of credibility, it was both unrealistic and difficult for TEVs to obtain additional financial capital required for resource allocation during expansion. TEVs under the two prescribed stages of development were found to have difference reliance on the type of resources and the form of intellectual capital, which were stimulating to their successive growth and development.

Moreover, this research explored the issue of venture governance for TEVs. Performance of TEVs was found to be complicated by disruptive technologies and emerging development in their respective specific technology sectors. Under such uncertainty, stakeholders of these companies were able to comprehend such complication only through active participation in the development of internal competence and external market dynamics. Through literature review, information asymmetry was unveiled as a critical problem especially for the equity stakeholders of technology-based companies. Under such information asymmetry, issues with moral hazard and adverse selection could arise and affect the interests of equity stakeholders. To mitigate such problems, corporate governance with effective monitoring of technology ventures was advocated; the importance of venture governance was supported by opinions of equity stakeholders.

Chapter 1 of this thesis provides a brief introduction to the background of this research project, purpose of research, summary of the research design, as well as definitions of certain frequently used terms.

Chapter 2 of this thesis lays out the summary of literature review and described the relevance of the articles to the theme of this research. Based on a holistic approach, the summary contains knowledge from the fields of management generally, and more specifically performance measurement, management of technology companies, intellectual capital, resource-based view, entrepreneurship, and venture governance. Discrepancies of knowledge are discussed.

Chapter 3 describes the research design approach adopted for this research study. It contains an additional literature review pertinent to research methodologies in order to help explain the rationale in adopting the triangulation approach. It further provides a description of the elements of the adopted triangulation approach, which includes case studies, survey, interviews and use of secondary data. The framework of intellectual capital flow is introduced. The operationalisation of the research is also detailed in this Chapter.

Chapter 4 provides a summary of data and information collected from the survey, case studies, interviews and secondary data. It further illustrates detailed analysis of the collected data and information. Quantitative analysis is used to perform statistical testing and interpretation of the survey results. In addition, qualitative information is structured and analysed to provide initial interpretation of results among the in-depth case studies and secondary data.

Chapter 5 comprises summary of the key findings, discussion of important results, and conclusions of this research study. The framework introduced in Chapter 3 is revisited with revised elements, incorporating imperative findings from the research. Contribution to the domain knowledge and future studies are suggested.

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I would like to dedicate this research to my parents for their continuous encouragement for my pursuit in knowledge. Despite the deprival of higher education during their youth, they have relentlessly upheld the education of their children understanding the importance of developing knowledge in a person. I am equally indebted to my family members in both Hong Kong and Canada for their understanding and belief in me.

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Chapter 1

1 INTRODUCTION

1.1 Background of the Research

With an objective to sustain growth and development, technology-exploiting ventures (TEVs), possessing limited resources, need to rationalise their resource allocation and utilisation of available internal capital. Recent research on intellectual capital pointed out the importance of intellectual capital as a key cluster of resources that facilitated growth and development of enterprises under the current knowledge-based economies. In particular, intangible assets were assumed to be a critical consideration not only to large enterprises but even more so to young ventures leveraging on the application of emerging technologies. For start-up businesses or early stage ventures, human capital of entrepreneurs, organisation capital and relational capital - such as strategic business networks and relationship with stakeholders - were viewed as important intangible assets that stimulated positive performance (Pena 2002).

To facilitate sustainable growth, it was essential for TEVs to perform planning for future technological development so as to tackle critical paths and to achieve corporate objectives under respective technological evolutions (Guild and Wang 1996). By anticipating such critical paths that required specific competency, TEVs could maintain an advantageous position to produce in-depth analysis of capital resource allocation at optimal timing in consideration of external development, with an aim to avoid misallocation of resources in early development years. Incorrect allocation of capital resources could result in undesired substantial cash outflow on the one hand, and under-investment in necessary assets to enhance delivery of products and services on the other hand. Research on technology-exploiting enterprises explored the importance of building technological infrastructure based on a system of technological knowledge, which was produced and distributed through networks of technological capabilities (Weiss and Birnbaum 1998). Such technological infrastructure enhanced the development of critical assets which in turn fostered expansion and delivery of innovation in products and services.

Growing attention was placed on performance measurement in relation to intellectual capital for sustainable growth of enterprises. In a recent research, Chen, Zhu and Xie (2004) found a significant relationship among the four identified intellectual capital elements, namely human capital, structural capital, innovation and customer capital, and business performance, based on a defined qualitative index system. It was concluded that such strong linkage and dependency between intellectual capital and business performance demanded enterprises to manage and improve intellectual capital in an integrative manner.

With the pioneer resource-based view of a firm, Penrose explored the phenomenon of the growth of enterprises through in-depth process analysis of the resources involved at various stages of development (Penrose 1959). Her study investigated the dependence of a firm's growth upon the availability of adequate resources at particular nodes of growth and development as observed in enterprises, which survived in an emerging business sector of rapid development with vast market opportunities for expansion. This particular phenomenon remained relevant to the contemporary growth of technology-based companies under rapid technological innovation in the information technology sector and among other TEVs. A detailed, interdisciplinary literature review was covered in Chapter 2.

Aiming to provide an integrated analysis of key performance drivers among TEVs, this research study adopted the triangulation methodology in order to collect an array of relevant evidence from the independent sources. Based on a survey targeted towards the equity stakeholders, opinions were obtained with regard to current practice in performance measurement and control for TEVs. Utilising in-depth case analysis, this research looked into two groups of companies from two respective technology sectors that relied heavily on technological innovation for growth and development during their early years of growth. To investigate the aspects of expansion-stage development, six companies from each of the two identified technology sector were selected to examine the pattern of resource utilisation based on longitudinal analysis. The complementary data were analysed to examine the composition of the key components of intellectual capital and the key performance driving resources which jointly enhanced a positive influence on growth evidenced by business revenue generation.

1.2 Statement of Problem

TEVs are commonly seen as high-growth business innovators that take advantage of new technology-driven business opportunities. As demonstrated in various actual cases, however, there had been significant failures among technology-exploiting ventures that were incapable of generating meaningful revenues in a timely manner, leading to substantial financial loss in operations. Effective allocation of capital resources for TEVs operating under uncertainty and the linkage to business performance constituted an area that required thorough investigation with contemporary analysis of actual cases. Furthermore, current research appeared to lack an integrated approach that accounted for both intangible assets and infrastructure assets; an optimal utilisation of resources and their respective conversion into intellectual capital and infrastructure at appropriate intervals of time could have enhanced not only survivability of TEVs under uncertainty but also facilitated their business performance and returns for their equity stakeholders.

1.3 Purpose of the Research

The key purpose of this study was to explore the spectrum of resource allocation, intellectual capital and performance management issues pertinent to TEVs through evidence entrenched in selected cases and opinions of stakeholders. It aimed to look into the significance of collaborating components of intellectual capital as the critical fusion of resources to facilitate organic growth and generation of revenues from the end-customers. Utilising a devised framework of performance measurement, this study investigated the critical capital resource allocation and conversion process of a selected group of TEVs through thorough analysis of their experience during the early years of growth and development. In order to understand the underlying interrelationship, this research also explored how the allocation of capital resources into critical components of intellectual capital including infrastructure assets would enhance the growth of the expansion-stage TEVs.

As TEVs tended to share similarities in utilising technological innovation for their growth and development process from the perspective of performance measurement and management, this research did not intend to limit its examination on certain types of technology. This empirical research initially attempted to explore three board business management issues related to TEVs during their growth and development: (i) For equity stakeholders, how could they, as the primary resource providers, monitor the performance of TEVs during their growth and development process in an effective manner? What was the current practice? (ii) Intellectual capital was generally considered the primary element for knowledge-intensive enterprises. However, intellectual capital alone seemed insufficient for continual growth and development. Researches suggested that continual growth and development of ventures needed to be complemented by strategic resource allocation in critical areas, such as technological infrastructure and agile operations. To facilitate economic return from such resource allocation, how and what should be the appropriate resources allocated during the growth and development process of TEVs? What should be the sort of performance enablers and drivers required to be adopted, and their implications on resources? (iii) Values of the technology-exploiting enterprises could only be sustained when human capital was effectively complemented with other resources within an appropriate timeframe. Nevertheless, how could such resource allocations be made effective for the growth of these enterprises with the consideration of the dimension of time? In particular, how would the timing of allocation of such resources and their interrelationship affect the growth of such young enterprises?

1.4 Research Design

This research utilised studies of cases to explore the nature of resource allocation among technology-exploiting ventures during their early-stage and expansion stages, adopting a combination of quantitative and qualitative data from both primary and secondary sources. An analytical framework was developed based on a set of conventional performance measurement tools incorporated with a set of theory-laden key performance indicators for the TEV. Such research design was intended to produce a convergence of evidence to investigate the contemporary approach in optimising the use of capital for TEVs' growth and expansion. To obtain opinion from equity stakeholders and current practice in performance management, a survey comprising structured questions was sent to a selected group of venture capital and private equity firms. Four cases of early-stage technology-exploiting ventures were investigated while 12 cases of expansion-stage were reviewed with in-depth analysis of their resource allocation experience. Chapter 2 delivers a detailed literature review on relevant theories and prior research studies using an interdisciplinary approach. Chapter 3 provides detailed discussions about Research Design and Methodology for this thesis. It is followed by Chapter 4 that delineates detailed data analysis, description of cases and interpretation of initial results. The final chapter provides a summary of findings, discussion and overall conclusions.

1.5 Definitions

The following is a list of definitions for specific terms frequently used in this research with the intention to avoid ambiguity in their specific meanings. These definitions were derived mainly from articles, publications and professional associations.

(i) "Technology" refers to the theoretical and practical knowledge, skills, and artefacts that can be used to develop products and services as well as their production and delivery systems. Technology could be embodied in people, materials, cognitive and physical processes, plant, equipment, and tools.[1]

(ii) "Technology-exploiting ventures" refers to newly formed companies that exploit emerging technology for application into development of new products and services that would better serve the end-customers. Such emerging technology could be disruptive to the current market landscape and produce new business opportunities for the new ventures. In this paper, these entities are referred to as TEVs.[2]

[1] Burgleman, Christensen and Wheelwright (2004), p.2.

[2] A term derived from the context of ventures that rely on exploitation of technology.

(iii) "Early-stage ventures" refers to TEVs that are in the early stage of development and growth, initially funded by the founders, angel investors and or venture capital with limited resources. These ventures are usually in their initial two or three years of establishment and focusing on product development through exploitation of emerging technology.[3]

(iv) "Expansion-stage ventures" refers to TEVs that are in the stage of expansion after a period of product development and establishment of a customer base. These ventures usually have generated certain amount of revenues and would seek venture capital and/or private equity to raise a more substantial amount of capital to fund their business expansions.[4] The expansion-stage TEVs studied in this research have gone through initial public offer to raise additional capital for subsequent development.

(v) "Performance indicators" refers to indicators used to measure performance outputs and results from an organisation, which should be linked to its specific strategy focus.[5] It is often referred to as PIs in this thesis and used as a general terms to reflect performance measurement for performance drivers and performance enablers or effectors.

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[3] A term derived from definition provided by Hong Kong Venture Capital and Private Equity Association.

[4] A term derived from definition provided by Hong Kong Venture Capital and Private Equity Association.

[5] A term derived from studies of Balanced Scorecard (Kaplan and Norton 2001).

(vi) "Performance drivers" refers to main activities, initiatives, processes and management executions, which have a cause-effect role in driving toward favourable outcomes of performance.[6]

(vii) "Performance enablers or effectors" refers to the combined effort of resources, both tangible and intangible in nature, including systems and infrastructure, which would enable the implementation of performance drivers.[7]

1.6 Delimitations of Scope

This research is an empirical study of the TEVs through examining the perception of equity stakeholders, investigating cases in two technology sectors, and reviewing the experience of these cases at stages of development. There were however dissimilar technology sectors whose developmental process and reliance on resources could be different from the two sectors being investigated. This research intended to explore the phenomenon in two selected technology sectors, which were impacted by rapid development and convergence of computing and telecommunication technologies. Generalisation of the results for all technology-based companies is not an intention of this research project.

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[6] A term derived from studies of Balanced Scorecard (Kaplan and Norton 2001).
[7] A term derived from the notion of "truly value creating resources" (Fernstrom, Pike and Roos 2004).

Chapter 2

2 THEORETICAL PERSPECTIVES

This Chapter provides a summary of relevant literature pertinent to the theme of this research study. Following the first section that explains the range of theoretical perspectives being explored, summaries of the different schools of thoughts are provided in the following section. Based on the review, a fishbone diagram is illustrated to provide a summary of the identified variables that would affect growth and development of TEVs. The purpose of this literature study is to survey the underlying researches that are relevant to this emerging field of study about growth and development TEVs with an interdisciplinary approach that integrates relevant knowledge and theories in business and management.

2.1 Introduction

As the domain of this study involved the interdisciplinary knowledge of managing technological innovation and intertwined performance management issues, the foundation of knowledge for this research was based on an integrated review of the contemporary study, principally in the areas of performance measurement, intellectual capital and technology management. To broaden the perspective in understanding the nature of growth in relation to resource management, this study looked into related studies and concerning knowledge body that were sensitive to growth and development of TEVs and the causal-effect of key elements involved. In this review, the major areas of theoretical aspects sharing an impact on this study included intellectual capital, intangible assets, performance measurement, technology management, venture governance and resource allocation for technology exploiting enterprises. In particular, the resource-based view originally developed by Penrose (1959) provided a profound knowledge base for understanding the economic theory of the growth of a firm. A diagram that illustrates the interrelationship among the connecting theories, school of thoughts and concepts is provided in Figure-1. Detailed review of pertinent research areas is delineated in the following sections.

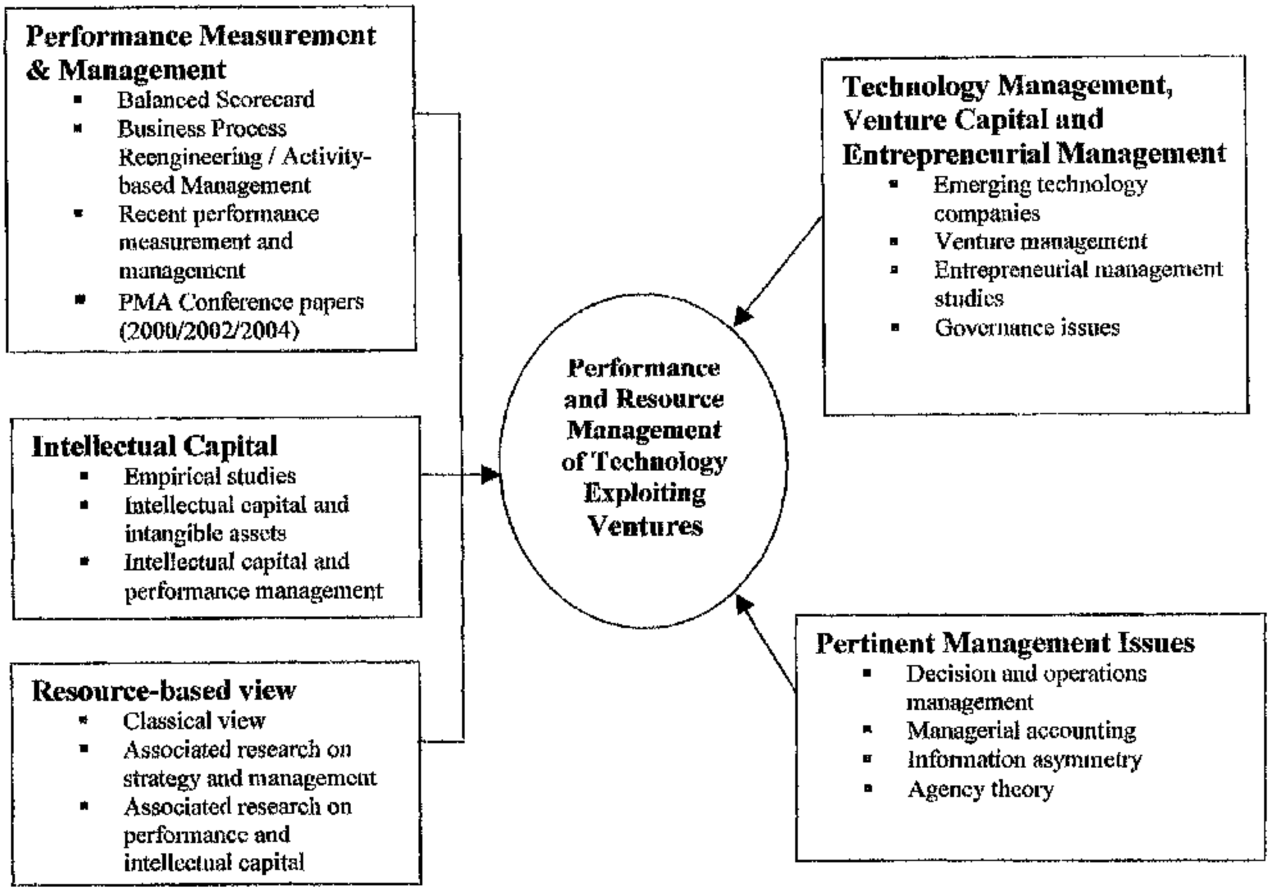

Figure-1: Interrelationship among key areas of research studies in the literature review

2.2 Summary of Literature Review

2.2.1 Performance Measurement and Management

Developed in the early 1990's by Robert Kaplan and David Norton for effective strategic management, Balanced Scorecard was designed to work as a comprehensive management tool that functioned as an interactive performance measurement system. This management tool was meant to facilitate the deliberation of critical qualitative factors in combination with the financial perspective in order to provide a fair evaluation of performance. In the past, performance measurement was recognised as a part of traditional accounting and financial reporting function, which was however criticised as too narrowly-focused on historical financial data and lacking useful edges in shaping performance. Kaplan and Norton (1996) pointed out that financial evaluation of performance was no longer sufficient in a business world in which intangible assets, customer relationships and internal capabilities became increasingly important factors for success. The two researchers initiated the development of the Balanced Scorecard, a multidimensional approach to measuring corporate performance that comprised both financial and non-financial factors. The early development of Balanced Scorecard was largely based on case studies of a group of 12 corporations from different business sectors, including financials services and energy corporations. In these initial studies, the authors described the experience in implementing scorecards and how to use them in a systematic way to enable execution of new organizational strategy. Beyond the concerns about activity-based management, Balanced Scorecard functioned more importantly as a dynamic management system that provided a mechanism for reinforcing continuous improvement and more measurable results. In the core framework of Balanced Scorecard, there were basically four major perspectives for analysing the performance of an organisation: (a) Business Process Perspective, (b) Customer Perspective, (c) Financial Perspective and (d) Learning and Growth Perspective. Subsequently, Balanced Scorecard emerged as an important business management tool that provided linkages to critical internal components within an organisation and external linkages to customers for integrated performance measurement and management.

In the early 1990s, other researchers in performance measurement explored topics in activity-based costing (ABC) under the subject of management accounting as well as business process reengineering (BPR). These earlier researches focused on identification of value-added activities, cost drivers and mechanisms to eliminate non-value-added activities through change management. Prior to Balanced Scorecard, Hammer and Champy (1993) discussed in their book about the importance of business process reengineering for a corporation to compete in the business world. Through redesign of critical business processes and proper application of information technology, corporations were able to improve their performances and delivery of services to the end customers. The author used case studies of large corporations in the U.S. to demonstrate successful experiences. Kaplan and Atkinson (1989) identified the problems with conventional cost accounting that used cost mark-ups to estimate product costs and the misleading short-run procedures involved in applying fixed costs to products. They argued, *"Corporate* *overhead departments tend to vary not with the volume of product items manufactured, but with their range, diversity, and complexity."* It was important to understand what generated the work in these overhead departments in the first place before making any allocation of cost. A product cost system should try to trace directly to all concerning business activities within an organisation but not just factory support costs. Traditional cost-markup method would create distortions and cross subsidies among products, it was argued. [8]

To investigate the linkage between quality improvement and financial return, Rust, Zahorik and Keiningham (1994) introduced the concept of return on quality as a decision support system to analyse the economic return from a quality improvement programme and thereby making quality improvement a critical element of strategic planning. The researchers described how to use logical flow of return on quality within a decision support system and emphasised the importance of linking with customer satisfaction and market share. They also used business cases to illustrate how the system could be implemented to anticipate and measure return on quality.

Garrison and Noreen (2000) later summarised that activity-based costing as a costing method was designed to provide managers with cost information for strategic and other decisions that would in turn affect capacity and therefore "fixed" costs. It was revealed that activity-based costing was used as an element of activity-based management,

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[8] The view was referenced to Robin Cooper and Robert S. Kaplan, "How Cost Accounting Distorts Product Costs," Management Accounting, April 1988, p.20-27.

an approach to management that focused on activities. The objective was to rationalise overhead and to understand the profitability of products and customers.

To develop a performance management framework that embraced strategy as the centre of management processes and systems, Kaplan and Norton (2000) articulated that there should be main principles for building strategy-focused organisations, namely (i) translating strategy into operational terms, (ii) aligning the organisation to the strategy, (iii) making strategy a job for every employee, (iv) making strategy a continual process and (v) mobilising change through leadership. Balanced Scorecard was a tool that could be relevant and useful for private, public and non-profit organisations. Kaplan and Norton (2001) further emphasised that financial measures were "lag" indicators that could provide report on the outcomes of historical events and actions. While mere focus on short-term financial measures could be unfavourable to creating long-term value, the Balanced Scorecard approach would draw attention to a range of measures on the performance drivers and lead indicators, in combination with financial measurement. The Balanced Scorecard approach called for focus on developing cause-effect relationships among the four perspectives and the linkages and processes involved in performance measurement. To further enhance the utilisation of Balanced Scorecard, the researches advocated strong association between corporate strategy and Balanced Scorecard in order to develop a continual process for performance management within a strategy-focused organisation.

Despite its acclaimed advantage, the application of Balanced Scorecard had not been extensively adopted across the industries ever since its introduction. One of the obstacles to its wide application was the amount of resources required to implement such an extensive performance measurement system, which was in fact quite different from the traditional management control and financial reporting systems. It required first of all a high-level, senior management support for its strategic-focused nature. Without senior management support, Balanced Scorecard could hardly be implemented, let alone the requirements to achieve the goal of building an interactive performance reporting system throughout an organisation (Ahn 2001).

Andy Neely, Professor at the Cranfield School of Management, led the research on the evolution of performance management and developed the Prism of Performance model (Neely 2000). Neely emphasised the importance of situating stakeholders as the centre point of concern in the development and implementation of a performance measurement system. These stakeholders should include shareholders, employees, customers and suppliers in order to meet specific criteria in such a management system. Kennerley and Neely later pointed out that a differentiating measurement system based on the development specifics of an organisation over time would be effective to monitor and shape its performance management. Evolution of measurement systems was necessary for an organisation to deal with changing circumstances. Both internal and external factors would have to be considered for the development of a dynamic and relevant set of performance measures. Process, people, infrastructure and culture capabilities were critical elements for an effective evolution of performance measurement system (Kennerly and Neely 2002).

On another perspective for the development of performance measurement system, Kennerly and Neely (2003) further explored in their research the dynamic environment that shaped development of performance measurement system adopted in organisations. The research suggested that a systematic process was required to modify performance measurement system continuously in order to accommodate transformed strategies and operations in reflection of the changing circumstances over time. In their case study of an electrical wholesales company, a longitudinal analysis was used to demonstrate how performance measures had to be modified in a subsequent phase of development to ensure relevant measurement of capabilities. The researchers investigated how organisations could take actions to ensure that their performance measurement system evolved over time to cope with changing external environment, which would have implications for modification of strategies and operations. Different strategic focuses would require responsive development of differentiating monitoring systems.

Another related performance measurement research emphasised the importance of balanced measurements. It also reviewed the non-financial measures of performance criteria of various intangible assets,.particularly intellectual capital, which was critical to overall strategic management of an organisation (Marr 2000).

Assessing the potential ignorance within the current practice of financial accounting, Lev argued the importance of measuring the value of intangible assets. While economic performance based on traditional production function was sustained by a company's physical, financial and intangible assets, future earnings and growth potentials could be enhanced by intangible performance as reflected in company valuation (Lev 2004). Increasingly, researchers were concerned about the presence of knowledge-based assets (KBA) and their impact on financial performance (Rodgers 2003).

2.2.2 Collaborative Research and Application of Performance Measurement

The Performance Measurement Association (PMA) is a non-profit organisation based in the U.K. that focuses on building a research community for the study of performance measurement. In the past three conferences held by PMA in 2000, 2002 and 2004 on the topic of Performance Measurement and Management, there were substantial research studies contributed by both the academics and industry consultants who explored the domain of performance measurement studies with integrative ideas from other disciplines of business and management (Neely 2000; Neely, Walters and Austin 2002; Neely, Kennerley and Walters 2004). These conferences gathered research interests and case studies that revealed the applications of performance measurement systems in a wide range of industries. During the earlier conferences, interests tended to focus on the manufacturing sectors and traditional industries. These research projects studied the processes and value drivers among the cases under review and analysis.

For instance, Barker (2000) studied through implementation of two electrical manufacture cases the use of a time-based performance measurement technique to analyse non-value adding activity and to reduce costs. The system was proven to improve manufacturing systems performance and profitability. In a case study of a small manufacturing company, Bititci, Turner and Bourne (2000) used business process view of performance measurement and tested a process design method with implementation of a performance measurement system. Investigating the influence of parent companies on performance measurement system, Borne and Neely (2000) examined the design and implementation of performance measurement systems in 12 manufacturing companies and found out the significance of the parent companies' initiatives. Moxham and Greatbanks (2000) studied the inadequate performance measurement system of a carpet yarn processing operation and the possible reasons for the resistance to proper measurement. Suggestions were made on improved performance indicators and for a review process to consider current business situations. More recently, Neely, Kennerly, and Martinez (2004) investigated two divisions of an electrical wholesales company in the U.K. on the results of implementation of a balanced scorecard system by one of the two divisions. The division that completed the implementation was found to be able to produce a positive impact on sales and net profit.

Increasingly, researchers shifted their focus from value-drive processes to the aspects of intangible assets and knowledge-based resources in their studies. Service-oriented organisations became the cases of investigation with an attempt to study the nature of intangible assets and intellectual capital that were critical to performance delivery of these organisations. These organisations included operating units of the governments, public utilities, hospitals, schools, universities and charitable organisations. For instance, Buckley and Watkins (2000) reviewed the benefits generated from implementation of a performance measurement system for the St. Andrew's Hospital. The results demonstrated that the system was able to improve understanding of the key success factors within the organisation, to facilitate ownership through involvement in design and implementation, and to enhance reflective practice in the hospital. With respect to the application of balanced scorecard in the healthcare sector, Baraldi and Monolo (2004) revealed the potential of adopting such performance measurement system in the setting of an Italian case.

Hwang, Lee, Lee, Hong and Yum (2002) examined the current performance measurement system of a public telecommunication company in Korea with a focus on the processes and management hierarchy and suggested improvement of strategy based on the best practices in the industry. Furthermore, Taylor (2004) diagnosed the processes undertaken by a public sector agency in the U.K. to improve performance management with the application of Balanced Scorecard. The study discussed the milestones and the lessons learned in the design and implementation of such a new performance system.

Other than these service-oriented organisations, there appeared to be increased interests among knowledge-intensive companies, which usually possessed technologies to facilitate growth and development opportunities. Researchers unveiled the significance of knowledge as a type of resource which could make a difference to performance delivery by a company. For example, Roth, Lettice, Evans and Prieto (2002) developed the functions and design principles for performance measurement that would improve managing knowledge reuse and invention in new product development. More importantly, Lev

(2002) summarised the current research on intangible assets and intellectual capital in the 2002 PMA Conference and that future research needed to focus on organisational infrastructure and its influence on enhancing productivity. Subsequently on intellectual capital, Carlucci, Marr and Schiuma (2004) argued for the importance of organisational knowledge assets and the development of visual representations that showed the mapping of causal models based on the Analytical Hierarchical Process methodology; as a result, the most important knowledge assets that contributed to performance were identified.

Nevertheless, despite the prior focus on the public and private sectors, researchers on performance measurement seemed to have lesser concentration on application in technology-based enterprises and ventures that needed to embrace growth and development. There were a few studies on performance measurement applied in emerging technology sectors, such as e-commerce and bio-technology. Marr and Neely (2000) looked into the issues related business performance measurement of e-business and m-business under a rapidly changing business environment. Lee and Huh (2002) on the other hand explored the current performance measurement system used to assess the venture businesses in Korea. The research argued against the financial focuses in the current system and suggested consideration of the ecosystem of Korean venture firms and development of simulator for realistic validation of venture business performance. In studying the performance measurement in small and medium enterprises in Scotland through case studies, Garengo and Bititci (2004) revealed that there were four contingency factors that would affect the performance measurement in these enterprises. These factors included corporate governance, management information system, business model and organisational culture.

2.2.3 Intellectual Capital

Intellectual capital received broad attention in recent years among the increasingly knowledge-based economies in the world today. Researchers initially looked into issues in knowledge management and more structured approach emerged through assessing possible components within intellectual capital. In fact, empirical studies intellectual capital had been carried out through cases in various industries; the implications to corporate valuation, performance measurement, and performance management were explored (Marr and Chatzkel 2004). Management of intellectual capital and knowledge was also considered critical to technology-based companies that needed to utilise human capital in facilitating technological innovation and entrepreneurial development activities.

Human capital development within organisations was identified as a key factor for their survival and vigorous business competition. Former studies on knowledge management pointed out the significance of human capital as the core competence in organisations. Continuous development of human and associated organisational capital could be enhanced through knowledge sharing and experiential learning; knowledge development life cycle had to be maintained in order to generate sustainable growth for a company (Gamble 2001).

Effective planning and deployment of resource for building intellectual capital in early-stage startups would have significant impact on their performance as new ventures. In fact, intangible assets were presumably a critical consideration not only for large enterprises but also new ventures. For start-up businesses, Pena found that human capital of entrepreneurs, organisation capital and relational capital - such as strategic business networks and relationship to stakeholders - are very important intangible assets that are observed to have a positive relationship with venture performance (Pena 2002). Although availability of tangible assets and financial resources is a concern, intangible assets play a strong role in contribution to the growth of a start-up company. Human capital should comprise the entrepreneurs' education, business experience and level of motivation.

Rodgers pointed out the importance of measuring knowledge-based assets, which would have to be re-conceptualised and quantified as a basis that links to a company's performance. In the information age, financial reporting should no longer focus solely on the existence of tangible assets but also provide presentation about the assets based on captured knowledge by the management. To enable better understanding of knowledge-based assets by end-users of information, knowledge-based assets could be classified into human, organisational and relational for further investigations (Rodgers 2003).

Hurwitz, Lines, Montgomery and Schmidt identified four areas of intangible assets: human capital, organisational capital, customer capital and intellectual property. They concluded that intangible performance driven by human and organisational capital has a significant impact on stock returns. Integration of resource allocation decisions on human capital and organisation capital with other intangible and tangible assets would ensure effective strategy implementation. The research also pinpointed the increasing implications of intangible assets on the stock market value of a firm while book value seemed to lose its association; intangible assets were seen as the resource to provide future earnings (Hurwitz, Lines, Montgomery and Schmidt 2002).

To explore the impact of intellectual capital on the performance of enterprises, an empirical study was launched with classification of intellectual capital into human capital, structural capital, innovation capital and customer capital; using such a component-based framework, the interrelationship among these components was found to be significant and their impact on business performance was noticeable (Chen, Zhu and Xie 2004). Having acquainted with the resource-based view, another team of researchers investigated the interdependency among resources within a firm, and how these resources would affect organisational performance. A taxonomy of organisational resources or assets with suggested performance drivers were analysed as intellectual capital. A value creation map was developed to enable identification of critical intangible resources that would facilitate and contribute to performance (Marr, Schiuma and Neely 2004).

To investigate the interrelationship among elements of intellectual capital, regression analysis was adopted to understand the dynamic relationship and the impact on market-to-book value ratios and future financial performance (Chen, Cheng and Hwang 2005). Other researchers used similar approach in understanding the impact of innovation capital and information technology investments on firm performance and explored the existence of optimal investments on research and development in electronics and bio-chemistry industries of Taiwan (Huang and Liu 2005). A similar investigation looking into the relationship among innovation capital and customer capital was launched to understand the underlying impact on performance within the information technology industry of Taiwan. (Wang and Chang 2005).

There was a comparable research launched on the relationship between intellectual capital and business performance in other industries. Based on a framework that took into account of human capital, structural capital and customer capital, Bontis, Keow and Richardson (2000) conducted a survey of companies from both service and non-service industries in Malaysia to review the influence of intellectual capital on business performance across the industries. It was revealed how these selected components affected these companies in a different manner. The results confirmed the positive relationship between structural capital across the industries as well as interrelationship among the components.

Companies that possessed strong capabilities and investments in science and technology were found to have positive impact on their future performance in the capital market (Lev 1999). These companies were able to successfully develop patents from investments in research and development, which also drove their productivity and growth. Recent researches in intellectual capital gave further emphasis on the impact of intellectual capital elements on business performance, building on prior studies about the cause-effect perspective among components of intellectual capital.

In reviewing the current practice on reporting intellectual capital, Guthrie and Petty (2000) studied the current measurement and reporting of intellectual capital among listed companies in Australia. On contrary to its counterparts in Europe and North American, these companies in Australia did not provide a consistent framework to report the key components of intellectual capital. Nevertheless the reported information tended to focus on human resources, technology, intellectual property rights, organisational and workplace structure.

Mouritsen (1998) examined the differences between Economic Value Added (EVA) and intellectual capital measurement in the reporting of business performance. The study pointed out EVA[9] tended to focus on financial measurements based on cost of capital and bottom lines. Intellectual capital measurement appeared to be related to non-financial elements, such as organisational knowledge and competence development, and thereby encouraged endogenous growth and creativity of employees.

Ordonez de Pablos (2004) developed a practical guideline to support the measurement and reporting of intellectual capital. In the report, the researcher proposed the development of intellectual capital statements which should be composed of the intellectual capital report, intellectual capital flow report and the intellectual capital memo report in order to facilitate formal reporting to the stakeholders. The author created a series of indicators detailed under the categories of human capital, relational capital and structural capital with different levels of "disaggregation". Given the increasing importance of

[9] EVA is a trademark owned by Stern, Stewart & Co., a New York based consulting firm. It is a financial performance measure that calculates the economic profit of a business entity after the capital charge.

intellectual capital in an organization, the paper intended to provide a pioneering guideline for consistent measuring and reporting of intellectual capital in light of the expected needs to formulate international harmonization.

2.2.4 Resource-based View

Resource-based view is a theoretical perspective that brings in a unique dimension of thoughts on managing growth and development of enterprises, operationally and strategically. It is able to fill in the missing linkage in business performance with respect to the resource requirements and the expected output from an organisation. This section provides a summary of relevant research in the core area with implications to performance management of TEVs.

In the early research of the resource-based view of a firm, Penrose investigated the phenomenon of growth of enterprises with in-depth process analysis of the resources involved at stages of development (Penrose 1959). The study illustrated with cases that growth of a firm would be dependent upon the availability of adequate resources at particular nodes of growth and development as observed in enterprises, which survived in an emerging business sector of rapid development with sizable market opportunities for expansion. Such a phenomenon currently appeared to be relevant and reflective to the birth of numerous TEVs under the swift technological innovation in information technology and telecommunication industries within the past decade. Penrose (1959) pointed out that resources should be characterized as both intangible and tangible which would be equally important for the growth of a firm.

Other researchers of interest in the resource-based view launched studies about the importance of understanding strategic management of firms with the perspective of resource management. Wernerfelt (1984) explored that firms could be analysed in terms of their competitive advantage through the perspective of resources rather than in terms of products themselves. Resources would help management determine the rational growth strategies through assessing existing resources available for exploitation and new ones that required development efforts. This analytical mechanism for a resource portfolio needed to take into consideration the balance between a short-term and long-term growth strategy.

In examining the sources of sustained competitive advantage, Barney (1991) looked into the relationship between resources and a firm's competitive advantage, under the assumption that resources of strategic nature distributed across the firm were heterogeneous and thus enabled differentiation from other competitors. The researcher identified four main characteristics of resources for sustaining competitive advantage, namely value, rareness, imitability and substitutability. With respect to imitability, the author argued that it would be difficult for imitating firms to duplicate the strategies of firms with a sustained competitive advantage, with causal ambiguity and imperfectly imitable resources being the core obstruction. With most resources of such nature generated internally, firms could hardly acquire sustained competitive advantage in the marketplace.

To further analyse the relationship between resource development and sustainable competitive advantage, Oliver (1997) explored the combination of resources that would impart critical influence on a firm's competitive advantage. The context and process of resource selection would create sustainable advantage for a firm with heterogeneity that was influenced by its institutional context. Such institutional context was suggested to be composed of internal corporate culture and other external factors including relationship with other firms and economic behaviour of the society. In her research, Oliver also introduced the concept of institutional capital consisting of incentive systems for resource innovations and competency sharing, decision support systems that diffused resource innovations, as well as training that facilitated resource adoption and learning.

In studying cases of strategy-focused organisations and their utilisation of Balanced Scorecard, Kaplan and Norton pointed out the reality that strategic initiatives could fail if required initiatives did not receive adequate staffing and financial support. "*Strategy-focused organisations build human and financial resource commitments for strategic initiatives into organisational plans and budgets and manage them separately from budgetary line-item expenses. This process makes achieving stretch targets far more likely*" (Kaplan and Norton 2001). Oliver (1997) in her prior studies further supported the analogy that resource capital would enable companies to maintain firm heterogeneity and sustainable competitive advantage. Institutional capital that embraced an internal organisational culture and enhances strategic relationship would be indispensable to a firm's competitive advantage.

Furthermore, resources were considered a critical element for development of core competence by both corporate ventures and start-ups established by independent entrepreneurs; *"The institutionalisation of resource combinations results in a capability and when that capability is defined as essential to achievement of the venture's basic mission, it has reached the level of core competence"* (Green, Brush and Hart 1999).

In examining the financing of business start-ups, Cassar identified that financial capital was the necessary resource for start-up enterprises to form and subsequently to operate. Capital raising decisions had critical implications for their business operations, firm performance, the catalysts for expansions and risk of failure. The research also argued that asset structure of a start-up firm and the tangibility of its assets would have an impact upon its financing opportunities (Cassar 2004).

Other perspectives of the resource-based view call for in-depth analysis of resources and their influence on organisational performance. Mills, Platts and Bourne investigated the architecture of the relationship between resources and competence within firms and found that performance of any competence at any hierarchic level to a large extent depended on the appropriateness of a firm's resources to the services required as well as the coordination of resources. The former aspect referred to how a person's skills, experience and training matched the particular service required, whereas the latter factor produced competence output and much performance of those output. *"Managers would* *need to spend efforts in coordinating their resources into services and competences in alignment with strategies"* (Mills, Platts and Bourne 2003).

Micheli, Franco, Marr and Bourne (2004) discussed that resource-based view appeared to provide an important ground to design a strategic measurement system. The system would be able to include the necessary value drivers that enabled the measurement of intangible assets and intellectual capital. Integration with the theory of resource-based view would provide the linkage with competitive advantage for a performance measurement system.

More recently, a series of research on resource allocation process (RAP) and complementary studies unveiled the pattern of resource commitments that originated across various levels of an organization and how strategy was in fact formulated and realized through the interactive process of resource allocation (Bower and Gilbert 2005). Through ethnographic studies of a number of cases in large organizations, the researchers involved in the studies explored the lessons in resource allocation through the bottom-up process, the top-down intervention and the other necessary iterated processes in order to formulate successful business strategies and pertinent executions. In exploring the role of top-down disinvestment, the study introduced a process model of disinvestment that identified the roles of customers and investors who provided the financial resources necessary for survival. For instance, it was revealed that incumbent firms would attempt to commercialize new technologies that failed to serve the requirements of their customers even though there were no hurdles in technological innovation. The pressure from capital providers could influence the investment decisions that were driven by expected financial performance, and could in turn play an important role in the internal resource allocation process.[10]

With specific focus on the characteristics about resource configuration in new ventures, Greene and Brown (1996) investigated the influence of the combination of resources on performance of new ventures. Looking into the capital categories of human, social, physical, organizational and financial, the research examined their relationship between capital structure and measures of new venture performance. The results showed that the specification of capital structures and the extent to which these differed depended on organizational and or individual firm characteristics. Human capital resources were regarded as the most important in the medical businesses whereas social capital, such as personal networks, was believed to be critical for the computer and telecommunication sector. The authors argued that the business owner's ability to configure resources was an important value because of the natural constraint of resources in startups.

Through three longitudinal case studies of three fast growing ventures, Lichtenstein and Brush (2001) explored their salient resources and how these resources changed over time. Focusing on the process of acquisition of resources, the study found that intangible resources are the most salient and suggested reassessment, reflection and discussion should be part of the continual processes. These intangible elements included organizational systems, technology resources and resources that promoted sales and service delivery. In

[10] It refers to Chapter 7 regarding the failure of bottom-up strategic processes and the role of top-down disinvestment on pages 135-169 (Bower and Gilbert 2005).

order to survive and grow, new ventures needed to "exhibit both incremental alternations and evolutionary developmental change in their salient resources and resource bundles" in accordance with the findings. The incremental intangible resources of promoting sales and service delivery were regarded as the most salient ones for their growth.

Another study that explored the resource configurations of research-based startups examined their initial resource base and how these ventures interacted with the institutional origin and market characteristics. Heriman and Clarysse (2004) empirically tested the interaction among human capital, financial resources and technological resources in the formation of distinct starting resource configurations. The study unveiled four different starting configurations: venture capital-backed startups, prospectors, product startups and transitional startups. It concluded that research-based startups varied greatly in terms of their starting resources and a multi-dimensional resource-based taxonomy did not seem to exist and venture capital was not relevant to all of the startups under this study. On the other hand, it specifically pointed out the startups that managed to develop new products and services and interacted with the market possessed resources demonstrated their ability to grow without venture capital.

2.2.5 Management of Technology Exploiting Companies

Technology exploiting companies were considered to have the characteristics of utilising emerging technologies for development of new products, services and solutions. Unlike the traditional industries, this type of companies would exploit technologies through continuous research and development activities to gain unique competence in delivering new products, services and solutions that would in turn bring values to the end customers. For these companies, technological innovation was critical for their survival and success in the marketplace. Management of technology exploiting companies represented a unique research area that required a distinct review.

In studying the sources of business opportunities exploited by entrepreneurs, Peter Drucker pointed out that knowledge-based innovation was the "super-star" of entrepreneurship (Drucker 1985). Such innovation was based on technical, scientific initiatives and social aspects, but involved challenges in time span and other complexity with convergences of new technologies. This sort of entrepreneurial opportunity could be considered to be more difficult to manage than the others. However, this sort of risk could be mitigated through timely integration with new knowledge as the source of innovation.

Companies that depended heavily on technological innovation needed to robustly review their own strategies in order to survive and prevail in a competitive arena of new value creation. Weiss and Birnbaum (1989) argued that a technology-based enterprises needed to have its strategy built in connection with technological infrastructure. As the essence of technological strategy was associated with institutional establishment, a firm needed to either maintain strong linkage in external infrastructure or to enhance the development of its own infrastructure for its continual stream of technological progress. Technological infrastructure was described as *"an elaborate and sophisticated system in which technological knowledge is produced and distributed"*, which was considered more complicated than the nature of technology built on a pre-existing technical and scientific knowledge. This suggested that a unique network of innovators and inventors was necessary to develop such an infrastructure.

With respect to internal management and control instrument, backcasting was introduced as a planning tool to critically analyse and access the technological prowess of a company in gaining competitiveness in the marketplace (Guild and Wang 1996). They pointed out this competence in management planning was a company's internal resource and unique capabilities to compete successfully while creating value for customers. The tool focused on reviewing a number of plausible futures and paths through working backwards from a range of future targets while investigating critical internal competence required as well as external competitive factors. To successfully implement this technique, companies needed to provide adequate monitoring of the technology companies internally and externally as they went through various critical stages of development. This planning tool also aimed to enable the management to be more decisive and confident in formulating business planning substantiated with continuous supply of relevant information.

However, the nature of disruptive technological change would affect normal pattern of sustained growth with the dramatic surge in technological advancement and resulting market penetration (Christensen and Bower 1996). Large firms tended to focus on current market requirements and might not regard the foreseeable needs of their customers. As a consequence, these large firms would overlook the timely opportunities to develop innovative products with the latest technological know-how, thereby losing its established market position to a competitor or a new entrant. It was examined that patterns of resource allocation would affect the success of innovation undertaken within a firm.

Research and development expenditures demonstrated the amount of new resources allocated to generating new intellectual capital for a technology-based company. Such Research and development expenditures would enable a firm to develop new products, patents as well as technological know-how that could create competitive advantage for a firm, as advocated by the resource-based view (Barney 1991). Moreover, Wilson and Appiah-Kubi (2002) examined a group of high technology entrepreneurial firms based in New Zealand for their reliance on internal and external resources and were able to confirm the significance of external resources, including the use of external networks and social communities, for their effective growth and development.

It appeared that the return from investments of research and development activities did require a longer timeframe as the effect of delivering new products and perhaps improvement of operational efficiency, as a result of research and development expenditures, would take years to realise. Since research and development expenditures that should have been recognised as intangible assets were mostly recorded as expenses in the fiscal year that they incurred, such expenses burdened the technology firms with worsened financial earnings while causing under-valuation in the capital market. Despite such short-term effect, firms with heavy research and development investments demonstrated to be under-priced and were able to outperform the market in the later years (Lev 2004).

In assessing the future of the semiconductor industry, a team of researchers reviewed the application of Moore's Law in forecasting the future growth pattern with respect to processing power and cost of microchips (Gulati, Sawhney and Paoni 2003). Despite Moore's Law's ability to project the pattern of development in the past decades, it was argued that the upcoming market disturbances combined with disruptive technology would greatly affect the persisted pattern that had repeatedly occurred in the past. Companies in this technology sector would need to further pursue sustainable strategy with strength in research and development and perhaps with creation of real options for securing disruptive technology that could alter the current landscape.

In predicting survival of high-tech firms that have gone through IPO, Wilbon (2002) investigated the survival of a group of hi-tech firms and found that those managed to survive possessed more experienced senior executives and more intellectual property rights than those did not. The research, based on a regression analysis, also showed that those survivors did spend less on research and development as a portion of sales at the time of IPO than their cohorts, implying the importance of timing, type and magnitude of resource allocation to sustainable development. Similar quantitative approach was adopted by Bass (2004) in simulating a new product growth model.

A frequently adopted technique to analyse technology-based companies was the real option method. There had been a number of studies that explore the application of real options in research and development investment opportunities technology-based firmed for purpose of evaluation and decision making (Angelis 2002; Angelou and Economides 2005; Calabrese, Gastaldi and Ghiron 2005; Neely III and Neufville 2001). These studies looked into issues of applicability of real options in different technology sectors, taking into consideration the expected future cash flow and probability of outcomes. However, such highly quantitative approach could hardly take into consideration non-financial measures in a meaningful manner.

2.2.6 Resource, Intellectual Capital and Business Performance in Technology Exploiting Companies

The study of performance management of technology exploiting companies demonstrated the increasing dependence on effectual integration of theoretical perspectives among intellectual capital, resource-based view and performance measurement. Traditional research studies on management of technology exploiting companies tended to rely on quantitative methods in their analysis. Recently pertinent researches integrating other management theoretical perspectives made use of case studies to investigate phenomena from the standpoint of resource management, intellectual capital and performance measurement. This section of literature review summarises the articles that are relevant to studying performance of technology management based on an integrative, theoretical perspectives.

In assessing the strategic options of technology-exploiting companies, Oriani and Sobrero (2001) looked into the internal resource allocation and analysed the valuation of the research and development capital by the stock market. Their research was able to confirm a positive effect of the research and development capital on a company's market value and the variability of such an effect on different industries in time. The results also showed that such a relationship was even more critical for research and development-intensive industries in recent years.

From their investigation based on case studies, Pandza, Horsburgh, Gorton and Polajnar (2003), argued that any framework to illustrate resource accumulation and capability development should take into account uncertainty and knowledge imperfections in the system. Through a process of deliberate trial-and-error, knowledge was accumulated within an organisation; resources and capabilities were developed and changed over time as knowledge changed. This study suggested the adoption of a modified real-options approach and the case of incremental investment in new facilities within a strategically important manufacturing operation at a large aerospace company (Pandza, Horsnurgh, Gorton and Polajnar 2003).

Davila, Foster and Gupta (2001) further examined the positive relationship between the number of employees in a new venture and its financial valuation; participation of venture capital also had a positive impact on the growth of technology start-ups. Day and Schoemaker pointed out the importance of allocating resources in learning capability to enable stronger knowledge built-up for an organisation as a whole; as a result, a start-up company could learn from failure and be responsive to renewed challenges in the future (Day and Schoemaker 2000). Having acquainted with the resource-based view, another team of researchers investigated the interdependency among resources within a firm and how these resources would affect organisational performance. A taxonomy of organisational resources or assets with suggested performance drivers were analysed from the point of view of intellectual capital. A value creation map was developed to enable identification of critical intangible resources that would facilitate and contribute to performance (Marr, Schiuma and Neely 2004).

As stated in the previous section on intellectual capital, Chen, Zhu and Xie (2004) in their research established a significant relationship between the four identified intellectual capital elements, namely human capital, structural capital, innovation capital and customer capital, and business performance, based on a defined qualitative index system. Cause-effect was found between these types of intellectual capital and business performance. It was concluded that such strong linkage and dependency between intellectual capital and business performance demanded enterprises to manage and improve intellectual capital in an integrative manner.

As investigated by Lev (1999), companies that possessed strong capabilities and investments in science and technology were found to have positive impact on their future performance in the capital market. These companies were able to successfully develop patents from investments in research and development, which also drove their productivity and growth. Recent researches in intellectual capital placed significant emphasis on the impact of intellectual capital elements on business performance, building on prior studies about the cause-effect perspective among components of intellectual capital. To investigate the interrelationship among elements of intellectual capital, regression analysis was adopted to understand such dynamic relationship and the impact on market-to-book value ratios and future financial performance (Chen, Cheng and Hwang 2005). Specifically, Huang and Liu (2005) used a similar approach in understanding the impact of innovation capital and the information technology capital on firm performance. The research concluded that investments of innovation capital would have positive effect on performance before an optimal point, beyond which influence of innovation capital on performance could become negative; in addition, it was shown the interaction between Innovation Capital and information technology capital would create positive influence on firm performance. For the information technology industry in Taiwan, research efforts were made for the investigation of cause-effect of intellectual capital on business performance; the results also indicated the significant impact of innovation capital on customer capital, and subsequently on business performance (Wang and Chang 2005).

Connecting resources-based view with intellectual capital perspective, a team of researchers looked into the effectiveness in deployment of resources and the robustness of resources in a research-intensive pharmaceutical company (Fernstorm, Pike and Roos 2004). The case study that examined the company's development experience demonstrated how the intellectual perspective would augment the strategic focus of the research and development department through a market-orientation that utilises external relational resources. The research advocated a stronger understanding of the nature of intangible assets in value creation of resources within a technology-driven organisation.

Nevertheless, Lev (2004) pointed out that the return from investments of research and development activities did require a longer timeframe as the effect of delivering new products and probably improvement of operational efficiency led by research and development expenditures would take years to realise. Since research and development expenditures that should have been recognised as intangible assets were mostly recorded as expenses in the fiscal year that they incurred, such expenses would burden the technology firm with worsened financial earnings and cause under-valuation in the capital market. Despite such short-term effect, firms with heavy research and development investments demonstrated to be under-priced and were able to outperform the market in the later years (Lev 2004).

In studying performance of companies having gone through initial public offers, Mavrinac, Chakrabarti and Low (2002) observed that companies' underperformance was largely due to failure in the development of corporate intangibles and measurement systems. The three most important capabilities to sustain performance were found to be (i) management credibility, (ii) effective board oversight, and (iii) innovative product development capabilities.

2.2.7 Decisions Analysis and Operations Management

Paul Keen's book on information technology provided insight on the exploitation of information technology for process improvement and related new organisational development. The evolution of information technology driven companies emphasised the importance of application of information technology and its integration into workflow for enhancing growth and development in an effective scale. As predicted, organisations would be redesigned and built through allocating resources in information technology applications (Keen 1991).

In growth and development of technology-exploiting companies, it was critical to consider supply chain management and related integration of technology concerns into the overall core competence of a company in maximizing the competitive advantage in operations. The main areas related to internal business process that were considered critical in this respect included acquisition of technologies (home-grown or acquiring from a third party), development of technological infrastructure, product development and integration with technologies, as well as development of services and skills. Supply chain perspective had significant implications on relationship with key stakeholders and the impact on market development, and very importantly the implications on fulfilling customers' requests (Chopra and Meindel 2001).

Carter (1994) on the other hand pointed out that new ventures should study carefully their unique position in the industry supply chain and their adoption of specific strategy archetypes. This particular research further provided implications about the importance of supply chain positioning in technology-based ventures. Proper resource allocation in supply chain development could lead to advantage in their execution and subsequent business performance.

In management science, researchers pointed out that decision makers in business needed to identify the decision variables and their values in order to seek out the "best" output for a model. The values that were able to deliver the "best" output were referred to as the optimal solution for a model (Anderson, Sweeney and Williams 2003). Such model needed to meet certain business objective, such as profit maximization, and was restricted by capacity constraints. To obtain the final solution, an analyst would be required to take the procedure with a trial-and error approach, through testing and evaluation of various alternatives to support decision making.

To support decision making for resource allocation problems, it was pointed out that a decision tree could be constructed to identify decision nodes and to evaluate pay-offs resulting from different decisions (Goodwin and Wright 2004). Also known as roll-back method, decision tree would allow management to evaluate complex decision problems with sensitivity analysis and probability application. Following the analysis, decision makers could develop optimal policy in order to ensure that optimal solution would be determined and delivered.

Evans and Lindsay (1999) discussed about the importance of maintaining management systems that could work with each other effectively in order to deliver quality to the end customers. These management systems should embrace the three core principles of total quality: (a) a focus on the customer, (b) participation and teamwork, and (c) continuous improvement and learning. These principles in turn needed to be supported by an integrated organisational infrastructure, which was typically composed of leadership, strategic planning, human resources management, process management and information management.

2.2.8 Information Asymmetry and Agency Theory

Management of ventures is perceived as an area that requires unique attention for the level of uncertainty and particular situations associated with their development. Information about the ventures under development, unlike publicly listed companies, could be relatively limited to the stakeholders. Intuitively, there were basically two levels of information asymmetry within technology-exploiting ventures. First of all, ventures develop in an environment where new technology was emerging rapidly; information about such an evolving marketplace due to disruptive changes could be unavailable or confined to the insiders involved. Market information could be complicated within a fast-paced environment of vigorous competition and constant evolution from the dynamic marketplace. Secondly, management's communication with the stakeholders through the board could be untimely and insufficient to reflect the current results.

Information asymmetry was an intrinsic problem about which management of private ventures was unwilling to disclose sensitive information, or the method of exploitation that would induce competitive advantage for them to make profit over the other market players (Shane 2004). While the founders might be defensive about disclosing sensitive business information, the resource providers needed to be aware of situations in which the entrepreneurial management would negotiate with them with an attempt to generate wealth at their economic expenses when information about a venture was incomplete. Furthermore, information asymmetry would create investment risks when entrepreneurs became willing to take excessive risk with the investors' resources, making it difficult to monitor effectively their executions.

Scott (2000) provided in-depth analysis about the concept of information asymmetry. He identified that there were two main types of information asymmetry. The first one was **adverse selection,** which happened when certain managers knew more about the current condition and future prospects of the firm than outside equity stakeholders. These managers and insiders could exploit their information advantage through managing the information released to the investors, thereby affecting their ability to make proper investment decisions. In order to control such adverse selection problems, financial reporting should take up the important role of providing credible information to the stakeholders. The second type was identified as **moral hazard,** which happened due to the separation between ownership and management control among business entities. Problems could be caused by managers who intended to "shirk" on effort and to blame any deterioration of firm performance on factors beyond his or her control. To deal with these problems related to information asymmetry, it was suggested that investors' interests could be served by reliable and relevant information that would enable fair assessment of the firm's future economic prospects, free of bias and management manipulation.

To investigate how research and development activities were associated with **information asymmetry** and insider gains, Aboody and Lev (2000) found that insider gains in firms with heavy research and development were more substantial than those with less research and development activities. Research and development being a poorly disclosed item could be taken advantage by insiders through manipulation on information about planned changes in research and development budgets. This particular situation was viewed as a form of **moral hazard** that could happen in a research and development-intensive firm where the management could intensify information asymmetry with outside investors attempting to effectively monitor utilization of resources and performance. Shane (2004) also pointed out that investors needed to be actively involved in new ventures in order to mitigate such problems associating information asymmetry. Ventures would be required to provide regular updates of business information to the investors so as to enable closer monitoring of latest development, and involvement in day-to-day operations could also improve understanding when problems related to information asymmetry is high. Degree of innovativeness of a venture would intensify information asymmetry as fewer sources of relevant information were available to the resource providers in a timely fashion. Monitoring of ventures was perceived as more important when they were growing in earlier stages of development.

To investigate how research and development activities were associated with **information asymmetry** and insider gains, Aboody and Lev (2000) found that insider gains in firms with heavy research and development were more substantial than those with less research and development activities. Research and development being a poorly disclosed item could be taken advantage by insiders through manipulation on information about planned changes in research and development budgets. In a recent study, Mohd (2005) investigated the **information asymmetry** existing in software development firms in which research and development activities were considered as intensive. According to the researcher, information asymmetry indicated that some investors were better able to assess the future benefits than others. The study found that information asymmetry could be reduced in firms that capitalized research and development costs of software development than those expensed the items. The article argued that under this accounting treatment the investors' uncertainty about the future benefits of software development costs was reduced.

Yoshikawa, Phan, and Linton (2004) studied the phenomenon of investment and risk management among Japanese venture capital firms. Unlike U.S. venture capitalists who actively monitored to look into private information in order to maximise from investments, Japanese venture capitalists were found to traditionally used portfolio diversification to attenuate investment risks. Performance-based compensation was found positively related to active monitoring. The study advocated that venture capitalists should be as concerned about the structure of their incentive systems for their fund managers as they were for their investee-firm entrepreneurs. It used **agency theory** to denote that contingent compensation was a self-governing mechanism for individual effort that was difficult to measure and verify. Equity ownership and performance-based pay could make significant influence on the strategic choices of managers.

Another research on potential **moral hazard** problems in ventures funded by angel investors revealed that there could be opportunistic behaviour by both the entrepreneurs and the venture capital firms who funded a start-up venture at a later stage (Elitzur and Gavious 2003). Through a model that applied game theory and signalling problem, the research suggested that moral hazard problem arising when actions required or desired under the contracts not freely observable would lead to prisoner-dilemma-like outcome. Free-rider phenomenon would also result from this inefficient behaviour. Such a problem could be avoided through corporate governance and financing mechanisms including stock options, staged financing and direct oversight.

Scott (2000) further pointed out that **agency theory** as a branch of game theory enabled the study of designing a contract to control moral hazard. An optimal contract could be designed with terms of performance measures that were observable by both principal and agent. While net income seemed to be an appropriate measure, a firm could consider alternative measures of performance depending on its organisational structure and environment.

Similarly, Micheli, Franco, Marr and Bourne (2004) argued that **agency theory** would be appropriately used to examine principal-agent relationships and related studies towards performance measures and compensation scheme. It was important to maintain a performance measurement system with the right measures of performance that would drive expected goals. The agents' compensation should be contingent upon performance measures specified in the performance measurement system.

In studying the financing of business start-ups, Cassar (2004) reviewed the issues related to **information asymmetry and agency theory** in the investigation of the determinants of capital structure and types of financing. The study revealed the problems that financiers needed to find ways to reduce the potential risks associated with financing start-ups given their little track record and the uncertainties with their future performance. The results suggested the importance of delivering appropriate signals for growth to the stakeholder and the need to establish credit relationship as early as possible. The study also found that tangible assets within the asset structure of a venture would have positive implications to its financing opportunities. Network resources would enable those lacking tangible assets to seek less formal means of non-bank financing.

In system theory, it was pointed out that organisations, which resembled open systems, had to "move to arrest the entropic process" and to "acquire negative entropy", or else an organisation would become gradually disorganised or perished in time (Shafditz and Ott 2001). An open system needed to continue to accept new energy from its environment in an amount greater than the expended quantity so as to generate storage of energy for creation of negative entropy. It was critical for an organisation to recognise that it operated in an open system that needed to constantly interact with its environment in order to obtain adequate information and feedback from the environmental forces. New ventures, which were in fact forms of organisations, were also subject to these issues raised in system theory. An effective governing board that was capable of contributing strategic input to combat with external environment might provide certain elements of negative entropy. The following section provides a summary of literature related to such issues.

2.2.9 Venture Governance and Performance Monitoring

Information asymmetry pertinent to investing in ventures has provided an explanation about the evolution of risks for the equity stakeholders. While agency theory suggests the use of engagement contract as well as stock option to institute alignment of interests, there are studies that explore the corporate governance and performance monitoring tools to manage the risks involved in direct investments in ventures.

Targeting the high-technology firms, Reid and Smith (2002) in their empirical studies investigated the risk-handling practices of investors in the U.K. venture capital sector. The study unveiled the three main risks perceived by the venture capitalists, namely agency risk, business risk and innovation risk. In managing agency risk, venture capitalists were found to put a great deal of efforts in monitoring their investments and communicating with the management of ventures. In addition to reviewing financial performance, the professional investment managers would try to understand the trends in the market and innovations that could disrupt the business. Sensitivity analysis and discounted cash flow methods would be used to assess the risks involved.

Daily and Dalton (1992) examined the organisational agent and firm performance linkage focusing specifically on the role of founder CEOs and the composition of the boards of directors among entrepreneurial firms. The study found that the CEO's ability to forgo some measure of control by inviting outside directors into the board might contribute to the overall high performance and growth of these firms. Despite the fact that it was unlikely that there would be an optimal board configuration that would effectively lead the entrepreneurial firm to success, making use of the expertise and resources provided by outside directors could facilitate healthy growth.

Sapienza, Manigart and Vermeir (1996) examined the issues related to venture capital governance utilising surveys of venture capitalists in the U.S. and the three largest markets in Europe. The study found that VCs saw strategic involvement as their most important role, such as providing financial and business advice and functioning as a sounding board and rated their interpersonal roles, as mentor and confidant to CEOs, as next in importance. It also revealed evidence that venture capitalists increased monitoring in response to agency risks, but the results were mixed. Monitoring was the most emphasised in early stage ventures, indicating that venture capital firms responded to high uncertainty by increased information exchange with CEOs. Firms with greater experience in the venture capital industry required less interaction with CEOs, whereas those with greater experience in the portfolio company's industry interacted more frequently with CEOs. Venture capital firms were increasingly expected to operate both efficiently and effectively. Venture capital firms that were able to choose the appropriate bases for determining governance effort and the appropriate roles for delivering added value to their portfolio companies would enhance their survivability.

Markman, Balkin and Schjoedt (2001) pointed out that substantial information asymmetry between entrepreneurs and their investors was a result of the complicated business nature of cutting-edge innovation projects. Such complication was perplexing with the uncertainty associated with young firms. The author suggested the development of a governance system to enable effective monitoring of ventures and to facilitate alignment of interests between entrepreneurs and investors. In another study, it was suggested that "governing economies" could be achieved when senior corporate managers were able to dislodge information embedded in divisions and to avoid problems of moral hazard in the process of allocating capital internally (Bower and Gilbert 2005).

The involvement of venture capitalists in facilitating management and financial controls was investigated by Sweeting (1991) to explore how accounting evolves in the early stages of the development of new technology-based companies. The study noted that while there was the need to ensure financial viability, there was a "primary aim" to manage technology during the early stage of development. It furthered that the venture capitalists were found to act decisively and provide support to these young companies at critical times for necessary changes, pointing out the factor of congruity of interests between the venture investors and the ventures themselves.

In a more recent study, Davila and Foster (2005), the authors examined cross-sectional differences in adopting management accounting systems in a sample of startup companies. The study found that startup companies that had gained access to venture capital tended to accelerate their adoption of budgeting and other traditional management accounting system components, such as variance analysis as well as internal control activities for approval of operating and capital expenses. Employment of a financial manger was associated with the timing of adoption of a management accounting system. The research remarked the importance of adopting components of management accounting system based on their venture capitalists' prior rich experience of success and failure in investing in startup companies. The adoption of such a forma; monitoring system was also found to be associated with subsequent growth in human capital.

The above studies on the relationship of venture capitalists, a key equity stakeholder, and the adoption of a formal performance monitoring and control system, provide additional studies and confirmations about their influence on such implementation of monitoring and control mechanism. It supports the other investigations that reveal the need to reduce potential information asymmetry and the associated problems that may evolve in ventures under growth and development.

2.3 Knowledge Discrepancies

Given the broad areas of knowledge that contributed to understanding the nature of resource utilisation, an integrative framework that synthesised the schools of thoughts would enable the development of a holistic approach to explicate the phenomenon of TEVs. Firstly, despite valuable research perspectives in understanding the nature of intellectual capital and performance measurement, such research outputs appeared to be deficient in considering the relevance of financial resources in measuring business performance driven by intellectual capital for TEVs. Furthermore, they had not considered in sufficient depth about the characteristics of the flow of capital resource, i.e. the timing and combination of resources, allocated to intellectual capital and its subsequent effects on business performance in an integrated manner. Past financial performance was in fact usually considered as the critical indicator for evaluation of direct investments within the capital market. There was however deficiency in the examination of the linkage between application of financial resources and the effective allocation of such resource into components of intellectual capital, which could impact on the growth and development of TEVs. As pointed out by Cassar (2004), financing of start-up business required the financiers, for instance, to obtain appropriate signals about growth and types of assets available within a venture.

Another fairly neglected factor was the current performance measurement and management control practice for the technology sector. While there were studies of performance measurement on both public and commercial sectors in the past years, little research output was found on TEVs, or on technology-based companies that needed to go through early-stage and expansion-stage of development before becoming a mature, self-sustainable organisation. Conventional Balanced Scorecard and other management accounting methods tended to focus on its application on companies in a mode of steady operations. There have been some recent studies that explore the importance of adopting a management accounting system but not much about the adequacy of the traditional monitoring and control methods for the TEVs.

As previously summarised in the literature review in performance measurement, Kennerley and Neely (2002, 2003) explained that a differentiating measurement system according to the development particulars of an organisation over time was effective in monitoring and shaping its performance management. Evolution of measurement systems is necessary for an organisation to deal with changing circumstances. Both internal and external factors have to be considered for the development of a dynamic and relevant set of performance measures. Process, people, culture capabilities and infrastructure are critical elements to be considered for an effective evolution of performance measurement system. The researchers pointed out that a systematic process is required to modify performance measurement system continuously in order to accommodate transformed strategies and operations in reflection of the changing circumstances over time. There is a need to examine such implication to TEVs during their rapid growth and development. However, in-depth studies would be required to investigate the characteristics about the performance enablers, performance drivers and key performance indicators for the TEVs at stages of development.

In monitoring growth and development of TEVs, an approach similar to that suggested by conventional literature on performance measurement appears to be relevant for the stakeholders to develop a tool to safeguard their interests. The equity stakeholders' involvement in corporate governance and the inherent risk of investing in ventures might place greater reliance on an adequate performance measurement system to help monitor and control performance and risk during their growth. Furthermore, to explore the phenomenon of performance measurement and management control of TEVs and their growth, it is important to understand the core issues about venture governance and its characteristics according to prior studies. Venture capital and private equity firms, which provide equity financing to TEVs, can influence substantially the availability of financial resources to initiate their growth and development. However, previous research studies on performance measurement do not seem to provide the critical linkage with venture governance in the technology sector and analysis of the characteristics involved.

Thirdly, recent studies on intellectual capital have successfully unveiled the interrelationship among the components of intellectual capital and business performance. However, there appear to be discrepancies in knowledge among these studies with respect to intellectual capital among TEVs. First of all, there is little understanding about how intellectual capital induces organic growth among the TEVs at stages of development and the appropriate mix of intellectual capital required for growth and development. Resource is acknowledged as a critical factor in the consideration. Pena (2002) studied the importance of human capital and other intangible assets to the performance of start-up ventures; however, the study did not embrace a comprehensive approach to take into account other potentially critical elements of resources, particularly structural capital. For instance, according to Pena, the role of infrastructure seemed to be less regarded under the recent weighted focus on intangibles within intellectual capital. Infrastructure, which provided a platform for facilitating delivery of products and services to a TEV's customers, needed to be considered cautiously, particularly its significance to the growth and development of TEVs in combination with other resource factors (Weiss and Birnbaum 1989).

A current publication by Bower and Gilbert (2005) about the linkage between the resource allocation process (RAP) and strategy revealed the critical processes in resource allocation and the interactions between the senior level of management and the operational level that deals regularly with the marketplace. However, the studies also noted one short-coming in RAP and resource-based view was the unexplored components of resources and their interconnections that would enable a "complementarity-seeking" approach towards theory development.[11] Further application of the resource-based view combined with the perspectives of intellectual capital and venture governance in a framework could build stronger relevance since TEVs under the stages of growth and development need to rely on both internal and external resources to fuel the necessary momentum towards an optimal approach. Such a framework that provides linkage with the concerning elements is discussed in the next chapter.

[11] This refers to the note by M.A. Peteraf under "Outside Commentaries on RAP Perspectives" on p. 423 of the book by Bower and Gilbert (2005).

Chapter 3

3 DEVELOPMENT OF RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This Chapter aims to delineate the research design and methodology adopted in this thesis. It starts with an illustration of an integrative framework adopted to complement with the discrepancies of knowledge in the literature review. Key variable factors are identified in order to enable deductive reasoning. With reference to the main research questions, this Chapter provides the explanation about the rationale in formulating the research design and methodology of triangulation, which combines the use of qualitative and quantitative data and information from interviews, survey, archives, and studies of business cases, thereby providing both primary and secondary data for this study. Relevant literature review on research methodology is also contained in this Chapter to explain the research design and methods adopted for the thesis.

3.2 An Integrative Framework

In order to embrace the missing elements among the prior research as stated in Section 2.3, a framework was proposed to incorporate financial capital as an external resource and to devise the cycle of information flow at two defined stages of development. In order to proceed with constructing the research questions, it was necessary first of all to explore an integrative capital resource allocation model that explained the stimulating factors for growth as well as the relationship among components within intellectual capital and business performance, which were evident in prior capital resource allocation and subsequent results. Recent researches were not elaborative in providing an integrated approach to assess the relationship between external financial capital and elements of internal enterprise resources, and how they would interactively create an impact on the performance of TEVs.

The following figure illustrates that financial capital resources are allocated into various components of intellectual capital throughout the development of a TEV. Corresponding performance indicators, together with performance drivers and performance enablers, could be utilised to assess degree of success in order to feedback to equity stakeholders with information about achievement of predetermined targets in performance. Since performance drivers and enablers would vary in different stages of development, requirements in intellectual capital resources would need to be adjusted and consequently the internal plan for the mix of resource allocation. Relevant performance indicators (PIs)[12] would deliver useful signals to the providers of financial capital, namely venture capitalists and private equity firms, for timely critical monitor and review of performance of TEVs, and would provide useful information about the effectiveness of previous resource allocation and coordination in support of subsequent financing decisions.

[12] PI is hereby adopted as a general term for performance indicators, which include output measures, as well as performance drivers and enablers.

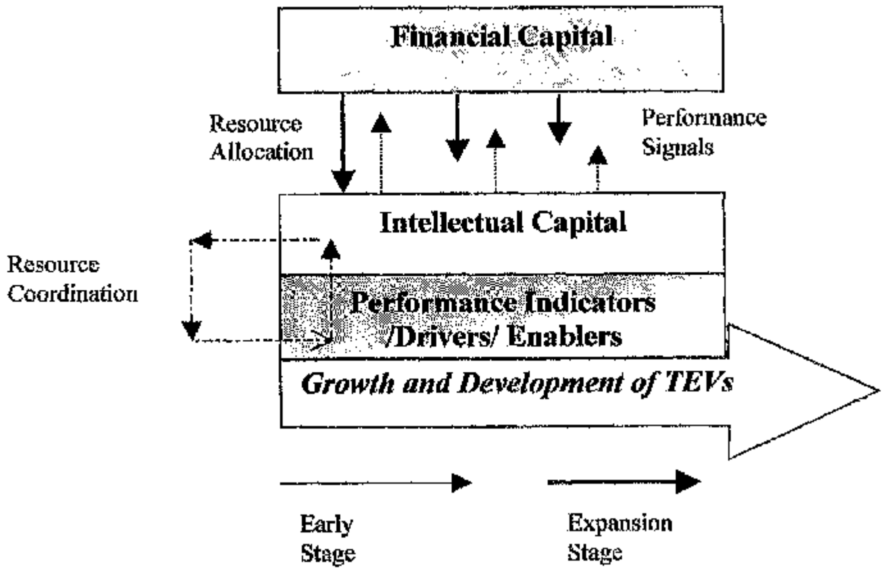

Figure-2: A framework of resource flow in TEVs

3.3 Components of Intellectual Capital

From the standpoint of resource-based view as provided in Section 2.2.3, a model for growth of such types of business entity could however be dependent upon the resources allocated during their early development stage, when new products and services were being designed and developed. In order to facilitate effective growth, certain combination of ingredients for effective incubation could enhance effective development of such young TEVs to become sustainable commercial entities. Adopting contemporary research on intellectual capital (Section 2.2.2), it was assumed that TEVs would contain the following four main components of intellectual capital that would have significant impact on business performance. With reference to previous literature review, contemporary intellectual capital could be categorized into Human Capital, Innovation Capital, Structural Capital and Customer Capital (Chen, Zhu and Xie 2004).

- **Human Capital**: intangible assets contributed by existence of experienced, well-educated and well-trained staff at all levels; contributed further by growth and development in human resources, learning activities, management motivation, entrepreneurship, and team-based culture.
- **Innovation Capital**: driven by research and development activities and evidenced by related resources, supportive innovative culture, pertinent expenditures and investments, together creating the capability to generate new knowledge and to develop new and improved products and services to the end customers.
- **Structural Capital**: evidenced by a combination of internal assets, internal administrative and management systems, facilities and external networks of technological capabilities, upheld through expenditures in pertinent equipment, facilities and systems, collectively creating the overall infrastructure to support operations.
- **Customer Capital**: reflecting the combined resources and capability to acquire new customers and to serve existing customers by experienced and well-trained staff and internal systems, providing the appropriate support to complete delivery of products and services.

The development of IC required resources to espouse growth and development of an organisation especially during its early stage. Examining the process of assembling and acquiring resources would be adopted as an ethnographic method in studying the success or failure experience among new ventures. Furthermore, in understanding the development of intellectual capital within the context of a new venture, it should be noted that financial capital was a key source of resource to fund their set-up costs, to hire staff, finance initial operations, and to acquire new assets. The type of assets owned by a venture would impact its financing opportunities (Cassar 2004). Besides external resources, the second most important source of resource would be effectiveness in coordination of resources by management as discussed in the previous section (Mills, Platts and Bourne 2003). It would help understand the effectiveness of the management of a TEV in utilising limited internal resources for growth.

This research attempted to explore the dynamics of resource allocation within a firm that accentuated technological innovation and growth under a performance-driven management system. First of all, in order to analyse the nature of PIs in general, within the components of intellectual capital, it was necessary in the first place to identify the key PIs as suggested in previous researches and to explain upfront the characteristics of these indicators as well as the implementation requirements for a venture. These PIs determined as important metrics in measuring performance of TEVs would be delineated in the Sections 3.3.1, 3.3.2, 3.3.3 and 3.3.4 under the four respective components of intellectual capital; their corresponding implementation requirements and characters of resource needed in such implementation were to be provided in Table-2a, Table-2b, Table-2c and Table-2d.

On the other hand, this study aimed to carefully identify the characteristics of resources required in implementation, which were proven to be vital to achievement of these PIs under resource-based view. Fundamentally, according to the research on resource-based view under Section 2.2.3, there were three main characteristics of implementation resources for TEVs: (i) Financial Capital-Dependent, (ii) Policy/System/Process-Dependent (PSP-Dependent), and (iii) Execution-Dependent, summarizing the previous studies of resource-based view. Financial Capital-Dependent PIs noticeably demanded initial injection of initial financial capital for acquisition of new external resources, such as equipment used in productions. The second type of PI on the other hand required development and installation of policy and related management systems and procedures to enhance and support the organisational development. It was argued that information sources and guidelines for policies, procedures and systems enabled establishment and formalization of an organisation and minimised mistakes (Green, Brush and Hart 1999). PSP-Dependent PIs might require both initial financial capital and coordination of resources to establish themselves, and the weighting would be determined by availability of existing relevant management systems or new ones. Lastly, Execution-Dependent type of PIs would mainly require active coordination of resources for execution of strategy by management aiming to generate performance that was critical to achieving pre-determined strategic and financial targets (Penrose 1959). This type of PIs could be represented by measurement of results or outputs from an organisation. Table-1 summarised the characteristics of the three main types of resources and their corresponding sources of resource that fuel their respective implementation. Figure-3 illustrated the anticipated interaction among the components of IC under an environment where resources of different characteristics were allocated.

Characteristics of Implementation Resource[13]	**Source of Resource**[14]
Financial Capital-Dependent	Financial Capital Allocation
Policy/System/Process-Dependent (PSP-Dependent)	Financial Capital Allocation and or Resource Coordination
Execution-Dependent	Resource Coordination

Table-1: Characteristics of the three main types of resources

[13] It refers to the characteristics of resource required in implementation driven by specific performance indicators.

[14] Such source is defined as Financial Capital Allocation or Resource Coordination; Resource Coordination refers to internal coordination of existing resources, whereas Financial Capital Allocation refers to injecting external resource into a TEV through monetary financing that enables acquisition of new resources.

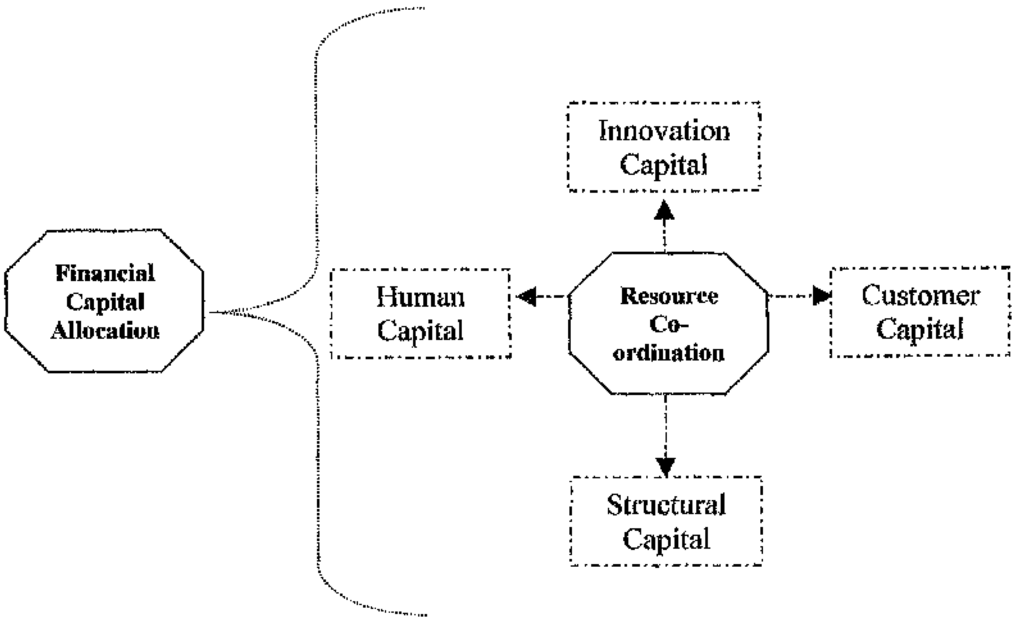

Figure-3: Interactions among components of IC[15]

3.3.1 Human Capital

Human Capital was pertinent to the capital resource of experienced and skilful workforce within an organisation. A number of research studies reviewed the critical influence of Human Capital as a key intangible asset vital to the performance of firms under the knowledge-based economy as stated in Section 2.2.2. Human Capital of TEVs, especially the founders and senior management, was reckoned as the key driving force for successful TEVs. Human Capital was considered the foundation of IC and found to have

[15] Financial Capital Allocation can be directed into one of the four components of the ICs. The achievement of PIs within the components could be affected by Financial Capital Allocation and or Resource Coordination.

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09 June 2006

ATTN:

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Dear Dr Southern

Please find enclosed for your information a copy of a letter sent to Miss Tara Cunniff

A copy of the attached letter has been sent to Miss Cunniff.

Yours sincerely

Joseph Ewesor

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Miss Tara Cunniff
4, Parkbrae Drive
Glasgow
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Ref:1/12200352

Date: 9 June 2006

Dear Miss Cunniff

Student Support

I am writing about your application for support to repeat the 1st year of your course in session 2006-2007.

I am pleased to tell you that we will give you support to repeat the year on medical grounds.

We generally only give repeat funding once. For this reason, you should make sure that you are fit to return to your studies.

Please contact us if you need any more information.

We have sent a copy of this letter to your adviser of studies for information.

Yours sincerely

JOSEPH EWESOR

REPEAT02

positive influence on Innovation Capital, Structural Capital and Customer Capital (Pena 2002). The following table outlined the key PIs of Human Capital for TEVs and identified the corresponding resource requirements:

Indicators	Implementation Requirements	Key Characteristics of Implementation Resource[16]	Possible Evidence
H.1 Founders and Senior Management's Experience in industry[17]	Employment of key staff with recurring resources	Financial Capital-Dependent	Disclosure on profile of senior management team employed and related expenses
H.2 Education/ Qualification[18]	Employment of key staff with recurring resources	Financial Capital-Dependent	Disclosure on profile of senior management team employed and related expenses
H.3 Staff Retention Policy[17]	Policy in place	Policy/System/ Process-Dependent	Availability of supporting policy
H.4 Stock Options[19]	Policy in place	Policy/System/ Process-Dependent	Availability of supporting policy
H.5 Training and Development[18]	Policy in place; Management execution	Policy/System/ Process-Dependent	Availability of supporting policy / Related training activities
H.6 Multidisciplinary Team[17]	Employment of multidisciplinary staff with recurring resources; Management execution	Financial Capital-Dependent and Execution-Dependent	Disclosure on profile of senior management team employed and related expenses; Actual management style and culture

Table-2a: Resource analysis for Human Capital

[16] The characteristics are based on the guidelines given in Table-1.

[17] The indicator is referenced to the list of human capital indicators suggested by Ordonez de Pablos (2004).

[18] The indicator is referenced to the indices of human capital suggested by Chen, Zhu and Xie (2004).

[19] The indicator is referenced to the confirmation about the use of stock option to improve alignment of interest by Elitzur and Gavious (2003).

3.3.2 Innovation Capital

Innovation Capital facilitated the development of new ideas, new products, and integration of emerging technologies, for the end-customers (Section 2.2.2). In essence, it enabled a company to remain competitive in the marketplace especially as product life cycle became shorter than before. Innovation required a combination of resources, including investments in research and development, staff and facilities, as well as effective coordination of inter-departmental employees throughout the innovation process (Chen, Zhu and Xie 2004). The following table outlined the key PIs of Innovation Capital for TEVs and identified the corresponding resource requirements:

Indicators	**Implementation Requirements**	**Key Characteristics of Implementation Resource**	**Possible Evidence**
I.1 Research and Development Capability[20]	Employment of R&D staff with recurring resources; expenditures in development of product prototypes	Financial Capital-Dependent and Execution-Dependent	Disclosure on research and development activities and capital expenditures employed
I.2 New Product Development Cycle[20]	Execution in development of new products	Financial Capital-Dependent and Execution-Dependent	Actual new product development success
I.3 Innovation Culture[20]	Supportive policy in place; Management execution	Policy/System/ Process-Dependent and Execution Dependent	Actual management style and organisational culture

[20] The indicator is referenced to the indices of innovation capital suggested by Chen, Zhu and Xie (2004).

I.4 Generation and Execution of New Ideas[20]	Supportive culture in place; Management execution	Policy/System/ Process-Dependent and Execution Dependent	Actual management style and culture
I.5 Responsiveness to Market Changes[20]	Management execution (market-driven)	Execution-Dependent	Management's response to market changes
I.6 Absorption Capacity for Emerging Technologies[20]	Execution of management (ability to integrate and absorb new technologies for product innovation)	Execution-Dependent	Management's ability to embrace relevant emerging technologies

Table-2b: Resource analysis for Innovation Capital

3.3.3 Structural Capital

Structural Capital provided the necessary capacity, facilities and systems to deliver products and services for a growing business as stated in Section 2.2.2. Appropriate Structural Capital was expected to generate favourable conditions and environment to utilise internal resources. More importantly, this sort of capital would enable scalable expansion for a venture on the edge of rapid growth and development. It also enabled the capturing of new customers who normally demanded confidence of a vendor with sound establishment. Structural Capital of TEVs could largely be divided into organisational capital and technological infrastructure. Organisation capital would contain the "software" of a TEV, including organisational policy, standards, procedures and collectively an administrative management system that would enhance effective operations (Chen, Zhu and Xie 2004).

Technological infrastructure referred to fixed assets, including plant, facilities, equipment, enterprise systems and networks, which facilitated the process of technological innovation as well as delivery of operational activities, ranging from production and manufacturing to logistics management. The following table suggested the key PIs of Structural Capital for TEVs and identified the corresponding resource requirements:

Indicators	Implementation Requirements	Key Characteristics of Implementation Resource	Possible Evidence
Establishment of infrastructure[21]	Acquisition or instalment of necessary and facilities (financial capital required)	Financial Capital-Dependent, Policy/System/ Process-Dependent and Execution-Dependent	Disclosures about fixed assets and capital expenditures in corresponding assets
Enterprise resource planning system or similar information system[21]	Instalment of necessary software, hardware and system (financial capital required)	Policy/System/ Process-Dependent and Execution-Dependent	Disclosures about fixed assets and capital expenditures in corresponding assets
Administrative / organisational policy[21]	Policy and system in place	Policy/System/ Process-Dependent and Execution Dependent	Development and Implementation of such policy and system
Supply chain management system[21]	System in place	Policy/System/ Process-Dependent and Execution-Dependent	Development and implementation of relevant system
Quality management system[21]	System in place	Policy/System/ Process-Dependent and Execution-Dependent	Development and implementation of relevant system

Table-2c: Resource analysis for Structural Capital

[21] The indicator is referenced to the indices of structural capital suggested by Chen, Zhu and Xie (2004).

3.3.4 Customer Capital

Customer Capital, an important part of intellectual capital, could be considered a resultant component of performance due to the contribution of resources from the other three components. For instance, quality of Human Capital would have a direct impact on delivery of products and services to customers; availability of a sophisticated information system would affect the data management of a customer relationship management system. Key indicators in Customer Capital would include client relationship management with established customers, customer relationship management system, effectiveness in delivery of quality service and solutions to customers, acquisition of new customers, and effective handling of customer complaints (Chen, Zhu and Xie 2004). Other researchers found similar nature in Customer Capital (Bontis, Keow and Richardson 2000). Consequently, the ultimate measurement of performance within Customer Capital could be reviewed objectively from the end results in the generation of sales revenues from customers. The following table outlined the key PIs of Customer Capital for TEVs and identified the corresponding resource requirements:

Indicators	**Implementation Requirements**	**Characteristics of Implementation Resource**	**Possible Evidence**
Established customer and related relationship management[22]	Sales and marketing workforce that maintain and build pre-existing customer relationship	Execution-Dependent	Disclosure about profile of existing customer accounts and resources/ expenses for sales and marketing

[22] The indicator is referenced to the indices of customer capital suggested by Chen, Zhu and Xie (2004).

Customer relationship management system[22]	Policy and system in place	Policy/System/ Process-Dependent and Execution-Dependent	Development and implementation of such policy and system
Delivery of products, services and solutions to customers[22]	Execution of operations and customer service in delivering products, services and solutions	Execution-Dependent	Disclosure about related activities and resources/ expenses for such workforce
Acquisition of customers, market channel development, sales closures, brand management and loyalty[22]	Execution of sales and marketing activities	Policy/System/ Process-Dependent and Execution-Dependent	New customers acquired, sales growth, market share, and customer satisfaction
Handling customer complaints[22]	Policy and procedures in place	Policy/System/ Process-Dependent and Execution-Dependent	Development and implementation of such policy and procedures

Table-2d: Resource analysis for Customer Capital

Delineation of the foregoing set of protocols aimed to enable the identification of the source of evidence, to specify necessary data and information collection strategy, as well as to formulate appropriate measurement methods.

3.3.5 Fishbone Diagram

The following Fishbone Diagram, Figure-4, referenced as the Taguchi Method of Problem-Solving or the Ishikawa Approach, served to provide a summary of the key factors within the four components that would affect the business performance of a technology-exploiting venture. A basic architecture of resource dependence for growth and development of TEVs was illustrated through the diagram to identify in turn the performance indicators that depended on various types of resources. However, it should be noted that this illustration did not assume different reliance on the types of resources between early-stage and expansion stage TEVs. This particular framework served to illustrate the variable factors and the potential correlation to business performance of TEVs. The diagram provided identification of the characteristics of implementation resources required in the four components of intellectual capital, leading this research to focus on the subsequent review of evidence in the case studies.

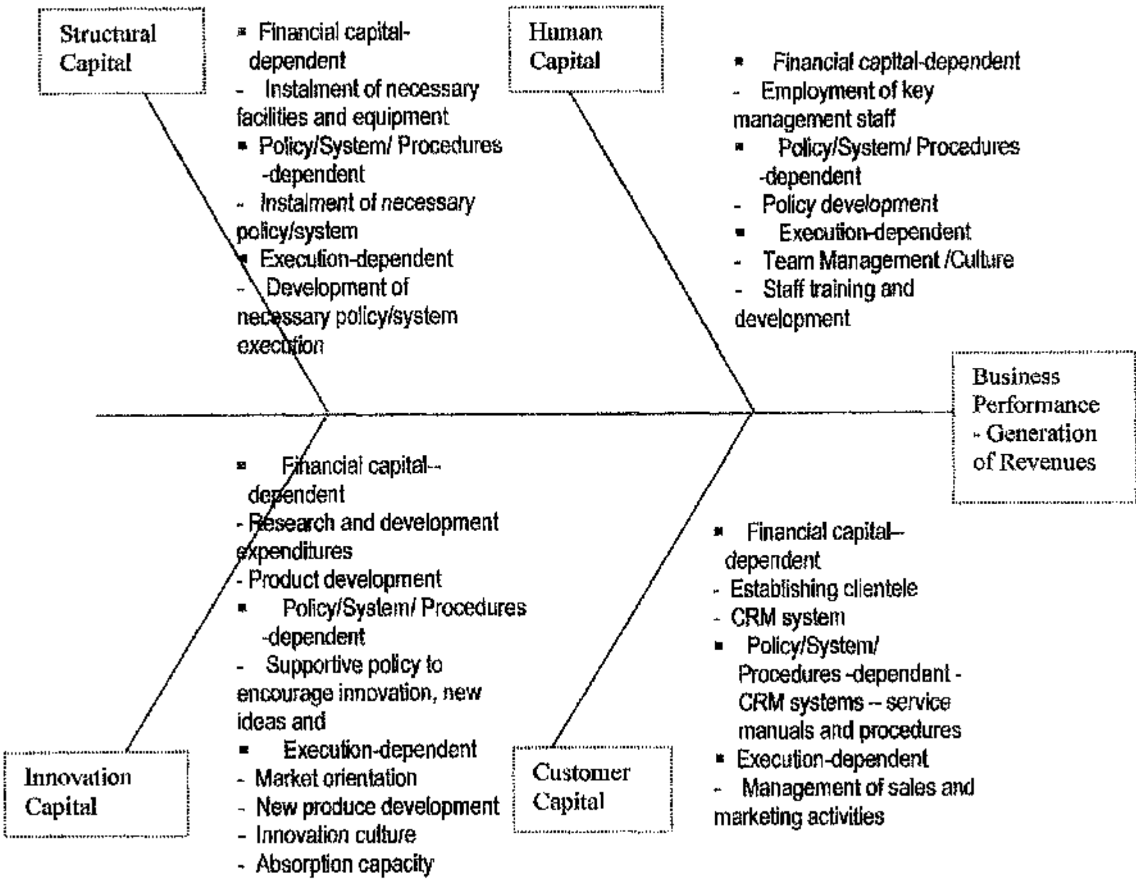

Figure-4: Fishbone diagram[23] of key variables for business performance in TEVs[24]

[23] The Fishbone diagram was introduced in Japan by Kaoru Ishikawa. It is a graphical method for presenting a chain of causes and effects and organising relationships between variables (Evans and Lindsay 1999).

[24] Customer Capital itself was revealed to be highly correlated with revenue generation and would not be taken into consideration as an independent factor for subsequent regression analysis.

3.4 Research Questions

The theme of this research accentuated the development and growth experience of technology-exploiting ventures (TEVs) and attempted to investigate the elements of resources, in particular from the perspective of intellectual capital, which could augment the growth of TEVs. Specifically, TEVs under this study had strong reliance on exploitation of emerging technologies in pursuit of new business opportunities. Such opportunities arise in an industry where delivery of products and services were enhanced with application and integration of emerging technologies, namely computing technology, information technology, Internetworking technology as well as wireless communication applications. Nevertheless, this research did not intend to limit its exploration on certain types of technology but to explore particular characteristics of TEVs in utilising technological innovation during their early years of growth and development process. Given the discrepancies in knowledge, this research attempted to explore three key business performance management *issues* related to development among TEVs, which had not been fully addressed in the prior researches. These three main issues were summarised in the following prior to crystallisation of the research questions.

i. From the standpoint of venture capitalists, it was critical for them to review the effectiveness of a particular business plan executed by a TEV in consideration of their economic returns. It was perceived in recent research that a specific set of performance measurement indicators would be relevant to knowledge-intensive enterprises. Business failure risk of a TEV however remained significant within its early growth and development when economic resources were limited and future revenues generated from operations for organic growth could be at risk given the uncertainty involved (Reid and Smith). How could performance of TEVs be monitored effectively and perhaps governed in order to mitigate the risks of venture capitalists' investments as the primary resource provider in the form of financial capital. What was the current practice?

ii. Human Capital was considered the primary element for initial growth and development of TEVs, namely entrepreneurial and research and development capabilities. However, it was doubtful whether Human Capital alone was sufficient for continual growth and development; literatures suggested that continual growth and development of ventures needed to be complemented by strategic resource allocation in critical areas, such as management systems, appropriate facilities, infrastructure, and research and development initiatives (Fernstrom, Pike and Roos 2004). To facilitate business performance with adequate resource allocation, how should various resources from the intellectual capital perspective be synthesised in the development and growth process of the new ventures?

iii. Values of the technology-based companies could only be sustained when Human Capital was complemented with other capital effectively within an appropriate timeframe (Lev 1999). Nevertheless, how would such resource allocation be made in an effective manner for the growth of the ventures within the dimension of time, particularly for TEVs? How would the timing of allocating such resources affect the growth of such ventures in a sustainable manner?

In the previous Chapter, the literature review largely focused on the main relevant areas of thoughts comprising performance measurement, intellectual capital, business venturing and technology management and looked into the contemporary research on managing and measuring intellectual capital within organisations in view of relevance to performance-driven management. Particular research was targeted towards the characteristics of technology-based companies and development aspects of ventures that exploited technological innovation for value creation. Such research initiatives provided the important foundation of knowledge in this research study. In consideration of the integrating effect on performance measurement, intellectual capital, business venturing and technology management, together with more specific and fundamental research questions were enhanced with the resource-based view on this study. Corresponding to the main issues identified in this section and the framework proposed in Section 3.2, this research was further structured and directed to examine three main empirical research questions concerning performance-driven resource allocation for the growth and development of TEVs at different degrees of maturity[25]:

[25] Kennerly and Neely (2002, 2003) revealed the differences in resource requirements under different developmental and environmental needs.

Part-1

a. For equity stakeholders and key resource providers in technology-exploiting companies, what is the current practice in monitoring performance of their portfolio companies?

b. What are the attitudes of venture capital and private equity firms towards monitoring performance of their portfolio companies? [26]

Part-2

a. Given the importance of resource allocation and requirements of intellectual capital for TEVs, how could resource allocation, in consideration of the *priority*, be made effective for growth and development of the TEVs? [27]

b. What should be the relevant key PIs among TEVs during early-stage and expansion-stage? [28]

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[26],[16] Balanced scorecard was recognized as an effective management tool for performance management of organisations (Kaplan and Norton 1996). Technology-exploiting ventures, however, might require different perspectives and modifications from the conventional framework and performance indicators. In particular, Neely discussed about changes in environment and conditions that would alter the performance requirements as an organisation continues to develop (Kennerley and Neely 2002, 2003). Other researchers in the field of business venturing discussed about the uncertainty during a venture's growth at different stages (Shane 2004). Resource-based view shared the concerns about resources requirements for the growth of a firm. (Penrose 1959). However, there have been few studies about performance measurement system for technology-exploiting ventures.

[27] Contemporary research on intellectual capital has argued about how different components of intellectual capital, namely human capital, innovation capital, structural capital and customer capital, among other resources, could affect performance of an organisation (Chen and Xie 2004) (Wang and Chang). Other researchers have explored the interrelationship among these components. While these studies had also been focused on the cause-effect analogy, there was insufficient analysis on the sequential combination of resources allocated to the corresponding components of intellectual capital and the resulting effect on performance and in particular the growth of a technology-exploiting venture, given the limited resources available. This question would be explored in association with the question raised in Part-2.b. on PIs.

Part-3

a. To optimise business performance from resource allocation, what should be the components and appropriate mix of resources (or components of intellectual capital) at early-stage and expansion-stage of growth and development of the TEVs?

b. How would timing and sequence of allocation of external resources affect the growth and business performance of such new ventures and provide any possible predictability of generation of revenues? [29]

An evolving management issue from the foregoing questions was the quest to optimise the allocation of capital resources in an emerging TEV. The dilemma was between turning the ventures into self-sustainable, high-growth operations during their early stage of growth and development with limited amount of available resources. The stakeholders were challenged with the task to utilise internally available resources and/or external resources wisely for allocation to suitable components of intellectual capital that would drive performance at particular stages of development of TEVs.

[29] Although prior studies on intellectual capital and performance measurement had explored the dynamics among the components of intellectual capital, the dimension of time was not taken into as a critical factor in considering the effect on performance as an output (Wang and Chang 2005). This research question attempted to find out how external resource allocated into components of intellectual capital would affect performance taking into the dimension of time.

3.5 Research Methodology

This particular research design aspired to embrace the advantage of adopting a mixed approach through collection of both qualitative and quantitative methods to study the growth and development of TEVs. First of all, a process approach was used to explore cases of TEVs with in-depth analysis. The focus was on their growth and development process between the early stage and the expansion stage with substantial amount of capital raised. Secondary data was collected from expansion-stage TEVs, which had gone through substantial financial capital raising exercises for expansions. Furthermore, a survey was launched to collect opinions from equity stakeholders about performance measurement of TEVs. These particular TEVs were analysed on their longitudinal experience in business growth. The evidence collected was composed of multiple, independent sources from selected samples.

3.5.1 Advantages of Ethnographic Approach

Jones and Coviello (2004) examined the research methodologies used in 52 articles in the field of international entrepreneurship with respect to strengths and weaknesses in these methods. While multidisciplinary approach was suggested to provide substantive knowledge in international entrepreneurship, it was pointed out that research design could combine both positivist and interpretivist methods, such as ethnography, in order to explain behaviour and value-creating processes. Moreover, longitudinal methodology, which took into consideration the dimension of time, could be adopted to effectively capture entrepreneurial behaviour and processes over time; with respect to sampling design and data collection, judgment samples were acceptable to the extent that the sample criteria were consistently specified and data were assessed for validity and reliability.

Macbeth (2002) adopted two case studies in examining the issues with respect to strategy formulation for cooperative supply chain change. Relationship positioning tool was used to analyse the key elements in benchmarking relationship within the supply chain improvement process, and to develop a process-based method for capturing areas that require improvement projects. Evidence from results of two cases participated in the test reinforced the process view approach for such strategy formulation. Addressing the application of case study in research studies, Yin suggested that in-depth case studies with thorough process analysis of examples would be appropriate where little prior research had been conducted (Yin 2003).

In this research, it was proposed that the methodology would include adopting an ethnographic approach through previous and current experience working with early-stage TEVs and examination of relevant documents. Gill and Johnson (1997) discussed about the nature of the ethnographic approach to management research and that observational studies of managers were possible with data sources derived from interviews, observations, and documents; there were articles that suggested management studies using ethnography as an alternative mode of inquiry to surveys and experiments.

McDougall (1994) in her research explained the formation of international new ventures using 24 case studies of international new ventures without random selection. As such, random selection method was considered "neither necessary nor even preferable". Method of investigation for these cases involved analysis of evidence, including business plans, financial statements, letters, faxes and minutes of meetings. Personal interviews and physical artefacts were utilised as well.

Utilising the ethnographic approach, this research was simulated to investigate selected samples of successful growth and development experience with a retrospective review on the characteristics of intellectual capital, and to examine how resources were in fact deployed at two defined stages of development and the plausible effects on various PIs. This type of evidence would be complemented with other independent sources of data, as explained in detail in the following sections.

3.5.2 Use of In-depth Case Studies

In research of social sciences, in-depth case study was frequently used as a methodology to study complex phenomena. Yin (2003) pointed out that case study was adopted in a number of situations to explore new knowledge of individual, group, organisational, social, political, and related phenomena. It was widely utilised as a common research strategy in business, economics, psychology, political science, social work, and sociology, etc. It was further suggested that case study method enabled the investigators to embrace the "holistic and meaningful characteristics of real-life events".

These events were to include individual life cycles, organisational and managerial processes, and the maturation of industries. Case study strategy would in fact be effective when there was no requirement on control of behavioural events but focus on contemporary events.

Gill and Johnson (1997) similarly pointed out that case study research would be an appropriate methodology for study of topic when there was little prior empirical evidence or literature in the field of concern. The case study approach would be effective in exploring the early stages of research study or providing a refreshing perspective in an established area. Case study based on the analytical induction approach if applied systematically would be useful to develop theory from observations of the empirical evidence. Analytical induction technique based on a set of methodological procedures was used in grounded theory. In their study, Gill and Johnson (1997) noted that grounded theory could be applied to a number of cases with the possibility of constituting generalisation. Different cases of phenomena could be chosen to study contrasts and comparisons aiming to examine a theory with the patterning of events under various circumstances. In order to avoid intrinsic problem in holding only the necessary conditions among the cases, it was proposed that a set of procedures for analytical induction to categorize variations among the cases under study with respect to similarity and difference.[30]

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[30] This technique was identified as Bloor's approach to analytic induction.

Nevertheless, Gill and Johnson (1997) also identified certain weaknesses in the case study approach. First of all, it was revealed that there could be a large amount of information generated from the ethnographic fieldwork, which would affect the ability to focus on the significant variables within a particular case. Repetitive testing would be needed to produce a "reasonable degree of confidence". However, due to the limited sample size in case studies, the method could rarely make conclusions about the representativeness of samples.

3.5.3 Use of Secondary Data

Secondary data were collected from selected samples of the wireless communication application and semiconductor industries. Emory and Cooper (1991) revealed secondary data might be used for three research purposes. First of all, secondary data could be applied for specific references within a research, such as benchmarking and comparison of results with published data. Secondly, secondary data could be used as an integral part of a larger research study. As Emory and Cooper (1991) noted, "*Research procedures typically call for at least a minimum amount of early exploration to learn if the past can make a contribution to the present study.*" Secondary data would be presented to help identify areas of research that required additional work and could be used as a source of hypothesis. At last, data from secondary sources might be adopted as the sole bases in a study. For instance, historical method was the classical case that made use of past published data. This approach would solve the problem related to limitation of data due to physical, legal or cost concerns.

Thietart et al (1991) further pointed out the characteristics of secondary data and its implications to internal or external validity, and its accessibility and flexibility. When using secondary data, it was important to understand the ontological standing of secondary data. Integrity, objectivity and reliability of published data needed to be examined as such data could in turn affect the subsequent analysis and the validity of a research. The source of secondary data needed to be examined as well. In addition, it was discussed that secondary data could be fairly inflexible since it was usually fixed and formalized in a predetermined format. This would limit its applicability to the phenomenon under a study. Thietart et al (1991) also reviewed the constraint of secondary data under certain situations. If the secondary data presented in a study were partial, ambiguous or contradictory, a research could hardly return to the source to reconcile and clarify the missing parts.

Given the limitation within secondary data, Thietart et al (1991) suggested primary data could be obtained to complement the use of secondary data at different stages of the research process. In areas that primary data was incomplete, secondary data, such as historical data, could be used to supplement qualitative information about an event. Secondary data could be used to weigh the case study again information from a different source. Further primary data could come from interviews and surveys.

3.5.4 Use of Survey and Supplementary Interview

To complement the proposed case studies and use of secondary data, structured questionnaires and interviews were proposed to collect opinion from the stakeholders of TEVs. It was intended that supplementary interviews would provide additional opinions on the experience in deployment of resources at various stages of development. Gill and Johnson (1997) suggested that survey research would provide *"a variable, intermediation position somewhere between ethnography and experimental research"*. Through an analytical survey approach, it was possible to understand the intermediate position and the connection with the logic of deductive inquiry. Analytic survey could be adopted to test the relationship among certain dependent and independent variables. While a descriptive survey might not be directly concerned with the development and testing of theory, it could be utilised to review the characteristics of a specific population at a point in time. In explaining specific techniques and procedures for survey and interviews, Fowler (2002) presented the practical problems and evaluated different options associated with survey available to the researchers.

To obtain elaborative comments from the stakeholders, supplementary interview was used in a semi-structured manner, based on the same questionnaire. Thietart et al (1991) noted, *"Interviewing is a technique aimed at collecting, for later analysis, discursive data that reflects the conscious or unconscious mind-set of individual interviewees. It involves helping subjects to overcome or forget the defense mechanisms they generally use to conceal their behaviour or their thoughts from the outside world."*

3.5.5 Triangulation of Evidence

Evidence of both qualitative and qualitative natures was expected from this research for subsequent analysis of results. Thietart et al (1991) discussed the advantage of combining both qualitative and quantitative methods by means of triangulation in which complementary analysis could be made to utilise their respective advantages. Independent points of observation enabled the researcher to improve the meticulousness of both measurement and description.

Creswell (2003) identified the use of the concurrent triangulation strategy as an approach to capture complementary data based on both quantitative and qualitative methods. This so-called "mixed approach" would be able to offset the inherent weaknesses inherent within one method with the strengths of a balancing method. Although it would be ideal to have equal weighting between the two methods, one of them would be given high priority in practice. In this particular research strategy, the results from the two methods would be analysed and interpreted to observe areas of convergence of the findings in order to strengthen the knowledge developed from the research, or to explain any existing discrepancies.

Gill and Johnson (1997) noted that triangulation had been defined as *"the combination of methodologies in the study of the same phenomenon"*. To apply this approach, multiple and independent methods were undertaken to study the same problem. This approach could produce greater validity and reliability than a single methodological approach. Results could be obtained through convergent validation with complementary qualitative and quantitative methods.

According to Gill and Johnson (1997)'s study of the triangulation approach, qualitative research itself could be enhanced with combined efforts in observation, interviewing and documentary sourcing. In a research case that studied organisational development with longitudinal designs, both quantitative and qualitative methods were advocated. Moreover, it was suggested that this triangulation approach would be appropriate for students "*undertaking extended piece of work*" in a research study, despite the time and efforts involved.

Taking into the relevance of the triangulation for this research study, sources of evidence proposed for application in this research methodology were consequently composed of qualitative and quantitative elements, divided into three main areas as follows:

(i) With reference to the operationalisation of the PIs in Section 3.3, a survey with structured questions and ratings was designed; supplementary questions to selected participants were incorporated with open-ended discussion.[31] The purpose of structured questionnaires was to gather opinion of the stakeholders who provided significant source of capital for TEVs. Focusing on the pre-set indicators and required resources, evidence and points of view were collected from the equity stakeholders with respect to the current practice as well as linkage between PIs and required resources during early-stage and

[31] PIs for technology-exploiting enterprises at various stages of development were developed based on prior research of the key components of intellectual capital (IC) with a theory-laden approach.

subsequent expansion-stage of growth and development. In the structured survey, additional questions were included to seek opinion about the use of performance management systems. The targeted participants were venture capital and private equity firms that focused on investments of TEVs in both early and expansion stages. Data obtained would provide internal validity of the PI architecture from an important group of stakeholders, for TEVs at both early-stage and expansion-stage.

(ii) Evidence to reveal the emphasis of resource among early-stage TEVs was obtained from case studies of two early-stage ventures from each of the two identified technology sectors. These four cases were composed of two ventures from the wireless communication application and the other two from the semiconductor related industry. Through interviews, observation and ethnographic approach, two companies from each sector were selected for investigating characteristics of their requirements in intellectual capital, actual utilisation of capital resources during their early growth and development, as well as the relevant key performance indicators. Cross-analysis of results among these companies was performed. The founders, advisors and/or board members of these early-stage ventures, as key stakeholders of TEVs with responsibility to execute growth and performance of the ventures, were approached to collect the required data. These individuals also contributed their insights about the key PIs and resource requirements for their growth and development. Their business plans, financial information, and publicly available disclosures that depicted actual resource deployment strategy were reviewed. Such in-depth case analysis was intended to review their emphasis on PIs and view on requirements of resources at stages of growth. Such evidence was used to study internal validity of the PI architecture for early-stage TEVs.

(iii) Evidence on the use of financial capital in resource allocation to various components of ICs and infrastructure facilities through retrospective review of resources utilisation within the two identified technology sectors as well as the characteristics in resource allocation for growth. Secondary data from the selected samples, which had successfully reached initial public offer (IPO), was obtained. There were 12 companies selected for this purpose, six from each of the two identified technology sectors. Both quantitative and qualitative disclosures from 10-k, 10-q reports, and prospectuses were reviewed. Based on the set of PIs proposed in Section 3.3, disclosures of pertinent matters for each measurement were examined and summarised. In additional, proxies were used to review resources allocated to the main components of IC at expansion stage. The IC components were examined to explore the changes in emphasis on resources and the corresponding variations in revenue generation - a factor that represented successful delivery of products and services to the customers. This analysis was completed through a longitudinal review of the concerning variables during the early years of expansion.

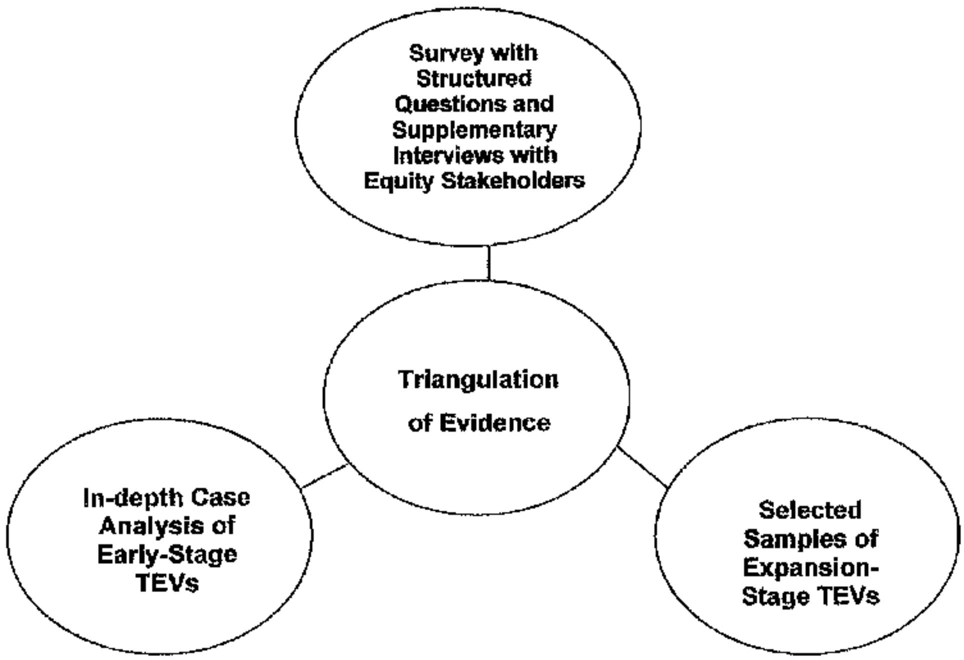

Figure-5: Triangulation of evidence

3.5.6 Operationalisation of Research

This section aims to provide further explanation about the approach in operationalising the research design in order to collect evidence targeted toward the three main research questions. Specific research tools, including questionnaires and forms for data collection and analysis, are explained in this section in order to tackle particular research questions. In the first instance, the three main research questions and respective objectives are hereby revisited:

Questions	Sources	Data Collection
Part-1 a and b	▪ Survey with TEVs' equity stakeholders ▪ Interview with senior management/ equity stakeholders of TEVs	▪ Opinions on performance monitoring tools ▪ Opinions on key performance indicators developed under the four components of intellectual capital
Part-2 a and b	▪ Survey with TEVs' equity stakeholders ▪ In-depth case studies of early-stage TEVs ▪ Secondary data analysis of expansion-stage TEVs ▪ Interview with senior management/ equity stakeholders of TEVs	▪ Opinions on importance of various performance indicators and their respective resource requirements for early-stage and expansion-stage TEVs ▪ Review of cases on resource co-ordination and external resource utilisation among key components
Part-3 a and b	▪ Survey with TEVs' equity stakeholders ▪ Case studies of early-stage TEVs ▪ Secondary disclosures analysis of expansion-stage TEVs ▪ Interview with senior management/ equity stakeholders of TEVs	▪ Opinions on importance of various performance indicators and their respective resource requirements for expansion-stage TEVs ▪ Analysis of emphasis on resources for early-stage and expansion-stage

Table-3: Targeted collection of data

Survey with Structured Questions and Supplementary Interviews

A survey was designed to collect opinions of equity stakeholders about the current practice of performance management and control of technology-exploiting ventures. A list of the questions was provided in Appendix-A. There were two main parts in the questionnaires designed respectively to infer attitudes towards performance management and control of TEVs, as well as to understand views about resource requirements and performance indicators between early stage and expansion stage. These structured questions were given different types of multiple-choice answers, with selection of answers, ranking of answers, and rating of significance.

Subsequently, supplementary interviews were made with two venture capitalists and two senior executives in TEVs, who were also members in their respective board of directors. Unstructured and open-ended questions were used to explore views about performance management and control of TEVs. Their views were especially sought in the area of current practice and difficulties in managing these growing ventures. The interview facilitated discussion about possible ways to improve from the current practice.

The Portfolio of Cases

All cases used in this research were companies from the emerging wireless communication application sector and the semiconductor industry. Early-stage TEVs typically funded by venture capital and angel funds had a business history of two to four years of growth and development experience, whereas expansion-stage TEVs would have over four years of business history and went through the process of mezzanine round financing and initial public offer (IPO) in order to obtain funding for further expansion. All TEVs cases were companies whose products and services were targeted toward the international marketplace and they relied greatly on technological innovation for new product and service development. These were the common denominators of the cases. The following was the list of cases studied in this research:

Case Code	**Industry**	**Business Nature**
Case A.W.1	Wireless Communication Application	Development of wireless enterprise platform and applications
Case A.W.2	Wireless Communication Application	Development of location-based wireless technology and applications
Case A.S.1	Semiconductor	Design and development of chips for components in mobile phones
Case A.S.2	Semiconductor	Design and development of system-on-chips for mini-storage device

Table-4a: The early-stage TEVs[32]

[32] The names of these companies were agreed to remain anonymous.

Case Code	Industry	Company
Case B.W.1	Wireless Communication Application	MDSI Mobile Data Solutions Inc.
Case B.W.2	Wireless Communication Application	Research in Motion Ltd.
Case B.W.3	Wireless Communication Application	InfoWave Software, Inc.
Case B.W.4	Wireless Communication Application	724 Solutions Inc.
Case B.W.5	Wireless Communication Application	01 Communique Laboratory Inc.
Case B.W.6	Wireless Communication Application	Zi Corporation
Case B.S.1	Semiconductor	Altera Corporation
Case B.S.2	Semiconductor	Broadcom Corporation
Case B.S.3	Semiconductor	Linear Technology Corporation
Case B.S.4	Semiconductor	Maxim Integrated Products Inc
Case B.S.5	Semiconductor	Novellus Systems Inc
Case B.S.6	Semiconductor	Xilinx Inc

Table-4b: The expansion-stage TEVs [33]

In addition, with a resource-based view on the development and growth of TEVs under a global competitive business environment, it was assumed that the local cultural factor submitted to the greater importance of entrepreneurial culture contained in the Human Capital component, the common international competitive environment, and the similar goal of delivering business performance.

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[33] The wireless communication application companies were selected from the list of most successful wireless technology companies chosen by the Brampton Group of Canada and were publicly listed; the semiconductor companies were constituents in the Philadelphia Exchange's Semiconductor index.

3.6 Procedures in Collection of Qualitative and Quantitative Data

3.6.1 Survey

A survey with structured questions was sent out to a group of 89 international venture capital and private firms affiliated with the U.S. Venture Capital Association and the European Venture Capital Association. These firms were selected based on their investment focus on the sectors of computer technology, semiconductor and wireless applications, as well as investment interest in both early-stage and expansion-stage. Only companies that disclosed a direct contact email address were forwarded with an email providing a hyperlink to an online survey. The survey was sent out on June 30th 2005 and a follow-up reminder was sent out after one week. A list of these questions is provided in Appendix A.

The survey was composed of 10 main questions and divided into two parts. Part-1 was included six questions, which targeted issues regarding participants' current practice in performance management and control, perception about performance measurement system and areas for improvement. These questions were structured in the form of multiple choices, ranking, rating, and "Yes"/ "No" answers. In Part-2, participants were asked to rank the type of resources needed for early-stage and expansion-stage TEVs. In addition, they were offered the opportunity to provide ratings on 22 specific performance indicators for both early-stage and expansion-stage TEVs.

Subsequent to the survey, the results were summarised into an Excel spreadsheet for statistical analysis. The Statpro application tool was utilised to launch Chi-square tests and t-tests. Other mathematical functions in excel were used for computation and analysis of data.

Four supplementary interviews were conducted respectively with two venture capitalists from two respective international venture capital firms and two founding executives from two respective TEVs. The first interview was conducted with a principal of an international venture capital firm in July 2005 through both face-to-face meeting and follow-up telephone conversations. Questions were asked to seek opinion about the current practice in performance management of direct investments by TEVs as well as perception about difficulties in monitoring their growth and development from the standpoint of an equity stakeholder. Additional questions were asked about the firm's experience in venture governance. The second interview with a venture capitalist was conducted in August 2005 focusing on the experience of venture investments, portfolio management, and issues related to resource utilisation during early growth and expansion of TEVs.

The face-to-face interviews with two founding executive of a TEV was made between July and August 2005. Based on the questions used in the survey, interview questions were designed to explore about how performance monitoring was conducted by the board and how they perceived such exercise from the standpoint of a senior executive. The second one focused on issues regarding resource requirements during development and growth.

3.6.2 Cases of Early-Stage

There are four main cases in this fraction of the research study. As the objective of the case study of early-stage TEVs was to analyse the development experience of the selected companies and the resource requirements, a range of information was collected from these companies. Initially, discussion was made with a senior executive of a selected company in order to understand the background and to collect basic business information about the company. Items including corporate brochures and product-marketing brochures were subsequently collected for a thorough introduction of the company's mission, objectives and offerings. Corporate websites were another source of information providing details about products and services being offered as well as corporation business summaries.

Additional information was requested for more in-depth review of the development and growth experience of these companies. Such information included detailed business plan, financial statements as well as press releases available to the public. Due to sensitivity of certain financial and business information, the financial figures were presented for analytical measures and the names of the companies would remain anonymous. Follow-up short discussions through telephone were made to clarify missing pieces of information in three of the four cases. The meetings and discussions with the case companies commenced in early June 2005, with successive follow-up information collection lasting for a period of two months. Subsequently, two personal interviews with an equity stakeholder, and a founding executive, associated with one of the cases were conducted in August 2005.

3.6.3 Cases of Expansion-Stage

There were 12 main cases in this fraction of the research study. As the objective of the case study of expansion-stage TEVs was to analyse the development experience of the selected companies and their resource requirements, historical financial information and qualitative information within the annual reports of these companies was collected and analysed. Five years of historical financial information of these selected companies, which crossed over the time spot of initial public offer (IPO), was collected, except for those having a shorter timeframe after IPO - with four years of data was collected. Four years of their post-IPO annual reports were reviewed in order to obtain the necessary qualitative disclosures for content analysis. Such financial data and corporate information was considered secondary data and extracted through their respective corporate websites and archives of the Securities Exchange and Commission of the U.S.

Subsequently, qualitative disclosures of the 12 companies under investigation were examined using content analysis of pertinent information specified in the prescribed PI framework. Such content analysis technique was simulated on the methodology adopted by Abeysekera and Guthrie (2004), who suggested the use of line count method in a research that studied about reporting of human capital. The study pointed that there was certain advantage of using line count method for *"drawing inferences from the narrative* *statements that characterize annual reports"*. Frequency of disclosures was then examined for each category of item in each year of the annual reports. This paper provided an examination of the particular areas of human capital emphasised by firms of a developing country.

3.7 Ethical Consideration

For early-stage TEVs, interviews were conducted with managers and relevant information was collected. Secondary data was collected from expansion-stage TEVs; these companies were publicly listed and the required information was sourced from their disclosures. For business information provided by private companies and interviews, prior consent was obtained from the subjects. Case studies of private companies would remain anonymous in the report. Comparisons between the two sectors as well as between the two stages of growth were made among the selected companies.

This research obtained approval by the Ethics Committee of the School of Business and Management at the University of Glasgow in June 2005. This research aimed to comply with the Ethics Guidelines of the Glasgow School of Business and Management on a continual basis. A copy of the Guidelines was provided in Appendix E.

Chapter 4

4. COMPREHENSIVE ANALYSIS OF DATA

4.1 Introduction

This Chapter provides a comprehensive analysis of data obtained from a range of research initiatives including survey of selected stakeholders, in-depth case studies of early-stage TEVs, as well as case studies of expansion-stage ventures with statistical analysis of disclosed financial information among the selected companies. These three main sources of evidence were provided with their respective quantitative data analysis and descriptive explanation of the cases under a structured format of presentation. Section 4.2 begins with a detailed report of the survey with the venture capitalists. Section 4.3 provides a comprehensive description of the in-depth cases and pertinent analysis of the information obtained in a structured manner. Then Section 4.4 focuses on the statistical analysis of the secondary data on the expansion cases and their significances are presented.

4.2 Survey Results

This section provides details about the results of the survey to a selected group of venture capital and private equity firms, as well as data analysis of the answers for the structured questions of the survey. There were 29 respondents out of the targeted 89 firms that indicated interest in investing in emerging technology ventures, namely wireless communication and semiconductor. The adjusted response rate, with complete answers to the two parts of the survey, was 42%, based on the non-response adjustment method suggested by Fowler (2002)[34]. The following two sections provided detailed analysis of the results of the survey. Opinions in Part-I focused on questions related to perceptions about the current practice of equity stakeholders in performance management and control of technology-exploiting ventures (TEVs). Part-2 of the survey concerned opinion about the resource requirements and importance of specific performance indicators towards the two different stages of development within TEVs. This analysis was followed by a section that summarised the supplementary interviews conducted to complement the concerned areas from the survey. While the responses to this survey were assumed to be random, no particular statistical inference about the population was made based on the results of this survey. As discussed previously in Chapter 3, it was inherently difficult to estimate the population of venture capital and private equity firms.

4.2.1 Opinion in Part-I

According to the survey, 74% of equity stakeholders believed that it was very important to maintain a performance monitoring system that regularly reviewed performance of a TEV. While 15% of them think that it was quite important, only 8% considered themselves neutral about the use of performance monitoring system. The remaining 5% expressed negative opinion about its importance. The distribution of opinions was provided in Figure-6. This result appeared to be in line with prior research

[34] Adjusted response rate = (Original responses + 2 x Responses from non-response sample)/Original total eligible sample

about the need for resource providers to regularly interact with management of a venture in order to effectively monitor its growth (Shane 2004). It also supported the point of view from the venture capitalists expressed in an industry conference.[35]

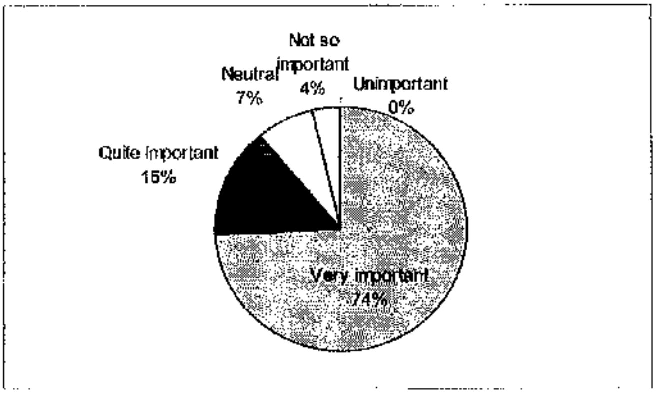

Figure-6: Importance of maintaining a monitoring system to regularly review performance of a TEV

With respect to the current practice in monitoring performance, 40% of the responding equity stakeholders opted to select traditional financial information and management reports as the most important means. Secondarily, 37% of these venture capital and private equity firms tended to make use of regular formal meetings with senior management to facilitate performance monitoring, while only 4% of them would utilise informal discussions or meetings with senior management to review performance. In specifying any other important means, close to half of the respondents who selected the "Other" category commented the importance of having a board seat as the most important

[35] The Annual Conference of the Hong Kong Venture Capital and Private Equity Association 2004.

means in monitoring performance. None of them selected Balanced Scorecard as the current means. The results tended to reflect the fact that equity stakeholders currently used a variety of mechanism to monitor performance, through participating in corporate governance, review of financial information and regular meetings, in order to deal with the intrinsic problems of information asymmetry (Elitzur and Gravious 2003). The significance of formal meetings suggested the importance of discussing and revealing risky elements and matters that might not be uncovered in regular financial and management reporting. The distribution was summarised in Figure-7.

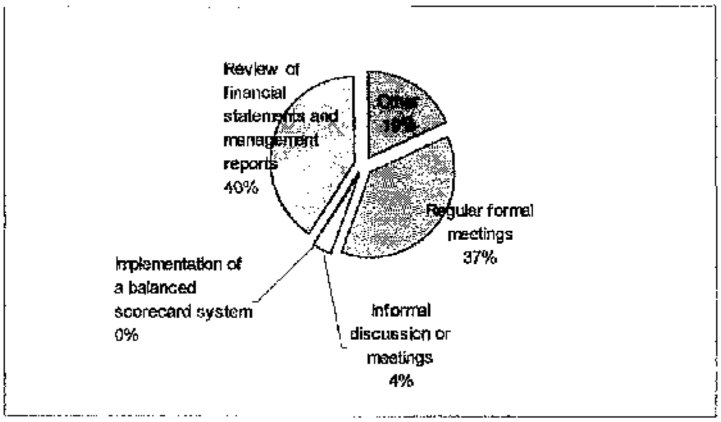

Figure-7: The most important means of performance and risk monitoring currently maintained for regular review

In assessing the most effective arrangement for performance management, the participants showed the strongest preference for obtaining a board seat among other arrangements, with reference to the method of paired comparisons (Emory and Cooper 1991). According to the survey, the second most effective arrangement would be demanding regular meetings with the management and regular review of financial information; these two factors were found to be equally important in the second place. The fourth important factor was maintaining a budgetary control and management reporting system. Including covenants in investment agreements was viewed as the least effective. This comparison, illustrated in the following Table-5, unveiled the importance of corporate governance in TEVs, which had not been treated with significant attention with respect to its association with performance management.

	A	B	C	D	E
A	-	9	11	8	9
B	18	-	17	14	17
C	16	10	-	14	13
D	19	13	13	-	16
E	18	10	14	11	-
	71	42	55	47	55
Rank	**1**	**5**	**2**	**4**	**2**

Table-5 [36] Ranking the order of effectiveness in monitoring performance of an invested TEV

In considering how their invested TEVs would prefer to be monitored differently from the current practice, 39% of the respondents selected the implementation of Balanced Scorecard or performance measurement system with specific indicators over other options. The second most popular choice was to have more meetings with senior management, either formal or informal ones, together generating 38%. Fourteen percent of the respondents selected to have more frequent submission of financial statements and

[36] This ranking is based on frequency of preference of column factor over row factor, where A is obtaining a board seat, B is including specific covenants in the investment agreement, C is demanding regular meetings with senior management, D was requirement of a budgetary control and management reporting system, and E was regular review of financial information

management reports. The remaining 11% selected the "Other" choice and expressed satisfaction with the current system in their comments. The answers reflected that the equity stakeholders would potentially prefer to obtain further qualitative information about their invested TEVs through communication with management and welcome the idea of adopting a performance measurement system to assist in monitoring performance. The analysis was presented in the following Figure-8.

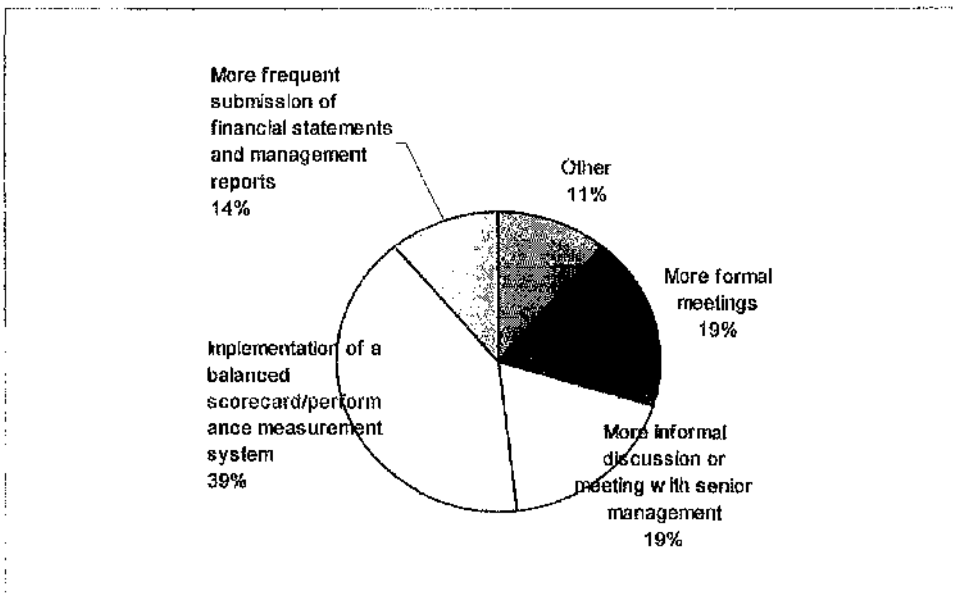

Figure-8: Preference for an invested TEV to be monitored differently

In evaluating the current level of information reported to these resource providers, the majority, 62%, believed that they have sufficient information. As shown in Figure-9, close to one-quarter of them felt neutral about the extent of being informed, whereas only 14% thought that the level of information was very sufficient for monitoring performance.

The answers tended to suggest that most participants believed that they had access to sufficient information about their invested ventures.

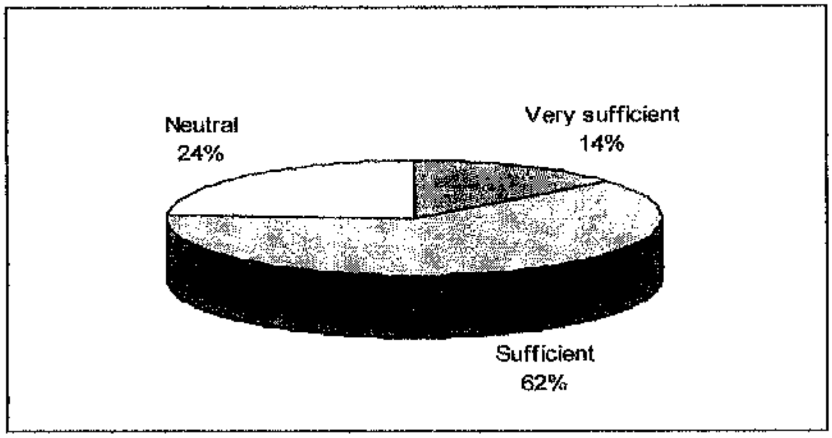

Figure-9: Sufficiency of information for monitoring performance

To further analyse the results obtained in the two foregoing questions, Chi-square independent test procedures were adopted to test the dependence of the perception of current level of information provided regarding the ventures and the preference for ways to improve from the current practice of performance monitoring (Albright, Winston and Zappe 2003). As shown in Table-6, a matrix was set up for the factors under the two respective questions. The results showed a computed p-value of 0.352. As this p-value was not significantly small, it could not be concluded that the row and column attributes were dependent. The distribution of figures analysed how the equity stakeholders would prefer to improve from the current performance management practice despite content with sufficiency of information obtained. Though mostly admitted that they had sufficient information about their invested ventures, they would consider using different mechanisms to improve the current way of monitoring performance. Over 60% of the respondents, who felt that they had sufficient or very sufficient information, would choose to have a Balanced Scorecard or performance measurement system to help them monitor performance. Within the category of neutral respondents, two-third of the respondents would select to do so. In analysing the other respondents, it was demonstrated that those who were satisfied with their current performance monitoring did not necessarily obtain very sufficient information from their invested ventures, suggesting that there might be other methods of monitoring performance in a less informal fashion, such as through their expertise in a particular sector.

Shown as percentages of row totals				
		Question 5		
Question 4	Neutral	Sufficient	Very sufficient	
More financial Info	0.0%	100.0%	0.0%	100.0%
Balanced scorecard	36.4%	36.4%	27.3%	100.0%
More informal meeting	20.0%	80.0%	0.0%	100.0%
More formal meeting	0.0%	60.0%	40.0%	100.0%
Satisfied	33.3%	66.7%	0.0%	100.0%
Shown as percentages of column totals				
		Question 5		
Question 4	Neutral	Sufficient	Very sufficient	
More financial Info	0.0%	18.8%	0.0%	
Balanced scorecard	66.7%	25.0%	60.0%	
More informal meeting	16.7%	25.0%	0.0%	
More formal meeting	0.0%	18.8%	40.0%	
Satisfied	16.7%	12.5%	0.0%	
	100.0%	100.0%	100.0%	
Chi-square test statistic				
p-value	0.352			

Table-6: [37]Chi-square analysis of sufficiency of information and choice of performance monitoring

[37] This test was used to test independency between perception of sufficiency of information (row) and preferred choice to improve performance monitoring (column).

4.2.2 Opinion in Part-2

4.2.2.1 Resource Requirements

In evaluating the forms of resources in terms of their importance to effective growth and development of early-stage TEVs, the equity stakeholders favoured mostly the utilisation of existing internal resources, such as Human Capital and technological know-how over the other resources, based on the method of paired comparisons (Emory and Cooper 1991). As presented in Table-7, the second most important aspect of resources was for the TEVs to obtain additional external financial resources. Acquisition of more experienced management and executive was ranked as the next less important type of resources. The two forms of Structural Capital, effective management systems and new facilities for scaling up operations, were treated as the two least critical resources for early-stage TEVs.

In evaluating the forms of resources in terms of their importance to effective growth and development of expansion-stage TEVs, the equity stakeholders favoured most the acquisition of more experienced management and executives, based on the same method of paired comparisons. Utilisation of existing internal resources, such as Human Capital and technological know-how over the other resources, was ranked as the next less important type of resources. The third most important aspect of resources was to obtain additional external financial resources. Like the results in the early-stage TEVs, the two forms of Structural Capital, effective management systems and new facilities for scaling up operations, were treated as the two least critical resources for expansion-stage TEVs.

	Utilization of existing internal resources, such as human capital and technological know-how	Acquisition of more experienced management and executives	Development of effective management systems, such as administrative and ERP systems	Acquisitions of new facilities and infrastructure for scaling up operations	Obtaining additional external financial capital
Early-Stage	1	3	5	4	2
Expansion-Stage	2	1	5	4	3

Table-7: Ranking on importance of different types of resources

To test whether there was any significant difference in the attitude towards the use of resources between the two stages of TEVs, t-test for paired two samples for means was used for the five types of resources suggested under this question. As illustrated in Table-8, it was found that there was significant difference in the stronger preference for acquisition of more experienced management and executives in the expansion-stage than the early-stage. No significant difference was found in the other categories.

t-Test: Paired Two Sample for Means

Acquisition of more experienced management and executives

	Early-stage	*Expansion-stage*
Mean	3.074074	3.555556
Variance	2.225071	2.487179
Pearson Correlation	0.750255	
t Stat	2.300864	
t Critical one-tail	1.705616	

Table-8: t-test: paired two sample for means for acquisition of more experienced management and executives

4.2.2.2 Performance Indicators (PIs)

For the last two main questions, the participants were asked to provide rating of the 22 PIs, on a Likert Scale of 1 to 5, for TEVs in both early-stage and expansion stages. The following analyses were organised into the four corresponding categories of intellectual capital, namely Human Capital, Innovation Capital, Structural Capital and Customer Capital.

PIs		Medians		
		Early-stage	Expansion-stage	Change
H1	Founders and Senior Management's Experience in industry	5.00	5.00	-
H2	Education/ Qualification	3.00	3.00	-
H3	Staff Retention Policy	3.00	3.00	-
H4	Stock Options	4.00	5.00	1.00
H5	Training and Development	3.00	3.00	-
H6	Multidisciplinary Team	4.00	4.00	-
I1	Research and Development Capability	4.00	4.00	-
I2	New Product Development Cycle	5.00	4.00	(1.00)
I3	Innovation Culture	4.00	4.00	-
I4	Generation and Execution of New Ideas	4.00	4.00	-
I5	Responsiveness to Market Changes	5.00	5.00	-
I6	Absorption Capacity for Emerging Technologies	4.00	4.00	-
S1	Establishment of infrastructure	3.00	4.00	1.00
S2	Enterprise resource planning system or similar information system	3.00	3.00	-
S3	Administrative / organisational policy	3.00	3.00	-
S4	Supply chain management system	3.00	3.00	-
S5	Quality management system (including manufacturing activities as appropriate)	3.00	4.00	1.00
C1	Established customer and related relationship management	4.00	4.00	-
C2	Customer relationship management system	3.00	4.00	1.00
C3	Delivery of products, services and solutions to customers	5.00	5.00	-
C4	Acquisition of customers, market channel development, sales closures, loyalty and brand management	5.00	5.00	-
C5	Handling customer complaints	4.00	4.00	-

Table-9.a: Medians of performance indicators

PIs		Means: Early-stage	Means: Expansion-stage	Change%
H1	Founders and Senior Management's Experience in industry	4.81	4.74	-1.54%
H2	Education/ Qualification	2.93	2.85	-2.53%
H3	Staff Retention Policy	2.81	3.19	13.16%
H4	Stock Options	4.07	4.44	9.09%
H5	Training and Development	3.15	3.67	16.47%
H6	Multidisciplinary Team	3.56	3.81	7.29%
I1	Research and Development Capability	3.96	3.63	-8.41%
I2	New Product Development Cycle	4.30	4.19	-2.59%
I3	Innovation Culture	4.26	3.81	-10.43%
I4	Generation and Execution of New Ideas	4.15	3.63	-12.50%
I5	Responsiveness to Market Changes	4.67	4.67	0.00%
I6	Absorption Capacity for Emerging Technologies	3.70	3.93	6.00%
S1	Establishment of infrastructure	2.96	3.81	28.75%
S2	Enterprise resource planning system or similar information system	2.44	3.52	43.94%
S3	Administrative / organisational policy	3.00	3.48	16.05%
S4	Supply chain management system	2.52	3.26	29.41%
S5	Quality management system (including manufacturing activities as appropriate)	2.96	3.67	23.75%
C1	Established customer and related relationship management	3.52	4.22	20.00%
C2	Customer relationship management system	3.22	4.04	25.29%
C3	Delivery of products, services and solutions to customers	4.41	4.44	0.84%
C4	Acquisition of customers, market channel development, sales closures, loyalty and brand management	4.48	4.44	-0.83%
C5	Handling customer complaints	4.04	4.19	3.67%

Table-9.b: Means of performance indicators

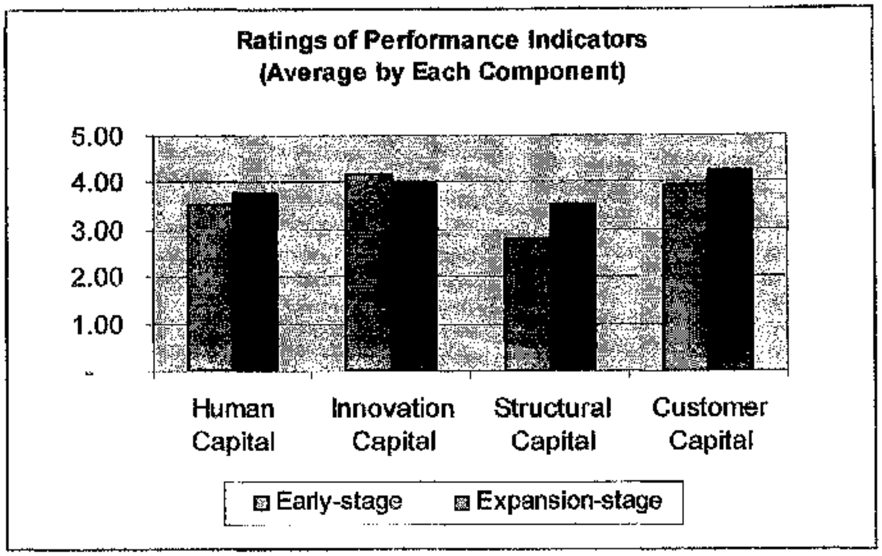

Figure-10: Means of performance indicators by components of intellectual capital

Human Capital

There were six performance indicators in this category. For the early-stage TEVs, the average score for the performance indicators under Human Capital was 3.56. The performance indicator with the highest in this category was the founders' and management's experience in the industry, giving an average score of 4.81 – also the highest among all the indicators. Existence of staff retention plan was considered the least important among the others in this category, giving an average score of 2.81.

For the expansion-stage TEVs, the average score for the performance indicators under Human Capital was 3.78. Similar to the early-stage, the performance indicator with the highest in this category was the experience of founders and management in the industry, giving an average score of 4.74. The least important performance indicator among the others in this and other categories was senior executives' previous education, giving an average score of 2.85. Except for this indicator on executive education, each of the other indicators in Human Capital obtained a higher average score under the expansion-stage as compared to the early-stage, especially for continuing training and development as well as multidisciplinary team.

Innovation Capital

There were six performance indicators in this category. For the early-stage TEVs, the average score for the performance indicators under Innovation Capital was 4.17 - the highest among the four components of intellectual capital. The performance indicator with the highest in this category was responsiveness to market changes, generating an average score of 4.67. Absorption capacity for emerging technologies was considered the least important among the others in this category, with an average score of 3.70.

For the expansion-stage TEVs, the average score for the performance indicators under Innovation Capital was 3.98. Resembling the early-stage, the performance indicator with the highest in this category was responsiveness to market changes, giving an average score of 4.67. The two least important performance indicators in this category were capability in research and development and ability to generate and execute new ideas, both giving an average score of 3.63. The importance of innovative culture and ability to generate new ideas were considered less than that of the early-stage.

Structural Capital

There were five performance indicators in this category. For the early-stage TEVs, the average score for the performance indicators under Structural Capital was 2.77 - the lowest among the four components of intellectual capital. The performance indicator with the highest in this category was the existence of administrative/organisational policy, generating an average score of 3.00. Existence of enterprise resource planning system or appropriate management information system was considered the least important among the others in this category, giving an average score of 2.44.

For the expansion-stage TEVs, the average score for the performance indicators under Structural Capital was 3.55, which was also the lowest among the four components of intellectual capital. The performance indicator with the highest in this category was the establishment of appropriate infrastructure/facilities, with an average score of 3.81. The least important performance indicator in average identified by the equity stakeholder was the existence of supply chain management system, with an average score of 3.26. Despite the relatively low scores of performance indicators under Structural Capital in comparison with other intellectual capital components, the assessment suggested that all performance indicators under Structural Capital were rated higher than those in the early-stage. In particular, there was a significant increase for the indicators of enterprise resource planning system and supply chain management system.

Customer Capital

There were five performance indicators in this category. For the early-stage TEVs, the average score for the performance indicators under Customer Capital was 3.93. The performance indicator with the highest in this category was the acquisition of customers, market channel development, sales closures, loyalty and brand management, producing an average score of 4.48. Existence of customer relationship management system was considered the least important among the others in this category, giving an average score of 3.22.

For the expansion-stage TEVs, the average score for the performance indicators under Customer Capital was 4.27, which was the highest among the four components of intellectual capital. . The two performance indicators with the highest in this category were: (i) acquisition of customers, market channel development, sales closures, loyalty and brand management, and (ii) effectiveness in delivery of products, services and solutions to customers, both giving an average score of 4.44. The least important performance indicator in this category identified by the equity stakeholder was the existence of customer relationship management system, with an average score of 4.04. Despite being lowest among all indicators in Customer Capital, customer relationship management system was rated as more important for a TEV during the expansion-stage than in the early-stage.

Significant difference by t-test

In order to reveal any possible significant difference between the ratings of performance indicators in early-stage and expansion-stage, t-test of paired for means was utilised to examine each of the performance indicators. Detailed outputs of the test results were provided in Appendix B. A summary of the t-values was provided in the following table.

H1	0.7004
H2	0.5273
H3	(2.1782)
H4	(3.4069)
H5	(3.8489)
H6	(1.7628)
I1	2.0817
I2	0.9014
I3	2.8844
I4	4.6469
I5	-
I6	(1.3628)
S1	(4.8185)
S2	(4.8912)
S3	(3.4662)
S4	(6.4758)
S5	(3.9497)
C1	(3.2151)
C2	(5.0781)
C3	(0.2964)
C4	0.2964
C5	(1.2798)

Table-10[38]: t-test: paired two sample for means for the 22 PIs

Within Human Capital, it appeared that there was significant increase in terms of its importance to performance during the expansion-stage, which could be driven by staff

[38] t critical one-tail value is 1.7247.

retention policy, stock option for senior management, continuous staff training and development, and induction of multidisciplinary team.

Within Innovation Capital, the results suggested that performance drivers of Innovation Capital led by innovative culture and ability to generate and execute new ideas became less significant in the expansion-stage than early-stage for TEVs. Significant surge in the rating of absorption capacity for emerging technologies was observed. Responsiveness to market changes and product development cycle was viewed as equally important for both stages.

With respect to Structural Capital, all of the five performance indicators received more significant ratings for expansion-stage than early-stage. The more significant ones were the establishment of appropriate infrastructure/facilities, enterprise resource planning system, or appropriate management information system. Quality management system and supply chain management also demonstrated significant increase in their ratings.

For Customer Capital, it was observed that performance indicators of existence of customer relationship management system, established customer base and ability in handling customers were viewed as more important parameters for TEVs during expansion-stage than early-stage.

4.2.3 Supplementary Interviews

Follow-up supplementary interviews on issues with performance management were launched to seek particular opinion about areas that had not been fully addressed through the structured questionnaires. There were two main interviews, one with an international venture capital firm and another with a founder/senior executive of a TEV.[39] Open-ended questions were used to facilitate elaborations of ideas and discussions on targeted subject areas.

4.2.3.1 Current Practice of Venture Capital and Private Equity Firms

First of all, questions were raised about the current practice with regards to how a venture capital firm would engage in managing performance of a TEV as an invested company. Its investment principal explained that in practice, her firm would require its portfolio company to provide regular management reports to the firm. For her firm, this requirement was usually delineated as a clause in an investment agreement in order to ensure that its invested portfolio companies would comply with this reporting requirement after an investment was executed. The management reports mostly included financial information, namely income statements and balance sheet. Such reports would help her understand the financial results and how capital was spent in various areas. Qualitative information that provided details as to how resources were allocated was not as elaborate in such reports.

In addition, her firm would usually require a board seat in an invested company. There were two main reasons for having a board seat. Firstly, the investment manager believed that a board seat would provide the necessary power and authority to exercise over

[39] In addition to these two interviews related to the questionnaire, two interviews were launched to ask questions related to the growth and development in one of the in-depth case studies under Section 4.3.

an invested company, through voting rights, veto power on certain corporate matters, as well as participation in board meetings. Secondly, it was important through corporate governance to formally demand timely management reporting and information that would enable monitoring of performance. These requirements critically changed the board configuration which was used to be dominated by a TEV's founders.

Furthermore, it was expressed that the investment strategy of her firm had been formulated to focus on certain technology sectors in which they had gained substantial industry knowledge through past experience of direct investments. Such industry knowledge was crucial for the firm to understand the latest trends, key players in the field and "first-hand" development that would affect its portfolio companies. It was highly critical for them to monitor potential problems and risks arising from the marketplace, which would affect the performance of the portfolio companies.

4.2.3.2 Use of Performance Measurement System

The investment manager believed that the use of performance measurement system, such as Balanced Scorecard might provide useful, specific information about indication of performance for her firm. However, she was concerned about the implementation of such a performance measurement system. Resources were usually quite limited among the management of TEVs, who needed to focus a great deal of their time on building an organisation and generating new business for their ventures. Establishing a new performance management system would diverge internal resources to non-core developmental activities despite the importance of performance management. For her venture capital firm, she was apprehensive whether there was allowance of resources in maintaining a formal performance measurement system.

Rather than spending efforts in developing performance indicators, a venture capital firm like hers would put resources in business networking and gaining intelligence about the latest trend and development in the domain industry. Latest technological advancement in the field was also critical for the firm to assess current competitiveness of is invested portfolio companies. It was quite important for these ventures to be able to stay ahead of competition and to remain agile in its emerging business sector. Frequent, informal communication would deliver the kind of information that they needed to monitor performance.

Interview with a founder of TEV provided comparable perception about performance measurement system. Despite his appreciation for a performance measurement system, the founder felt that time was so limited that he had to focus on development of new products and services and acquisition of new customers. He was concerned about the costs associated with developing and maintaining such as reporting system. He would therefore rather devote efforts to meeting with investors and providing verbal reports or updates in a less formal manner. To assist in current reporting duties, his company had a small accounting department to produce periodic financial statements that were sent to the board of directors on a quarterly basis. Qualitative information would be complemented through formal meetings with other board members. When asked about willingness to implement a balanced scorecard to enhance the reporting function, he noted that he would be opened to this initiative if the board were to insist on this requirement with allocation of the resources needed for implementation of such a new reporting system. He however expressed scepticism about its usefulness.

4.3 Cases of Early-Stage

There were four cases of early-stage technology-exploiting companies under this investigative analysis. Two of these cases were ventures in the emerging wireless technology sector while the other two were ventures related to the semiconductor and computer industry. Corporate information and data of these cases was collected and analysed focusing on resource management and growth experience during their initial years of growth and development. Each of them was given a brief description on its business scope and history. The focused areas of concerns, namely utilisation of resources and issues related to growth and development, were discussed within each case; a detailed assessment ensued with reference to the four components of intellectual capital.

4.3.1 Case A.W.1

4.3.1.1 Company Background

Case A.W.1 was a technology-based start-up company (A.W.1) that focused on development of Geographical Information System (GIS) and location-tracking technologies in southern China for applications in safety logistics and risk management. The company was founded two years ago in Guangdong Province of China by two business partners from Hong Kong who established a start-up team that initially developed a set of digitised national geographical maps of China in detailed scales integrated into a proprietary GIS. One of the founding shareholders of A.W.1, having extensive professional experience in the area of insurance and risk management, advocated the applications of such technologies in China for a range of location-based applications, including safety logistics management for fleets, asset management and emergency support for individuals travelling in China, as well as SOS repatriation services for the injured. The second founding partner was an experienced engineer with extensive construction project management experience, in particular with toll road construction in China.

The core business of A.W.1 was determined to be providing an integrated range of third-party logistics risk management services for corporations that needed to transport goods and for individuals who travelled frequently to China. The company spent its initial two years concentrating on the refinement of its national digital map and developing applications of (Global Positioning System) GPS for a wide range of location-based commercial applications.

A.W.1's goal was to become a leading value-added service and solutions provider for safety logistics based on its applied technologies in the Greater China Region. It planned to utilise wireless data transmission technologies and to develop data management system in China to enhance logistics and risk management with its integrated solutions in GIS/location tracking technology, including a 24-hour data management service centre.

Building on its development, A.W.1 targeted to meet the increasing demand for reliable safety logistics solutions, such as vehicle navigation system, for the rapidly growing economic integration and resulting traffic of goods and humans starting in the current southern China region.

Such demand was particularly high among multinationals operating in the Pearl River Delta of Guangdong setting to emerge as a cluster of global manufacturing basins that provided low-cost manpower and manufacturing facilities for the rest of the world. While most of international travellers and logistics companies carried insurance coverage by international insurance companies, the local logistics support, navigation services and emergency operational support were considered ineffective and inadequate in many instances. In southern China, despite such rather less developed conditions, annual cross-border travellers from Hong Kong, Taiwan and Macau had been growing steadily each year and amounted to nearly 90 million in 2001[40]. A.W.1's founders believed that this situation represented a unique opportunity for the company to offer products and services that would complement such limitation within a high-growth, emerging economy.

[40] Based on estimates provided by in-house research of A.W.1.

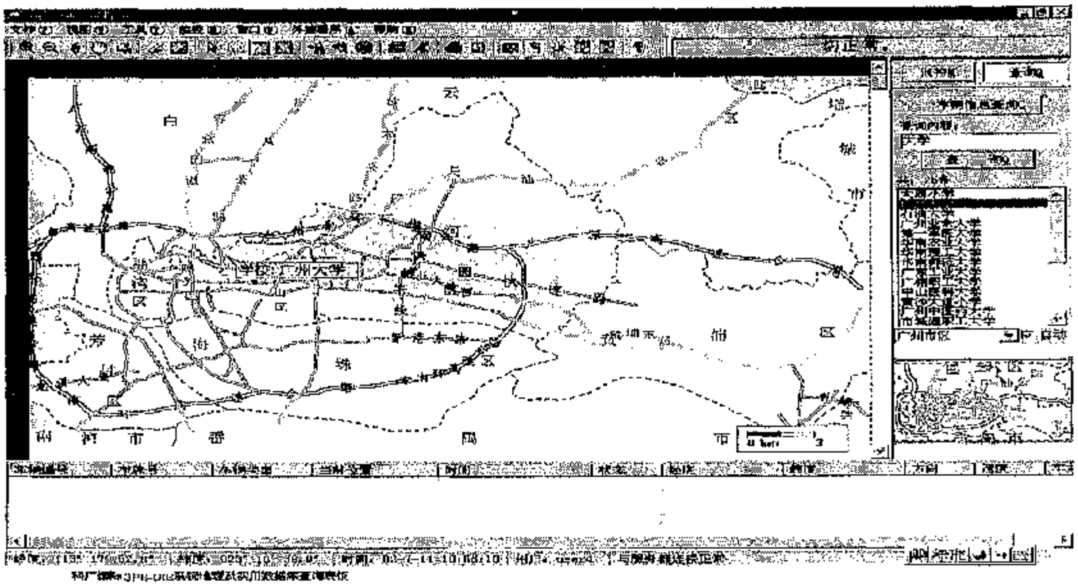

Figure-11: GIS interface[41]

4.3.1.2 Growth and Development Experience

During its first two years in China, A.W.1 largely focused on research and development activities of a national GIS as well as its integration into a triangulation-based location tracking system that utilised the local mobile communication network. On the other hand, the management team also looked into other wireless technology options, such as satellite communication network including the Global Positioning System (GPS). In addition, a 24-hour data management and service centre was established at its development facility in Guangzhou, China. A.W.1 was a business and technology partner of a North

[41] Source of data from A.W.1 with permission granted.

American satellite communications company with both hardware and software solutions. Most members of the technology development team were hired locally in Mainland China.

After two years of immense development, A.W.1 in its third year of development completed a prototype for its location tracking solution based on a hybrid technology solution that utilised a local mobile network and a transmitter imported from North America. The founders were determined to commercialise such a solution through timely applications in the marketplace.

The market for safety logistics and vehicle-navigation-related products and services in China was still in its early stage of development. It was in lack of comprehensive technological infrastructure and mature risk-management solutions to enable reliable delivery and support for such products and services. The founders expected such demand to increase steadily as the economic integration within the Pearl River Delta continued to expedite with increasing policy-level government support in the region. The start-up venture was positioned to build a business that would fill the need of the missing services demanded in the marketplace.

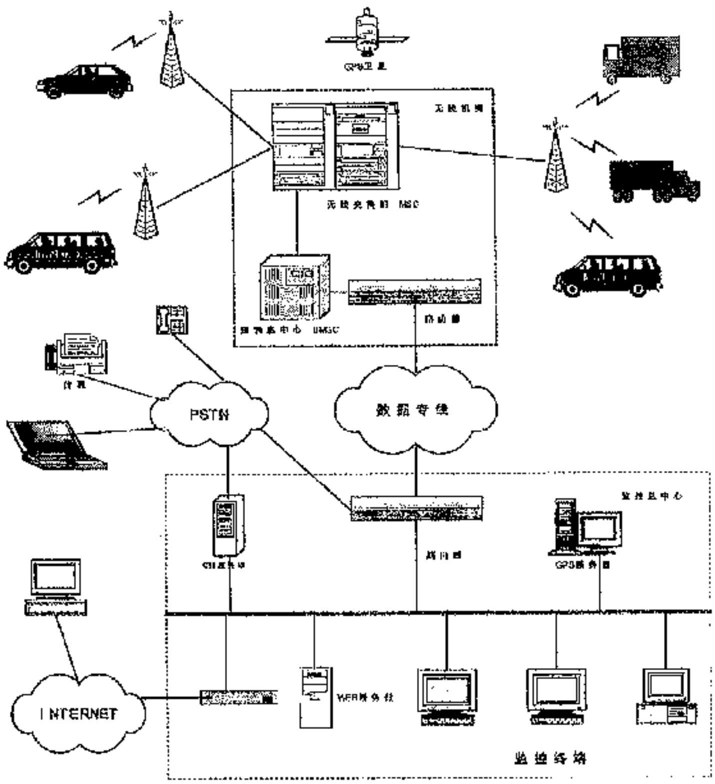

Figure-12: Planned system for data integration[42,30]

The management approached several major cross-border bus tour operators based in Hong Kong and noted strong interest in adopting a local-tracking navigation solution that enabled the operators to monitor movements of their buses travelling across the border. Furthermore, hired bus drivers of these potential clients who had experienced emergency

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[42] This Schematic illustrated an integrated system for real-time data exchange between mobile units and GPS-GIS monitoring centre to facilitate fast and effective local emergency support services. The system was intended to enable priority reporting to public emergency services and healthcare utilities; a direct dedicated China-Hong Kong data transmission line for exchange of data with international client-insurance companies.

situations before in China were interested in the 24-hour emergency support centre available with the monitoring service. Road accidents among cross-border business in China were notorious and drew attentions on travel safety issues among both passengers and regulators. Travel insurance companies were also aware of pertinent risks in these cases of travel and the stakeholders had been seeking possible mitigating solutions. In fact, enquiries had been increasing for reliable logistics solutions resulting from the heightening economic integration between southern China regions and Hong Kong. The senior management of A.W.1 were encouraged by such feedback and intended to swiftly offer its one-stop monitoring service as soon as feasible.

4.3.1.3 Resource Allocation Experience

Human Capital

A.W.1 had two key founders, Mr. Lee and Mr. Young. Mr. Lee, the Chairman, was the major shareholder of A.W.1 who has 30 years of international professional experience in the insurance industry. An entrepreneur with track records, Mr. Lee founded an insurance brokerage company in Vancouver and built it into a successful insurance brokerage business; he subsequently expanded the business back to Hong Kong and China. Mr. Lee held a number of international insurance brokerage licenses and studied law in the U.K. On the other hand, Mr. Young was a professional engineer with extensive experience in project development and management of large-scaled infrastructure projects in China, such as toll roads and power plants.

Other executives in the Group were experienced professionals in marketing, IT, finance and risk management with international business exposure. The technology development team, with strong knowledge of location-based tracking technology, was locally hired and based in Guangzhou. The senior technical person, entitled Professional Computer Engineer, was hired in Beijing for his strong technical background in the mobile communications industry. The development team spent most of its time inside China and met with colleagues once or twice a month. Out of the 25 employees, 15 of them were based in China and the rest in Hong Kong.

While the senior technical person was granted with stock option as a performance incentive, the rest of the employees were salary-based with no other particular incentives. In-house, job-based training and development was available to the staff on a need-basis. Additional staffing was being planned for 24-hour operators of the emergency support centre. Staff turnover was about 10% during the first two years of development but the management thought that only employees capable of sharing the same vision would naturally stay.

Innovation Capital

In terms of product innovation, A.W.1 was able to understand the requirements of potential clients by adopting location-based technology, and correspondingly new products and services were being built. In terms of technological innovation, A.W.1 did not develop the full spectrum of technologies required in delivering its products, services and solutions. For instance, A.W.1 acquired the technology of GPS transceiver through strategic alliance with a North American company that integrated data communication solutions with a satellite communication company. While this particular business cooperation and technology transfer strategy enabled A.W.1 to acquire internationally proven technologies without substantial initial expenditures in research and development, the company had to rely on a third-party for supply as much as the next generation of GPS technology. A.W.1 was still in the stage of designing and developing a range of products and services that were yet to be fully integrated with the required technologies prior to introducing them to the marketplace.

Gradually, the management became concerned about the timeliness for A.W.1 to fully incorporate potential client's requirements into the specifications of new products and services. Given the knowledge gap between Mainland's local staff and Hong Kong's professionals in areas of international practice, the technical development team in China needed to collaborate with the market development team in Hong Kong for an effective product development cycle.

Structural Capital

In order to provide reliable services to the customers, A.W.1 needed urgently to design and implement a technological infrastructure to effectively execute its business plan and to integrate seamlessly with its range of new products and services. Such technological infrastructure would support an effective implementation of its operations and delivery of its product and service matrix with a high level of integrity. A reliable and sophisticated technological infrastructure integrated with daily operations was much needed to establish its unique position as a service provider in the market. Management of the company particularly desired to swiftly make use of its enabling technologies to enhance logistics and risk management of individuals and transportation companies with logistics operations in China. It also sought to make use of its integrated vehicle navigation solutions with GPS, as well as its existing 24-hour service centre. As the company was positioned for the increasing demand for reliable logistics solutions resulting from the escalating economic integration between cities in south China and Hong Kong, such logistics and location-based solutions could only be produced through permutation of various key technologies, including delivery of data communication via satellite facilities. Solution delivery that depended on well-equipped data management facilities with an integrated information system would require significant capital expenditures by A.W.1.

With respect to the development of internal management systems, it was observed that A.W.1 only possessed very basic internal administrative measures to help organise and process its internal matters. Computerised accounting system was not implemented within the young organisation as most of the administrative activities were still handled manually. Nevertheless, a basic procedure manual for operators in the call centre had been documented and put in place.

Customer Capital

Since location-based technology was still perceived as a new concept for the potential customers in the region, it would take time for A.W.1 to introduce the related products and services before being formally adopted by the end-users. Despite initial feedback of interests from potential customers in the field of logistics and travel management, this would require the venture to gradually educate and demonstrate to potential customers about the advantage of adopting their new services. Since the company had not signed up any major customer, the management believed that a customer relation management system was not yet necessary for A.W.I to maintain at that stage.

4.3.1.4 Observations

Strength

A key internal strength of A.W.I was its in-depth knowledge in research and development of the GIS of China, whereas its potential competitors were still in an earlier stage of development. In addition, A.W.I was able to build an effective technology management team in China that possessed the professional knowledge and experience in developing location-based applications in the country and the capability to upgrade for the next generation of GPS, through integrating GIS technology within the business and regulatory environment of China.

In particular, the company managed to obtain the required business licenses and operate its location-based applications as well as its 24-hour service centre in China. Its likely competitors were largely focusing on the GPS business in Hong Kong and lacked an integrated approach in delivering products, services and solutions in the Pearl River Delta; the standards of technological application and related systems in China were very different from those under Hong Kong' international-standard approach. Furthermore, due to the founders' risk management experience with multinational companies operating in the region, A.W.1 was ahead of its competitors in terms of customer-orientation as well as specific knowledge in end-users' requirements.

Issues with Growth

(a) Reliability of products and services

While a number of GPS solution providers were pursuing this new market in China, the market itself was still in its early stage of development when product specifications were not clearly defined and product integrity was an area that customers were sceptical about. With improved understanding of the requirements from the users, A.W.1 took the step ahead by developing a range of customised products and services integrating with technology and services that were critical in the delivery. The opportunity could be significant for A.W.1 if the company managed to deliver its defined range of proven products and services to the customers in a timely manner. In the current market situation, such location-based application of products and services were in virtual demand and yet there appeared to be a lack of credible providers to deliver.

(b) Capacity in technological innovation

According to the management, they were quite concerned about the aspect of technology transfer for certain components of the location-based technology -- GPS transceiver technology from a third-party vendor who controlled and determined the research and development strategy of the next-generation technology. This reliance could jeopardise the company's independence in technology strategy and might be costly for

A.W.1 as there was no long-term relationship in place with the third-party vendor. The transfer pricing of the transceiver needed to be competitive enough for A.W.1 to remain competitive in the local marketplace.

(c) Areas that required additional resources

Given the limited resources available for the start-up company, A.W.1 needed to further rationalise its resource planning in order to build a sustainable business for growth and development. In particular, the company needed to determine the imminent product development strategy and to perform constant marketing as a reliable supplier of its new products and services in China. Additional system development professionals with substantial expertise in international standards and practice would be required for the technology team.

In fact, management of A.W.1 was planning to develop a Knowledge Management System for Safety Logistics in the Pearl River Delta. The system would represent an open data communication platform in which critical components are built in to provide a reliable data management centre to facilitate safety logistics and risk management for logistics operators in the region. These components should contain a comprehensive data management system for monitoring the concerned assets, vehicles and individuals: an integration capability with GIS of both Hong Kong and China integrated with a customer relationship management application as a part of the system. Under this initiative, the company planned to perform the following key tasks in developing the system:

- Identify detailed users' requirements based on targeted customers;

- Complete an overall design of the system in consideration of mission-critical components;
- Evaluate various communication technologies to enhance the system, including mobile communications, virtual private network (VPN) and Internetworking.

This system would include an intelligent monitoring system that enabled effective risk management and safety logistics for people and asset movement within the Pearl River Delta. With a successful delivery of the above items, this implementation aimed to enhance the company with the unique possession of a reliable risk management and safety logistics centre in the Pearl River Delta. The centre would be able to integrate key information, including hospital facilities and other strategic third party services like mobile applications into the system. In particular, four key industries benefiting directly were expected to be travel, manufacturing, healthcare provider and logistics services. Such a reliable technological infrastructure for safety logistics would not only enhance A.W.1's operations but also enable A.W.1 to build up a unique capability to differentiate itself from other potential competitions.

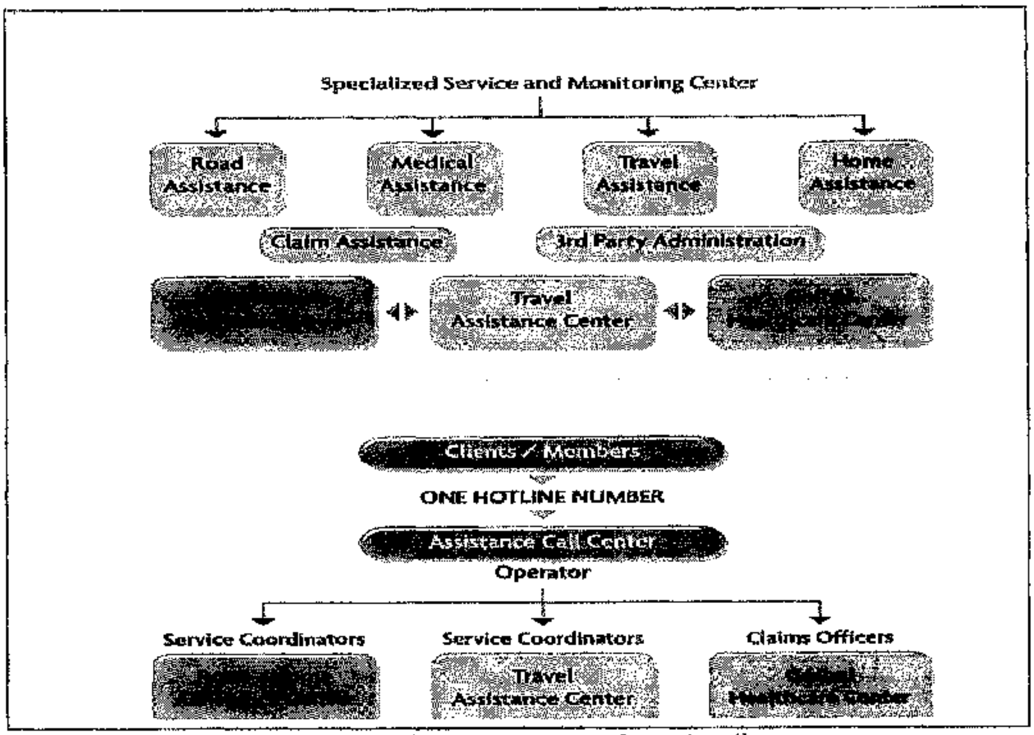

Figure-13: Planned range of services[41]

4.3.1.5 Financial Capital Raising

In order to develop the new information system and related computer facilities, it was estimated that at least US$5 million funding would be required. The founding shareholders were planning to raise external financial capital through private placement of equity shares. Despite a show of initial interest for the vast market opportunities of location-based technologies, feedback from a venture capitalist after preliminary due diligence was that it was difficult for financiers to assess the performance of the emerging venture given the fact that track record in revenue generation was not in place during their early years of development. Some revenues were generated from the outsourced monitoring services in its call centre but not very substantial. Uncertainty was revealed for the amount of time required for the market to widely accept their new products and services, which had yet to be fully introduced to the potential customers.

4.3.2 A.W.2

4.3.2.1 Company Background

A.W.2 was founded in year 2000 by a veteran of an internationally acclaimed management consultancy firm specialised in delivering information technology solutions to the telecommunications sector. With an electronic engineering degree from a reputable university in North America, Mr. So earned over 7 years of management consultancy experience in the telecommunications industry of Asia Pacific region prior to founding A.W.2. Mr. So was promoted to the director position in his early thirties in an international management consulting firm, widely known as the youngest executive reaching that senior position. In the mist of the Internet and e-Commerce bloom, he established A.W.2 at the height of his professional career. The other two co-founders supporting the initiative also possessed strong technical background, one of them a PhD in computer science and another one a business colleague from the same consultancy firm.

The incumbent core management team was formed during the initial establishment of the company. Mr. So had been holding the Chief Executive Officer (CEO) position while the other two founders were respectively Chief Technology Officer (CTO) and Vice President of Technical Solutions. The management invited several experts in the field of wireless communications to be the company's advisors. Initial funding in the form of seed capital for A.W.2 was provided by the three founders, their family members and two angel investors.

Since the very early stage of development, A.W.2's management had determined to position its core business as providing value-added wireless communication solutions to the mobile operators as well as other key users in the value chain of the mobile communications sector, integrating online and wireless data communication through a flexible and reliable platform. Focusing its efforts on developing its core competence and technological advancement during the beginning 24 months of growth and development, the company developed its proprietary wireless Internet product platforms that were proven to enable the increase of usage among end-customers of the mobile operators as well as average revenue per user (APRU) in different Asian countries. Their popular features included solutions for ring-back tones, aggregation of download games, and online community platforms that integrate with mobile phone networks. Due to concerns about intellectual property protection in Mainland China, A.W.2 resolved to focus its initial development efforts on other Asian markets, such as Hong Kong, Taiwan, Korea and the Philippines for the early stage of market development.

4.3.2.2 Growth and Development Experience

Although the initial focus was on development of proprietary products, the management team of A.W.2 was able to utilise its strong management consultancy experience in telecommunications by taking up certain fee-based project management assignments from the telecommunication operators, which were developing new services in wireless data communication. Some senior managers were concerned about diverting resources in rather short-term, project-based assignments. However, the founding members felt that it was critical for them to maintain a working business relationship with the regional telecommunication companies, and more importantly to generate certain income for sustaining its continuous development.

A great deal of research and development effort of A.W.2 was made on specific platforms and software development targeting toward enhancement of wireless communication. Its main principle of software development was to create applications by employing the open standard, distributed system and cross-platform design. Most of its products were designed to be scalable, platform-independent and of carrier-grade standard. With compounding growth in voice and data traffic via wireless communication, A.W.2 aimed to capture such potential through providing solutions that drove the convergence of Internet and wireless communication to transform the way businesses operate and ideally to enable transactions to be made anywhere, anytime.

With respect to the development of wireless application platform, A.W.2's product platform was designed with the principles of openness, scalability, interoperability and reliability, according to the management. The following was a delineation of some specific features of the platform developed by A.W.2 as disclosed in their products and services brochure.[43]

Openness. The company emphasised that its unique platform is developed using an open architecture design. The system was built on common J2EE tool sets, employing open programming technologies such as Java, Servlet, JSP, EJB and Java-script. Support for a variety of end-user devices was facilitated through the XML deployment, which enabled an efficient translation into HTML, WML, HDML, cHTML and MML.

Scalability. A.W.2's wireless application platform achieved scalability by adopting a modular design. The platform provided a set of open architecture allowing additional functionalities implemented through the use of additional modules. The architecture also used a multi-tier design, allowing different modules to be deployed across multiple servers. It was both horizontally and vertically scalable to allow for peak usage and future expansions.

Interoperability. Since the platform developed by A.W.2 provided a set of open architecture accessible to all applications, individual applications that determined whether customer information, customer behaviour and point system could be configured as standalone or sharable by other applications so as to enhance the overall functionality.

[43] The description was a summary of A.W.2's product features based on its brochures.

Reliability. Network and server redundancy, such as routers, firewall and web servers, were deployed for load-balancing and ensuring resilience. The system was designed to operate on a 24-hour, 7-day a week basis with stand-by machines for service switch over in case of failure of the primary machine. Escalation procedures were formulated to minimise any service outage. Data reliability was achieved by a hardware mirrored raid disk, data replication between multiple servers, and incremental backup of data at an offline facility.

A.W.2's in-house technical developers maintained a database scheme that ensured up-to-date and cross-checking of customer data. Data verification with the mobile operator clients could be performed regularly to synchronize customer data. Furthermore, encryption of customer data was deployed to protect customer information privacy.

Integrated Technology

With an infrastructure software product compatible with 3G, 2.5G and 2G wireless networks, A.W.2 formulated to offer wireless carriers highly scalable and flexible solutions that readily facilitated the adaptation of wireless Internet technologies. A.W.2 applications made use of a standard open architecture built on the J2EE application platform. They were programmed entirely in Java to support flexible and industry-standard technologies, including Enterprise Java Beans, Servlets, JSP, XML, cHTML and WML.

A.W.2's developers used a range of programming technologies to build systems that had the flexibility to run on various application servers. The company provided easy-to-use tools to integrate with existing enterprise or legacy applications; moreover, all A.W.2 applications could be tailored for different Asian languages.

Software Architecture

A.W.2 further developed a branded solution for its merchant clients identified as Mobile Marketing Solution (MMS), a comprehensive mobile marketing application software platform designed to support merchants from a wide variety of industries in understanding the needs of their customers, acquiring new customers, and retaining valuable customers.

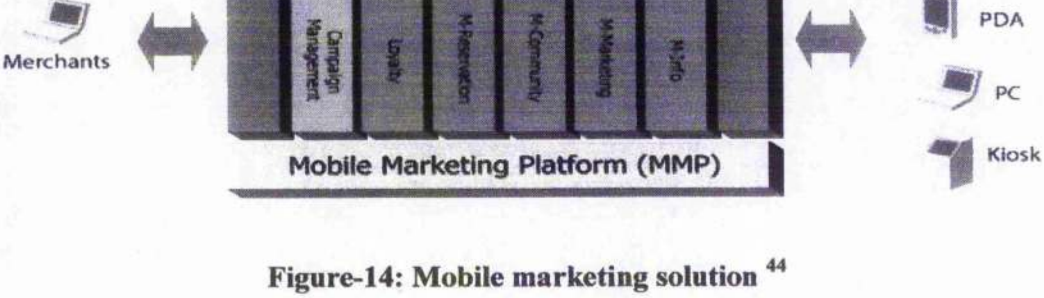

Figure-14: Mobile marketing solution [44]

AW.2's MMS included two major components: Mobile Marketing Application (MMA) and Mobile Marketing Platform (MMP). Believing in the importance of product differentiation, A.W.2 developed the following functionalities in their products:

i. Mobile Marketing Application (MMA). The overall MMA includes the following six major software modules:

[44] Source of data: A.W.2 corporate brochure with permission granted.

- M-Info Module. The M-Info module managed applications that improved understanding of customer needs and wants. These applications included market research survey and direct voting to targeted mobile users.
- M-Marketing Module. The M-Marketing module managed applications that assisted in acquiring new customers. These applications included push promotion-messages or personalized mobile coupon book for targeted mobile users.
- M-Community Module. The M-Community module provided applications that helped merchants retain existing customers. These applications included mobile circles, reverse auctions and networked games for targeted mobile users.
- M-Reservation Module. The M-Reservation module enabled mobile user to make reservation with merchants through Internet and mobile phones, with confirmation via SMS (short messaging services).
- Loyalty Module. This was a website module that provided an interface and connection point for the mobile users through Internet. It enabled mobile users to register and modify their profiles, which included demographic information, psychographic information, preferences of the maximum number marketing benefits and the timeframe in which the users were willing to receive data.

- Campaign Management Module. This module provided a web interface for the merchants to create, develop and monitor their mobile marketing campaigns. Merchants could monitor real-time results of marketing activities such as the number of mobile coupons downloaded and results of a mobile survey.

ii. Mobile Marketing Platform (MMP). Mobile Marketing Platform (MMP) was the core engine that delivered the functionalities of marketing applications. It contained a comprehensive set of basic components for the applications to make use of. The overall MMP platform included the following components:

- Personalisation Component. The Personalisation Component matched the demographic and psychographic of consumers with mobile marketing benefits. Integrated with A.W.2's latest location sensitivity function for location-based services, merchants could ensure that non-intrusive and relevant marketing benefits were forwarded to their target customers. The personalisation module automatically updated customer profile as intelligence, thus increasing knowledge about the customers as they participated in activities through mobile phones.
- Data Mining Component[45]. The Data Mining Component enabled suggestive marketing for merchants to cross-sell new products to existing

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[45] The primary objective of the Data Mining Component was to continuously increase the effectiveness of conducting marketing campaigns on mobile channels for the merchants. It could be applied to five key predictive models:

customers and to sell their products to new customers. It enabled merchants to segment its potential and existing customer base and to ensure that targeted benefits could be passed onto loyal customers based on their user profile, behaviour and transaction history over time. It allowed the extraction and manipulation of data to determine rules for plausible marketing suggestions.

- Scheduler Component. Scheduler Component provided a planning tool for the merchant to manage its mobile marketing campaign over time. It captured the history and transaction details of all mobile marketing activities pertinent to the merchant.

Hardware Architecture

Another differentiating factor of A.W.2's platform was its ability to provide multi-tier component architecture as shown below:

- Profiling and Personalization. Profiling and personalization was the fundamental element of data mining. It aggregates and processes data from both static and dynamic sources to allow the data mining engine to explore data set relationship.
- Intelligent Targeting. A.W.2's Data Mining component added knowledge-based intelligence on top of the general personalization capability instead of simply matching merchants' criteria and users' preferences.
- Suggestive Marketing. Suggestive Marketing contained machine-learning feature of A.W.2's Data Mining engine. It was designed to increase customer loyalty for the merchants.
- Cross Selling. The Cross Selling feature was designed to enhance convenience for the mobile user. Our Platform's Data Mining engine possessed the capability of making suggestions to a mobile user when he or she performs a specific action.
- Smart Shopping. The Smart Shopping feature was designed to increase the convenience of the mobile users; Smart Shopping encompasses a range of ingeniously designed features such as "Priority Placing", "Instant Bonus", "Early Bird Shopper", etc.

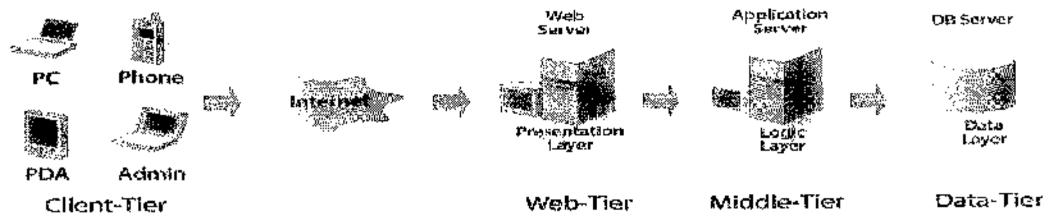

Figure-15: Hardware architecture

A.W.2 developed four tiers in the structure: Client-Tier, Web-Tier, Middle-Tier and Data-Tier. Client-Tier was responsible for the presentation of data, receiving user events and controlling the user interface. It supported several channels of client technology, including HTML, WAP, XML, Java Applet and J2ME client. Web-Tier provided presentation logic and accepted user input from HTML, WAP, XML clients, and generated appropriate responses for the users. Middle-Tier implemented business logic of A.W.2's applications based on Enterprise JavaBeans (EJB) technology. This particular tier protected the data from direct access by the clients. Data-Tier provided data servicing for Middle-Tier based on EJB technology. This tier was utilised for data storage.

A.W.2 determined to design a device-independent platform in order to enable broader interconnection with different types of end-users. A.W.2's platform was built as a completely web-native solution. With its web solution, users could access applications via any computer terminal without having to buy or install software. Most of the applications and data could be accessed from anywhere, anytime via any computer terminals with a standard browser.

These applications were designed for full integration with accessing information from Personal Data Assistant (PDA) devices. While users were away from the computers, users could switch on to PDA and manipulate information and data. Through an Internet connection, users could synchronize data with their personal accounts using synchronization function as well as other wireless devices, such as Blue-tooth and GPRS phone. A.W.2's platform facilitated mobile phones users to access services real-time at offsite locations. For regular 2G handsets, A.W.2 platform also enabled easy access of applications through a range of voice interface, including short-code and voice-activated system. A.W.2 gained experience to leverage its own Interactive Voice Response System (IVRS) system to deploy solutions for new clients. Access to A.W.2' platform was broadened to different telephone users, regardless of fixed or mobile.

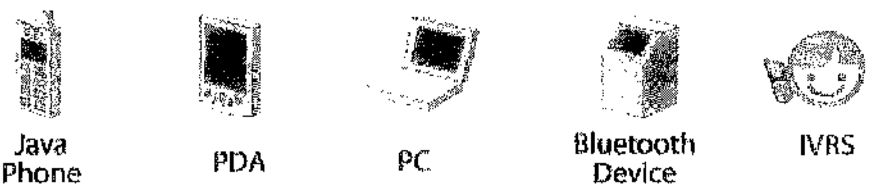

Figure-16: Access options [44]

4.3.2.3 Resource Allocation Experience

Human Capital

Since the initial formation of A.W.2, Human Capital had comprised experienced professionals of wireless communications and information technology backgrounds. The three main founding members had altogether about 25 years' experience in the field, combining IT consultancy work, as well as research and development project management. These individuals also possessed in-depth professional experience working in projects for telecom and mobile network operators. One of the most valuable experiences as claimed by Mr. So was the working knowledge with operators and rapid technological development within the industry throughout the past decades. With such in-depth knowledge about the requirements in innovation of new solutions and products for the end-customers, A.W.2 was in an advantageous position to design and develop value-added services that were created for the evolving wireless communications market.

Currently A.W.2 hired more than 30 employees; about half of them were technical staff focusing on research and development needs, and the rest included account executives, IT support and administrative staff. For core research and development activities, the management determined to maintain most of their staff in Hong Kong while having none in Mainland China despite their lower wages. The main concern was associated with protection of intellectual property and their proprietary technology. Nevertheless, the management was planning to open up a development centre in Shenzhen in the near future to delegate some of the non-core programming activities and back office IT support.

The senior executives, including the founders, were mainly responsible for strategic development as well as new client development as they believed this was the most critical task to accomplish during this particular stage of growth and development. Technical knowledge was believed to be fundamental in marketing their solutions to regional mobile operators. The executives found that project management and execution skills earned in management consultancy were useful assets in gaining confidence from the potential clients.

Key senior executives hired after the formation of A.W.2 were granted with stock option as a performance incentive, the rest of the employees were basically salary-based without any other particular incentives except for bonuses granted to account executives with outstanding performance. The management saw that junior staff should receive on-job training through rotation of projects under supervision of senior staff. Other than that, there had not been any formal training provided to its staff so far. One of the reasons, as suggested by the founders, was that they have been too pre-occupied with ongoing business activities to think about training and development for the staff.

A.W.2 formed a board of advisors with high profiles in the field of e-commerce and wireless technologies, who met on an ad-hoc basis for the management to consult on high-level strategic issues. One of the advisors in fact pointed out to the senior management the need to hire a full-time Chief Financial Officer to handle the corporate finance and management accounting duties as A.W.2 had been growing steadily and financial matters had to be taken care of by an experienced financial professional.

Innovation Capital

Coming from a background of management consultancy and project management, the founders endorsed the significance of team spirit within the growing organisation. Mr. So and the other founders advocated the maintenance of a rather flat organisational structure that encouraged team work and open communication between the senior management and staff in general. Bureaucracy was kept to its minimal form as much as practicality permitted. The management also appeared to welcome new ideas from the staff through various channels. Regular internal meetings were held regarding new product development among staff of different departments. In attendance were not only the research and development staff, but also marketing executives and IT support staff who were invited to provide their opinions.

In terms of product innovation, A.W.2 understood the requirements for mobile operators to develop new value-added services which would retain their existing customers and absorb new ones from their competitors. More significantly, the mobile operators were keen to generate additional revenues through these new services, such as ring-tone and Short Message System (SMS) services.

The founders of A.W.2 intended to develop and own their proprietary solutions through their own internal efforts to adopt the technologies without relying on any third-parties. To ensure market orientation of new solutions, the management incorporated the client's specific requirements into specifications of new products and services. It had been determined by the management that research and development activities would only increase in the future and such efforts should not be isolated from the marketing and solution development team. The management believed that it was strategically important for the company to acquire knowledge of any emerging technologies that would affect the landscape for delivering mobile communications.

Structural Capital

The current business model of A.W.2 required the company to deliver solutions that integrated a range of software with specific hardware architecture on the client side. Part of its non-core infrastructure and data storage facilities were outsourced to third-party data centre service providers. However, as A.W.2 continued to grow, the management needed to formulate plans to strengthen its own technological infrastructure in areas of research and development, as well as internal facilities for scalable expansions.

Management of A.W.2 were aware of the importance of maintaining constant investments in research and development activities in order to sustain its current competitive position in the marketplace. For research and development activities, there should be effective computer equipment and facilities, office space and proper environment for creating new products and services. Given the limited financial budget in the initial years, the facilities were acquired to the extent that the basic infrastructure is in place, whereas purchase of new equipment required a stringent procurement process to ensure only necessary and economical ones are acquired. To expand its software development team, the company started planning for its new software development centre in China.

The management also projected the need to acquire additional computer equipment, such as servers and enterprise systems that would enable the delivery of a new community platform for the end-users of the mobile operators. This emerging business initiative would create new sources of revenues for the venture and diversify its customer base in the region. Nevertheless, this business model would require substantial amount of upfront capital expenditures and represented a challenge to AW.2 given its availability of financial resources. The management needed to assess such financial commitment in light of the potential business risk involvement.

In regards to development of internal management systems, it was observed that A.W.2 had acquired some basic internal administrative measures - including adopted procurement procedures - to help organise and process internal matters. An off-the-shelf basic computerised accounting system was implemented to facilitate financial reporting activities.

Customer Capital

Senior management of A.W.2 had been focusing its effort on clientele development in the mobile communications sector since the early stage. Strong customer relationship was established with several regional mobile operators. Currently, the main challenge for the company was to deliver effective after-sales-services and to retain the existing small customer base. Early adoption of certain mobile operators provided A.W.2 with some good references for other potential customers. For the existing customers, the company was able to maintain adequate delivery of solutions and to facilitate incremental traffic flows among their end-users. Customer satisfaction was highly regarded as an important business performance indicator for A.W.2. A customer relationship management system was embedded into A.W.2's solutions, which enabled review of detailed customer information in an effective manner.

4.3.2.4 Observations

Strength

The founders emphasised that an important strength they possessed as a start-up company was their strong ability in business plan execution and familiarity with the rapid development in the wireless communications market. They were capable of understanding the specific needs and requirements of mobile operators and delivering solutions to them satisfactorily. The founders' previous experience in the sector also enabled them to build on the industrial network for quicker access to potential customers

There was little doubt that the company had been able to build up its technological edge in delivering value-added solutions for the mobile communications sector. Continuous investments in research and development with a focus on requirements of the end customers had proven to be necessary in acquiring new business and generating revenues. The founders claimed that their company was in a leading position to deliver "cutting-edge", proven solutions for mobile operators in the international market.

Issues with Growth

(a) Development of new, scalable products and services

Despite an early success in acquiring customers, the management was aware of the need to develop new products and services that would enable the future growth of A.W.2. The research team had been tasked with standardising some of the products' specifications through designing individual modules that would either integrate with others or stand alone according to the needs of the end-customers. Their modules needed to maintain the principles of open platform and easy accessibility by various devices. Through a dynamic product development strategy, the management hoped to broaden their customer base in the future development and to have less reliance on a handful of telecom operators.

(b) Quality of technical staff and key management positions

According to the management of A.W.2, it was not easy to acquire technical people who possessed adequate knowledge and experience in wireless data communications and system development. It would take time to recruit new ones and to train them up with the necessary skills to become an effective part of the research and development team. The management also observed the need to establish an organisational structure for the company as it continued to expand. To be effective, a more structured functional group was required to specialize in current tasks. For instance, a customer service department needed to be set up to focus on after-sales services. A senior financial officer was being sought to fill the key position that handled corporate planning and financial management matters.

(c) Regional expansion

The management was accessing business opportunities in both China and India. While these two countries represented two of the world's largest mobile user markets, the management was concerned about the regulatory issues and their market complexity. The management was in fact more concerned about the potential requirements of resource allocation for entering these two huge markets before additional resources became available.

(d) Areas that required additional resources

In rationalizing resource allocation, the management identified the following areas that would require immediate allocation of new resources to facilitate the next stage of growth:

- Hiring additional customer service and IT support staff to handle after-sales services and support so that the development team could re-focus their effort on research and development;
- Hiring additional research and development at junior level to support the experienced technology development team in exploration of new products and services;
- Acquiring more advanced computer equipment, internal management systems and additional facilities - such as office space - to enable effective operations within the organisation;
- Hiring a seasoned finance professional to undertake the CFO position.

4.3.2.5 Financial Capital Raising

In order to secure the resources suggested above, it was estimated that at least US$6 million would be required. The founding shareholders were planning to raise external financial capital through private placement of equity shares to venture capital and private equity firms. Strategic investors in the field of telecommunications were also considered. About 40% of such new financial resources would be used in acquisition of equipment and facilities; the remaining were intended to be working capital for research and development expenses and additional recurring expenses associated with additional Human Capital. Initial feedback from several venture capital firms was positive. A.W.2's track record in acquiring certain anchor customers and in generating timely revenues in its early years had demonstrated to be an important indicator of business performance for their potential investors.

4.3.3 A.S.1

4.3.3.1 Company Background

A.S.1 was founded about three years ago under the leadership of Mr. Wang and a team of four key technical and manufacturing professionals, all veterans of computer electronics industry in the Silicon Valley of the U.S. This management team, composed of expertise in research and development, manufacturing and marketing, together with over 100 years of collective experience, was previously responsible for the development and volume delivery of world-leading products from hard-drive manufacturers such as Maxtor, Seagate, Fujitsu and NEC. Having experienced the bureaucracy in the traditional hard disk drive (HDD) industry and its slow adoption to disruptive technologies, the founders shared the vision to pursue a new and exciting direction for the next-generation data storage. The founding team members deliberately selected the consumer electronics industry to implement their vision in application of "minidrive", as the industry appeared to be less constrained by legacy concepts and more open to new ideas and innovations in application of new technology.

Focusing on the rapidly growing application data storage requirement in consumer electronics, A.S.1 was formed to concentrate their initial efforts and resource allocation on research and development of "minidrive" products. A.S.1 was seen as having the core competence in challenging the position of other traditional manufacturers as an alternative supplier of low-cost, high quality "minidrive" products embedded with latest microchip technology. Riding on the unexpected market momentum toward portable consumer electronics storage devices, A.S.1 released - after six months of its formation - its very first prototype ready for mass production: a 1.8-inch hard drive capable of storing 20 Giga-bytes of data. This product was tested with success for applications in more than a number of portable consumer devices, including MP3 players as well as other digital gadgets featuring a JPEG camera, MPEG-4 movie functionality, stereo audio recorder and MP3 player. By increasing storage capacity in the next generation of products, the "minidrive" developer intended to propel its device into a variety of next-generation portable combo products ranging from video cameras and portable GPS devices to camera phones and high-resolution digital still cameras combined with MP3 players.

At this early stage, Mr. Wang was able to gain support from a corporate venture fund and decided to move swiftly into building production facilities for A.S.1's first "prototype". The production was based in an inner province of China. The young "minidrive" venture company expected to capture the fast-growing demand for its new product and to generate favourable revenues within the next 18 months of growth and development.

4.3.3.2 Growth and Development Experience

In the consumer electronics market, it was revealed that the need for larger storage capabilities would continue to grow as an increasing number of multi-functional "combo" products emerge in the market featuring enriched audio and video functions. It was anticipated that the advent of mobile handsets equipped with hard drives could take place in the coming years. Being aware of increasing demand on storage capacity from other electronics consumer products, such as digital video camera and portable GPS devices, management of A.S.1 was in the active mode to develop 1"-sized products with 2 Giga-byte and 4 Giga-byte storage. The development team in California was mandated to pursue the research and development of such new products under the pipeline.

Data storage solutions were improved drastically over the past few years with densities in HDDs soaring about 100% a year from 1998 to 2001. And most recently, flash memory producers had demonstrated themselves to be constantly enhancing density and storage capacity in closer comparison with "minidrive". Such growth was however expected to slow down in the coming years as noted by the key industry players. More importantly, this miniaturisation trend in data storage could become mature in terms of capacity and size-enabling extensive multimedia applications in consumer electronics. While there seemed to be no absolute technological advantage between "minidrive" and flash memory, the current challenge was in fact for the capacity to meet end-users' rapidly increasing demand at competitive pricing. The following Figure-17 provided an analysis of the projected growth in storage density in hard-disk drives.

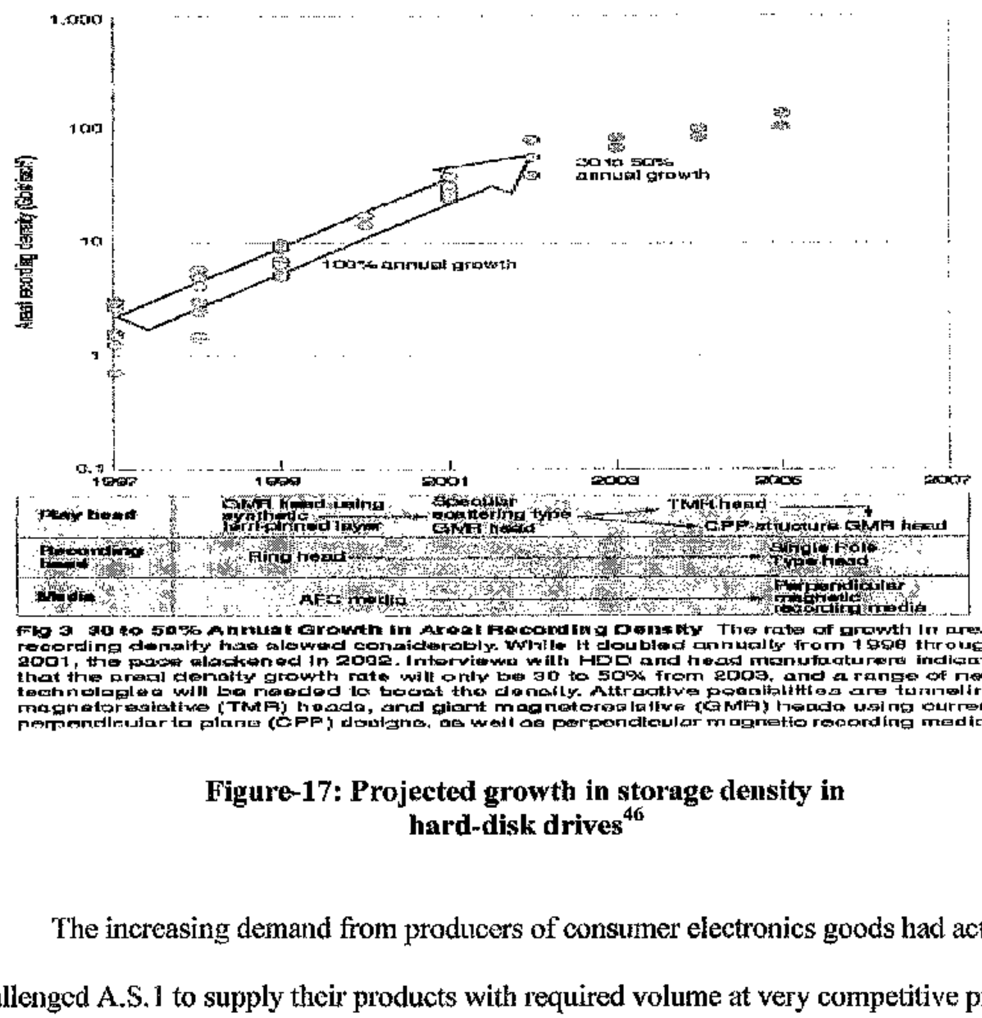

Figure-17: Projected growth in storage density in hard-disk drives[46]

The increasing demand from producers of consumer electronics goods had actually challenged A.S.1 to supply their products with required volume at very competitive pricing. Like other manufacturers of "minidrive", A.S.1 was required to deliver solution, which was

[46] Source: http://neasia.nikkeibp.com/neasia/001583 (July 2005 Issue, Nikkei Electronics Asia)

adequately designed for the specific requirements of the electronics products. For instance, "minidrive" was well accepted by digital camera producers for their ability to transfer data of high-resolution picture files in a speedy and reliable manner, though further improvements were needed for specific usage requirements. In the near future, similar efforts were expected for the adoption of "minidrive" in mobile phone and PDA products. Customisation at competitive pricing with high delivery capacity would be the victorious combination of factors that drove the objective of market performance of a "minidrive" or compact flash producer.

Senior management of A.S.1 determined that the company needed to materialise its local cost advantage given the increasing pressure on marketing pricing driven by emerging competitions from other players. The manufacturing plant in China would deliver products in a highly cost-effective manner, the management expected. It would take time for the other global competitors to develop similar low-cost, high-tech production facilities. This would provide A.S.1 with the advantage in capturing market share with price-competitive "minidrives" during the early stage of product-life cycle.

Meanwhile, between two major blue-chip giants who had been leaders in research and development in HDD, one of them sold its own "minidrive" business to the other through a complete acquisition, including its know-how. The newly combined company would incorporate the HDD operations of other giants. With substantial and dedicated research and development resources, the new giant was presumably well-positioned to emerge as the leader in storage technologies, despite concerns about resources for postmerger reorganisations and traditionally high operating costs in blue-chip giants. This movement in the industry represented a major threat to A.S.1 - a young, entrepreneurial technology venture.

4.3.3.3 Resource Allocation Experience

Human Capital

As the leading founder of A.S.1, Mr. Wang had in-depth experience in the computer industry from Taiwan as well as the Silicon Valley in California. Mr. Wang managed to assemble a founding team of technology professionals from a number of blue-chip hard-drive manufacturers in both U.S.A. and Japan to start up the operations of A.S.1. These professionals respectively specialized in research and development of "mini-drive", manufacturing of hard drives, quality assurance, and international marketing of electronic products. Most of them had earned a master degree in computer science or engineering and one of them had a PhD degree. Mr. Wang intended to build an all-rounded start-up team in order for A.S.1 to become a fully functional "minidrive" manufacturer in a timely fashion.

The technology development team was originally based in the Silicon Valley of California, where clusters of companies closely associated with the component-oriented technologies of "minidrive" were headquartered or research and development facilities were planted. As A.S.1 was establishing its manufacturing facilities in China, the senior management despatched the manufacturing and quality control professionals to set up and commission the production of facilities and assembly lines at the work site. Local assembly line staff workers were trained for the precision assembly procedures and implementation of the internationally practiced total quality management scheme. An experienced plant manager from South East Asia was recruited to take up the deputy plant manager position, which was also responsible for overall training and development of local staff. Locally hired staff workers were mostly female with college education and 20-20 eyesight due to the precision assembly procedures involved.

Most senior staff were granted stock option by the company as a performance incentive upon joining the venture. Their overall compensation package was at least as good as their previous employers, which was an attraction for them to join in the first place. In addition to in-house, job-based training and development for the local staff, housing allowance and canteen were provided to enhance the overall employee benefits. The local staffs viewed training as a very attractive element in the new job. On the other hand, local staff members were eligible for discretionary performance bonus due at the end of each calendar year.

Innovation Capital

In terms of product innovation, A.S.1 had to seek various innovative applications of "minidrive" in electronics consumer products. Personal data assistant (PDA) had undergone rapid changes with respect to functionalities and applications. PDA products were now integrated with different functions of electronic devices including email, word processing, electronic spreadsheet, data management, MP3, multimedia and even those of a mobile phone. Large data storage capability became a necessary feature to enable these digital applications with increasing demand for data usage. A.S.1's management needed to work closely with electronic consumer product companies from the stage of product design to understand the requirements of data storage. A.S.1 understood the importance of this relationship with customers and began to focus on the need for embedded components in the architecture of electronics consumer products, such as controllers embedded to enhance management of data in multimedia products. System-on-chip emerged as a critical technological know-how for innovation of the next-generation "minidrive".

The original research and development team, based in California, possessed in-depth development experience in the design and architecture of "minidrive", having focused largely on the race to create the next smaller and higher storage-capacity "minidrive". They insisted on maintaining their research and development facilities in the Silicon Valley because of the highly-dense clusters of computer technology companies in the area and an environment that nurtured the culture of creativity. At times, it appeared that formal communication between the research and development team in California and the senior management - who now spent a huge amount of time on manufacturing operations in Asia - had been dwindling recently. The direction of product research and development continued to focus on size and capacity; the global marketing team on the other hand frequently provided feedback to the senior management on the market trends of PDA.

Attempting to inject a culture of innovation among the local staff in China, the management believed in the importance of feedback from local staff working in the manufacturing plant in order to successfully implement a system of continuous improvement. However, the management found it not easy at all to effectively induce an open communication culture within a greater, traditional top-down bureaucratic culture of central planning.

Structural Capital

The senior management perceived that its new manufacturing plant would be able to create an advantage for A.S.1 in meeting the vast global demand for "minidrive" at low cost, as competitors had not yet pursued a similar strategy. Mr. Wang was able to convince the board of directors to utilise available funding for building its manufacturing plant in China as soon as feasible, for the perceived low-cost production advantage. The new facility was built in a swift manner and commenced its operations at the beginning of A.S.1's third year of establishment. The facility was well-equipped with imported precision machines and quality control system.

The new plant manager on the other hand worked very hard on the implementation of a quality management system, which included training and development of inexperienced assembly line workers. The production of "minidrive" required highly precise assembling of miniature components including lenses, controllers and mechanical parts. Any scale of defects had to be eliminated in the production process. All manufactured products that came out of the production line had to be tested thoroughly before being delivered to the customers. The plant manager was under pressure to maintain a high-quality production environment.

Further to a quality management system, A.S.1's overall technological infrastructure required a thorough supply chain management system. The "minidrive" required several critical components for the particular architecture of "minidrive" and these component suppliers in turn required orders of specific quantities in advance. For the end-customers of A.S.1, the demand was expected to go up drastically in the near future. Currently A.S.1 maintained its own supply chain management which was ensconced in its self-developed enterprise resource planning system. All production data was not yet integrated with any of its suppliers or customers.

With respect to the development of an administrative system that helped organise and process its internal matters, most of such responsibilities were centralised at its de facto headquarters in Hong Kong. Computerized accounting system was not fully implemented within the young organisation as each operating site perceived as individual profit centre seemed to maintain its own financial records and reporting system.

Customer Capital

A.S.1 initially acquired two important customers who had ordered substantial quantity of "minidrive" from the company. Other customers started placing some orders with A.S.1 as trials. As a matter of fact, the brand of A.S.1 was new to these customers. The company admitted that it would take time for customers to learn about A.S.1 and its products. To increase networking and publicity for A.S.1, the company participated frequently on a number of international trade shows for computer electronics. An after-sales service centre was opened in Hong Kong to offer customer services as well as repair and maintenance services. A.S.1 installed a customer relationship management system that integrated with its call centre mostly to deal with after-sales enquiries.

4.3.3.4 Observations

Strength

Of the recognized strengths of A.S.1, it was worth noting that its product development team was proven to have the capability in completing prototypes within a very well-defined time frame, which enabled A.S.1 to move onto the stage of mass production in a timely manner. A.S.1 was able to build its early core competence on the "minidrive" technology and to maintain its research and development capability for the next-generation "minidrive". Another key strength of A.S.1 was that it had gained timely access to low-cost production facilities in China, which also enabled capacity for large-quantity production. It appeared that A.S.1 was positioned for the anticipated growing demand for "minidrive".

Issues with Growth

(a) Production facilities development.

In order to establish its production capacity for the respective upsurge in demand, A.S.1 needed to prioritise the development of production facilities that were flexible enough for manufacturing different models of "minidrive". At the same time, the company needed to maintain its cost advantage over its competitors, as micro-drive would soon become more or less a consumer product similar to a highly price sensitive commodity. On the other hand, A.S.1 had to carefully ensure that the quality of the production process was maintained, as the plant in China moved into full production mode quickly.

(b) Supply chain management

The opportunity to develop a large manufacturing base in China needed to be explored with careful consideration for relevant supply chain factors. In manufacturing its products, A.S.1 continued to work closely with its component suppliers, which also had business with A.S.1's competitors. Meanwhile, growing demand from the end-customers was expected to cause commotion in the overall supply chain in the "minidrive" and conventional hard-disk drive sectors. As a relatively young technology-based company, A.S.1 aimed to swiftly build up its supply chain with respect to order management with its suppliers, demand forecast for its end-customers, production scheduling, logistics and transportation management, as well as related quality assurance management. A.S.1 had to consider developing a global supply chain management system that integrated and managed the mission critical data in support of its strategic development plan.

Furthermore, aiming to keep manufacturing costs down, to ensure best-of-breed quality, and to instil customers with confidence that A.S.1 products would be available in required volumes, the company would need to team up with its component suppliers to secure high-volume supplies in motors, heads and suspensions. Increasingly, A.S.1 was under pressure to develop a streamlined supply chain and assembly system that enabled fast and profuse manufacture of A.S.1's end-products.

(c) Research and development of new products.

It was foreseen that the future generations of micro-drives would become smaller with higher storage capacity. However, the design and applications were expected to require further innovation with stronger linkage to the electronics consumer market. Development of new product would depend not only on the technological development of "minidrive" itself, but also required stronger liaison with the design of electronics consumer products. A.S.1 could be better prepared for the future with effective planning tools, such as the technology backcasting technique that emphasised the critical milestones of development for anticipated achievement and results. The management felt that this initiative was even more effective if a cross-functional team composed of expertise in production, marketing staff and research and development team could be assembled at an early stage. A thorough lead-user analysis was much needed in order to project the latest trend in end users' requirements.

(d) Emergence of disruptive technologies

Industry analysis pointed out the fast emergence of competition from similar data storage products posing a threat to "minidrive". For instance, compact flash memory card had become quite a popular product in consumer electronics. Although the price per mega byte for compact memory card remained higher than that of "minidrive", such discrepancy seemed to be narrowing down and its application in consumer electronics goods had broadened briefly in recent months.

(e) Areas that required additional resources

An orchestrated approach in upcoming allocation of resources would be critical for the continual development and survival of A.S.1. The critical areas of organisational development in face of rapid market development would be augmented to accommodate continual growth and to improve the survival ability of A.S.1 in this highly competitive industry under the rapid miniaturisation trend in data storage, which was seemingly integrating with consumer electronics industry.

The management of A.S.1 had obviously taken the chance to invest heavily in large capacity of production based on their own assessment of demand on their products. Their low-cost manufacturing plant was now in place for full operation though the plant had yet reached half of its full capacity.

Following its heavy investment in plant facilities, A.S.1 needed to further rationalise its resource planning in order to build a sustainable business for growth and development. In particular, the company had to determine the imminent product development strategy and to respond to the rapid changes in application for data storage in various consumer electronic products. The research and development team in California had recently demanded an increased budget to explore new technologies for "minidrive". The marketing department had also called for joint development efforts with customers in new products that were embedded with microchips to enhance the controlling function.

According to the senior management, additional financial resources to strengthen various internal technological infrastructure of A.S.1 became imminent in order to compete effectively in the intensifying consumer data storage business over the next few years.

Such infrastructure developments should include capital expenditures in advanced production facilities, supply chain management system, as well as expenditures in new product research and development-related activities. In particular, the company - through this business plan development initiative - should develop specific execution plans and prioritisation for allocation of financial resources into various key functional areas that would augment growth and development of A.S.1 in the coming few years.

4.3.3.5 Financial Capital Raising

Anticipating the upcoming emergence of disruptive technologies that could threaten "minidrive", the management felt strongly about placing additional resources on the research and development team, especially in the area of system-on-chip technology. The company had approached venture capital and private equity firms to discuss about the initiative in raising equity capital for its expansion plan. The company had been asked of financial statements for review. With respect to operations, it appeared that previous investments in plant facilities had generated substantial depreciation expenses that exceeded the gross margin from sales of products during the past reporting periods. Scepticism about future return compounded with uncertainty in the emerging technology of flash memory, a substitutable product, was found in initial feedback from the potential investors.

4.3.4 A.S.2

4.3.4.1 Company Background

Established about four years ago, A.S.2 was an independent "fabless" semiconductor company specialising in design, development and sale of proprietary integrated circuits (IC) solutions that facilitated sophisticated display applications such as cellular phones and handheld displays. The two founders of the company used to work for larger multinational corporations in the semiconductor industry. Each of them had accumulated over 20 years of industry experience especially in the functional area of sales and marketing. The founders saw the increasing opportunities in design and development of specialized IC solutions, such as display applications. The venture was initially funded by the founders and angel investors. Going through rapid growth in sales, the company currently targeted to become one of the leading independent display IC producers for cellular phones. A.S.2 managed to commence shipping display ICs in its second year of operation, a majority of its products being display ICs developed for use in cellular phones.

A.S.2's headquarters was based in Hong Kong, with regional offices set up in the China, Singapore, Taiwan and the United States, in addition to authorised representatives and distributors in Europe, Japan, Korea, the China, Southeast Asia and Taiwan. A.S.2 had successfully developed products, which were adopted by international cellular phone manufacturers and display module makers. A.S.2's display IC products became vital components of consumer electronic products such as MP3 players and PDAs.

While A.S.2 developed products for different display technologies, A.S.2 intended to focus on higher value-added sectors such as colour screen and multifunctional single chip solutions. A.S.2 emerged to move into production driver/controller ICs for cellular phone and other mobile device applications with super-twisted nematic (STN) technology. The latest development effort of A.S.2 focused on IC products for large panel TFT-LCD display applications such as notebook displays, desktop monitors and flat screen televisions, which A.S.2 planned to launch in the near future. A.S.2 was also developing other new IC products for display technologies which are at their early stage of commercial applications, such as micro-displays.

4.3.4.2 Growth and Development Experience

The founding chief executive recalled that during the early development of this start-up, one of his most important tasks was to build the core management team and "stick" the team members together. Soon after the formation of the company, the founding members concentrated on building a core team with multidisciplinary background, including senior research and development staff, as well as sales and marketing executives; there were several cases of resignation. According to the founders, it was essential to maintain a strong team spirit and leadership was exceptionally critical to uphold the entrepreneurial culture and to shield against any negative thinking during the early days.

Due to the strong network already developed within the electronics industry, the founding executives of A.S.2 managed to form timely strategic collaborations with international brand owners to co-develop products in order to deliver advanced display IC solutions. Being well-positioned as an independent display IC producer, A.S.2 was able to leverage the in-depth IC design and development experience to create advanced products for other brand owners. The research and development capability for new products and services was viewed as a very important core competence of A.S.2. Nevertheless, given the limited financial resources available, the management made the decision to outsource the overall manufacturing process to specialised semiconductor contract manufacturers, such as wafer foundries, packaging and testing factories. A.S.2's in-house engineers maintained and controlled the manufacturing procedures. A system that contained both testing software and hardware was built to ensure product quality and to control the use of A.S.2's intellectual properties. To further focus their efforts in developing market-driven and advanced technology products, A.S.2 collaborated with regional and global distributors to embark certain market development and logistics management activities.

Forecasting the future development, management of A.S.2 expected that communication, electronic organisers, multimedia and gaming functions would gradually converge within the mobile device market. Aiming to capture the trend in this converging multimedia handset/handheld market, A.S.2 made plans to develop mobile device display ICs with integrated multimedia controllers, which enabled integration of display, audio and other non-display functions into a single chip. Another major potential application identified by the management was the TFT-LCD displays, which became increasingly popular with consumers. Such application would induce further enhancement in manufacturing processes and reduction in production costs. Further down the road, A.S.2 saw the potential to launch its large panel TFT-LCD driver ICs and the development of advanced display ICs, including timing controllers and display interfaces. A.S.2 disclosed that the company would collaborate with other technology leaders to explore new applications and be among the pioneers to develop commercial display ICs for emerging display applications and technologies. For instance, the company currently worked closely with micro-display manufacturers to explore new application markets.

As A.S.2 continued to grow in its fourth year, the management of A.S.2 became aware of the importance of securing production capacity for its future success. To improve the supply chain management, A.S.2 rationalised to work closely with A.S.2's contract manufacturers on the development of advanced manufacturing processes, pinpointing further improvement of productivity and cost efficiencies. Contract manufacturers were selected to collaborate in operating regional supply chains at strategic locations, with the objective to shorten the cycle time within the manufacturing process and to reduce logistics costs. Furthermore, the company continued to invest in equipment for use in product development and management information system targeting to build an effective information system in line with its growth, which in turn allowed A.S.2 to better collect, manage, analyse and utilise information in its business operations.

4.3.4.3 Resource Allocation Experience

Human Capital

The founders with an engineering background believed that their previous professional experience in the field of semiconductor accumulated within a blue-chip multinationals had been valuable asset to their company. Through their 20 some years of experience in the industry, the founders built a strong network with key players along the supply chain of semiconductor and understand the evolutionary structure of the industry. They developed strong sensitivities toward the latest trend and development within the industry and therefore understood the emerging opportunities led by disruptive development from both new technologies and the marketplace.

In the specialised field of IC design, the management claimed that it would normally take about 10 years to train up a well-qualified individual. It was critical for the management to recruit certain experienced engineers in the industry and to train up younger ones in order to have a sustainable research and development team. The management also trusted having proper human resources policies to retain existing research and development staff. A research centre in Hong Kong or Singapore was being planned to provide well-equipped infrastructure for the research and development of new products for A.S.2.

Upon joining the company, members of senior management - including the research and development department - was granted stock option as a performance incentive. With support from the angel investors, the company decided to recruit a financial controller within the first 12 months of establishment believing that it was quite important to set up a proper financial control and reporting system in its early days. The financial controller also joined from the semiconductor industry and was able to provide managerial support in areas of resource planning and asset management, in addition to investor relationship management.

Innovation Capital

In terms of product innovation, A.S.2 understood the need to maintain strong sensitivity to current market development and to anticipate future technological development in the field. The management needed to explore the range of potential applications for IC display technologies on various consumer electronics products, and it required effective collaboration with customers in a broad range of new product development. For instance, the development team started looking into the application of its display technology on camera electronic viewfinder, monitors in mobile devices and large LCD displays.

During the initial growth, the founders continued to take up this role in providing leadership in product innovation. Internally, the management closely collaborated with the research and development team to ensure that new ideas are turned into actual development of new prototypes in a timely manner. New technology development was monitored closely by the senior management for any potential threats and opportunities. With a culture of excellence in technological innovation in its specialized field, the company managed to maintain a strong absorption capacity for spectrum of technology that needed to be integrated with the existing ones.

A.S.2 recently moved into a local science park that housed a number of technology-based ventures and created a cluster of computer and information technology. In addition, it was perceived that the environment of a science park would nurture the culture of innovation and new ideas. The management recognised that the research and development team needed to be motivated to generate original thinking on a continuous basis. Team spirit was also encouraged to ensure effective multi-functional teamwork in a development project.

Structural Capital

The company intended to invest in a new enterprise resource planning (ERP) system soon, which enabled the organisation to share, analyse and report data for more effective management. During the early days, most management reports and analysis were produced manually and there were fragmented management and accounting systems, which did not seem to share data among themselves. As the number of suppliers and customers rapidly increased, resulting in a surge of transactions, the current systems needed to be revamped with stronger integration and automation within the overall management information system. Moreover, now that the company had multiple locations of research and development facilities and subsidiary offices, a more "powerful system" was much needed by the management to monitor and process operational data.

The management remained hesitant about investing in their own production facilities and opted to continue outsourcing the manufacturing functions - including mask making, wafer manufacturing, packaging and testing - to external semiconductor makers.

Instead of making any commitment to build production capacity, A.S.2 invested in testing equipment for quality assurance, certification, and in developing very stringent procedures for controlling quality performance with respect to the manufacturing processes outsourced to external shops.

With respect to facilities for research and development, the company made its decision to station at the local science park, which apparently had provided convenience for the company to develop its own technological infrastructure networks with other key participants in the industry.

Customer Capital

A.S.1 acquired international brand customers within a relatively short-time framework, partly due to the founders' previously-developed strong network in the industry. One of the key customers continued to remain as a major customer who contributed to over 30% of A.S.2's total sales revenues for the initial years. The customers expressed satisfaction toward the products and services delivered so far, but were currently negotiating strongly on the pricing as competition had been intensified. A basic customer relationship management system was in place to provide after-sales support.

4.3.4.4 Observations

Strength

A.S.2 had demonstrated effectiveness in execution through forming a founding management team of both in-depth industrial experience and diversified functional backgrounds to charge rapid development in its early years. The founders managed to swiftly determine their market positioning and product development competence in display IC. While discovering new opportunities to serve in the evolving sector of display of technology, A.S.2 acquired its few but important anchor customers to enable timely generation of sales and confirmed its position in the market as a pioneer of the field. Recognising the important function of research and development, the company continued to stay ahead of its competitors in anticipating other potential disruption in display technologies and their applications in consumer products. The founders believed that they not only had the first mover advantage but also the ability to execute the plan in a timely and effective manner.

Issues with Growth

(a) Development of IC designers

Management of A.S.2 understood that the core competence of the venture was its display IC design and product development capability. In order to stay competitive and to establish its market leadership status, it had to continue building its research and development team. There had been increasing demand for exploring new potential applications of IC display technology, which created pressure for the current development team to generate more timely output. However, development of a seasoned IC designer would take years and it was critical to both retain the experienced ones and nurture the young ones. It became imminent for the company to formulate staff training and development strategy in order to enhance a strong base of internal IC designers.

(b) Supply chain management

While A.S.2 did not own its manufacturing facilities; it took a great deal of effort to manage the value chain that runs across the IC display, semiconductor manufacturing and consumer electronics sectors. The management recognised the rapid changes in demand and supply in the value chain as well as the need to make responsive adjustments as a consequence of such push and pull in the chain. Furthermore, A.S.2 was required to ensure that proper quality management system is in place to safeguard the manufacturing process outsourced to any third party. The product design team needed to work closely with the operation team to determine effective control procedures for the final output of their products before shipping them to the end-customers on time and within schedule. However, the company currently did not have a system that would integrate critical data among various functional groups and enable timely data exchange for effective supply chain management.

(c) Research and development of new products.

The product lifecycle for display IC products was perceived to be shortening as the next generation of technology could emerge with incoming competitors. The management's view was that the company's core competence in display technology should be leveraged into a wide spectrum of products. It was reviewed that technological innovation should be enhanced through joint development efforts in specific electronic products. Lead-user analysis performed with a client could enable swift development results. A.S.2's competence in system integration and its depth of experience with system-on-chip (SOC) design would also affect such joint development initiatives.

(d) Areas that required additional resources

Senior finance management believed that an ERP system should be in place to serve as the central point of information system management for A.S.2, and to take care of increasingly complicated management issues with supply chain management. A.S.2 was in the midst of developing multi-locations in Asia and would need a sophisticated information system to enable effective and timely data management. Data exchange with selected third party suppliers and customers would require A.S.2 to upgrade its current information technology facilities with an advanced enterprise system. This new system should also provide timely information for the management to make business decisions.

The management understood the importance of strengthening the research and development function, which was A.S.2's core competence. The company had plans to establish research and development centres in China and Singapore in order to build a network of specialised display IC designers to support its future development of new products and applications.

The management also faced the dilemma of minimizing capital expenditures upfront versus the potential risk in unmet manufacturing capacity. A.S.2 initially opted to remain as a player with asset-light operations and most manufacturing needs sub-contracted to third-party manufacturers, including wafer fabrication factory. Given its current growth, the company had to reconsider its position. A key founder mentioned that in building a factory, the company would not only need to spend money, but also to invest time and expertise. It was unlikely that the company would move up along the value chain by producing displays itself, for instance, which could inevitably create conflict of interest with business partners.

After reviewing its resource requirements in the immediate future, A.S.2 determined to put priority on building up its research and development capability with new development centres. In addition, it was reviewed that a sophisticated ERP system should be purchased in order to swiftly enhance its supply chain management capability. The company would however continue to outsource to third-party manufacturers, with closer arrangements made with these sub-contractors in providing guaranteed minimum production capacity.

4.3.4.5 Financial Capital Raising

A.S.2 had been able to demonstrate outstanding management execution and delivery of notable business results including early generation of operating profit within two years of its formation. The founding and angel investors were quite satisfied with the early success and have made favourable references to venture capital and private equity firms regarding potential interests in investing in the next round of share placement for expansions. The expansion plan aimed to raise financial capital for use in working capital and investments in testing equipment for its products. The company intended to hire additional technical staff for its research and development department. Nevertheless, A.S.2's management was still rather reluctant to commit itself to manufacturing facilities in the foreseeable future. The potential new investors responded quite receptively about the placement plan to capture the high-growth feature of A.S.2.

4.3.5 Summary of the Cases of Early-Stage TEVs

These cases of early-stage TEVs represented the growth and development experience among four independent companies in the technology sector. These TEVs were observed with the perspective about the potential dynamic influence of resource channelled into the components of intellectual capital. The indicators under the four components were viewed as business performance enablers and drivers that were in turn affected by the amount of resources allocated to them individually. A scoring system was assumed in an analysis to reflect the level of resource commitment by the companies, under the categories of Financial Level, System Level and Execution Level as suggested in Section 3.3[47]. Detailed scoring assumptions and results in every performance indicator by each of the four cases were provided in Appendix C. The following Figure summarised the average results from the assessments of the four cases.

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[47] Financial Capital-Dependent PIs noticeably demanded initial injection of initial financial capital for acquisition of new external resources, such as equipment used in productions. The second type of PI on the other hand required development and installation of policy and related management systems and procedures to enhance and support the organisational development. It was argued that information sources and guidelines for policies, procedures and systems enabled establishment and formalization of an organisation and minimised mistakes (Green, Brush and Hart 1999). PSP-Dependent PIs might require both initial financial capital and coordination of resources to establish themselves, and the weighting would be determined by availability of pre-existing relevant management systems or new ones. Lastly, Execution-Dependent type of PIs would mainly require active coordination of resources for execution of strategy by management aiming to generate performance that was critical to achieving pre-determined strategic and financial targets (Penrose 1959). This type of PIs could be represented by measurement of results or outputs within an organisation.

Case A.W.1	Financial Level	System Level	Execution Level
Human Capital	0.500	0.167	0.833
Innovation Capital	0.333	0.333	1.000
Structural Capital	0.333	0.333	1.000
Customer Capital	-	0.200	1.000

Case A.W.2	Financial Level	System Level	Execution Level
Human Capital	0.667	0.667	1.667
Innovation Capital	0.667	0.667	2.000
Structural Capital	1.000	1.000	1.333
Customer Capital	0.400	1.000	1.400

Case A.W.3	Financial Level	System Level	Execution Level
Human Capital	1.000	0.833	1.167
Innovation Capital	0.833	0.833	1.000
Structural Capital	1.600	1.400	1.600
Customer Capital	1.200	1.200	1.000

Case A.W.4	Financial Level	System Level	Execution Level
Human Capital	1.500	1.500	2.000
Innovation Capital	1.667	1.667	2.000
Structural Capital	1.200	1.200	1.600
Customer Capital	1.200	1.000	1.400

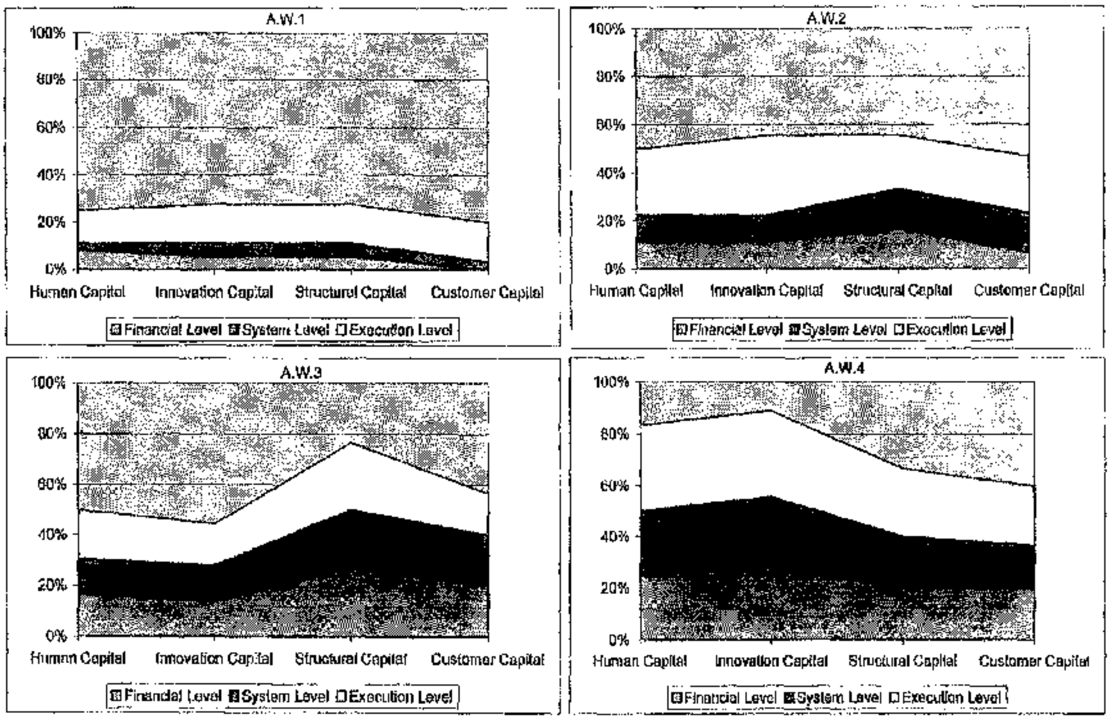

Figure-18: Summary of average scores of resource utilisation in the four components of Intellectual Capital among the four early-stage cases

Case A.W.1

The first case possessed the least commitment in resources among the four cases. Although the management had taken up most responsibilities in execution of the business plan, other forms of resources were quite limited and there was little development in internal management system that could facilitate effective workflow and delivery of services. As financial capital was deemed insufficient, the company attempted to raise additional equity capital. However, business growth remained unsubstantial under the current situation.

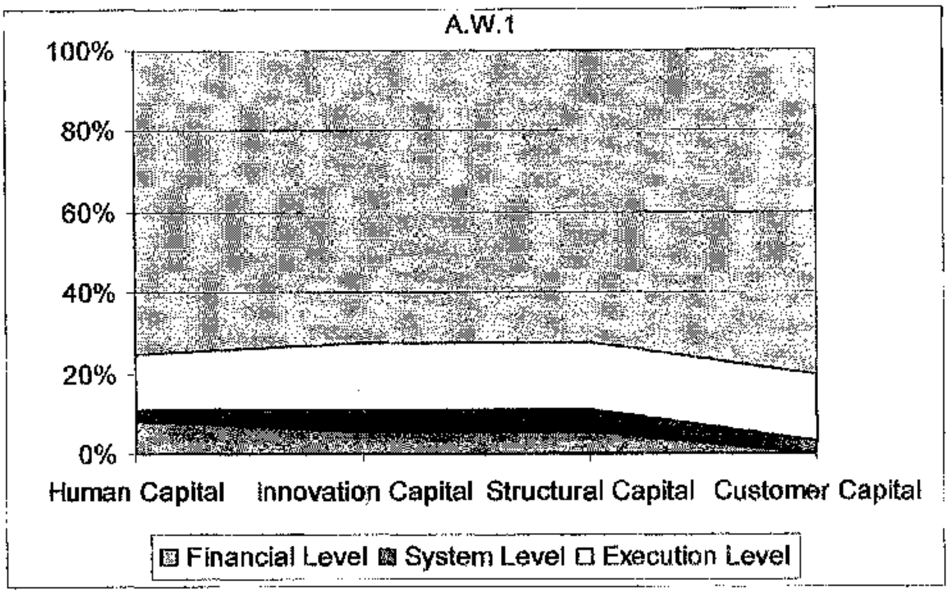

Figure-19: A.W.1's distribution and commitment of resources [48]

[48] If a company has full commitment to all three types of resources, it would receive a total score of 6 as each contributes a score of 2.

Case A.W.2

The second case showed equal commitment to both Innovation Capital and Structural Capital despite its limited financial capital. The senior management had demonstrated strong execution ability in new product development, customer acquisition, and setting up necessary initial management systems to support the operations. They took up a high degree of responsibilities in execution of the business plan; other forms of resources were quite limited and there was modest development in internal management system. Nevertheless, the level of financial capital utilised to support the development of intellectual capital remained flat among the performance enablers. Despite such limitation, the management was able to achieve steady growth in revenue generation.

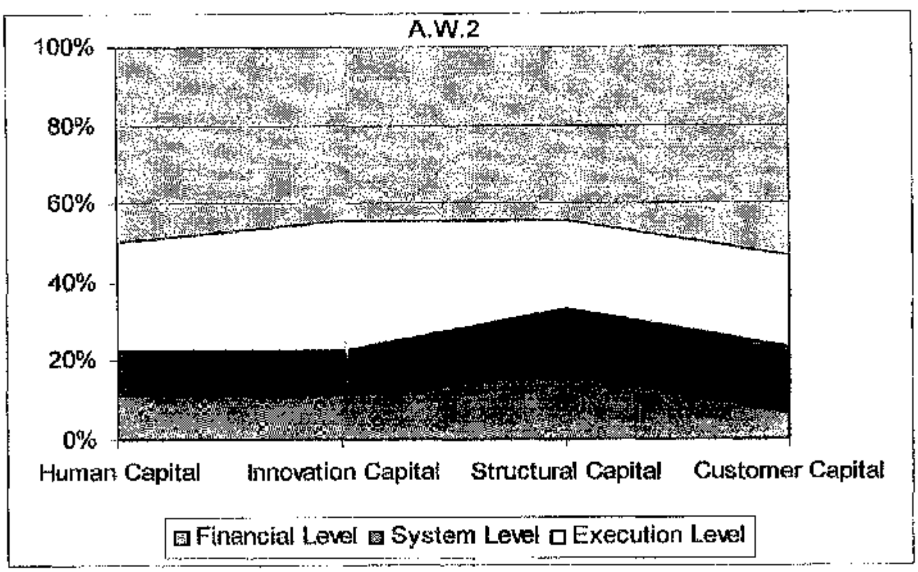

Figure-20: A.W.2's distribution and commitment of resources

Case A.S.1

The third case appeared to be most committed to Structural Capital, as the senior executives made the decision to have their own production line and to build their own manufacturing facilities. The company was able to obtain the required initial financing to support capital expenditures; related management systems and customer service support system were committed. However, the focus became less significant on Innovation Capital, and resources for research and development remained stagnant in comparison with Structural Capital. Emphasising the establishment of an advanced manufacturing plant, the management had allocated resources to training and development of manufacturing staff along the assembly line. Despite such strong commitments, the growth in revenues remained constant and price competition became intensified with the introduction of new technology in the sector. A.S.1 had apparently lost its absolute competitive edge as it shifted its emphasis of resource allocation to the component of Structural Capital.

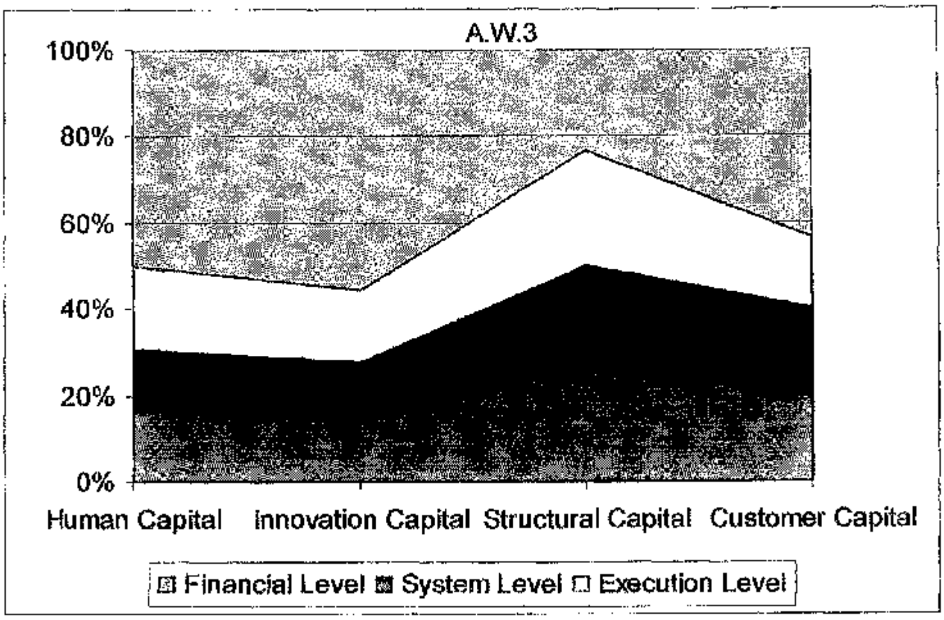

Figure-21: A.S.1's distribution and commitment of resources

Case A.S.2

This case had the highest commitment of resources in Innovation Capital, followed by Human Capital and Structural Capital. The senior executives put strong emphasis on research and development activities, as well as recruitment and nurturing specialised technical staff. The senior executives had systematically planned for development of the next generation of products, aiming to be a leader in the sector. These founding executives demonstrated their outstanding execution capability leveraging on their previous in-depth industry experience. Since the early days, the company had established certain administrative system, based on their previous corporate experience, to support the day-to-day operations, which facilitated internal workflow management. Among the four cases, A.S.2 appeared to place stronger emphasis on the resources of Human Capital and Innovation Capital than the other two components of intellectual capital. Recently, the company experienced substantial growth in revenues and acquisitions of new customers.

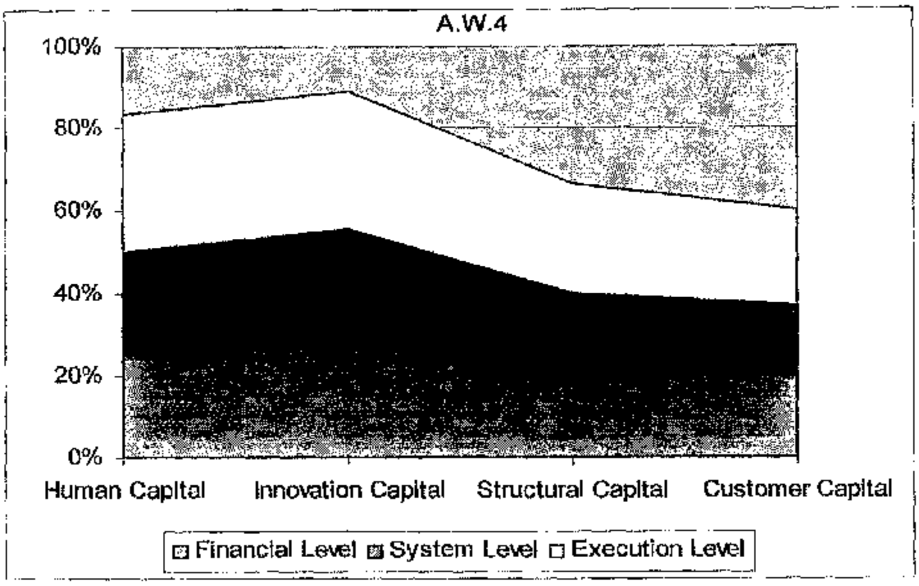

Figure-22: A.S.2's distribution and commitment of resources

4.3.6 Supplementary Interviews

A supplementary interview was conducted with a principal of an international venture capital firm based in Hong Kong with equity interests in one of the early-stage TEVs under the in-depth case analysis. The questions were focused on growth experience of the TEV with respect to critical resources and hurdles to the growth. The principal pointed out his firm made the initial decision of investing into the TEV due to two important assessments. First of all, they were impressed with the professional experience of the founding executive team. They had gained valuable experience in the industrial sector with successful track records in delivering results and their reputation was verifiable by peers in the industry. The executive team was able to lay out their vision in the business plan and provided convincing presentation about the future executive strategy. Secondly, the venture capital firm had prior experience in start-ups in the business sector and understood the dynamics in the emerging technology business. The firm made thorough assessments about the risks and opportunities underlying the proposed business venture that made use of certain technological know-how to capture new arising business opportunities. With respect to the risks involved, they believed that the quality of human resources and execution ability was the most critical in tackling problems during the early-stage of development and growth.

In assessing an investment opportunity, a venture capital firm would have to be satisfied with the growth of the early-stage TEV's performance throughout the past few years. Risk factors would have to be considered and discounted in the valuation of a potential TEV investment. Literally a higher cost of capital would be assumed and a lower entry price be negotiated for early-stage TEVs due to their lesser track record in delivering notable financial results and their unproven ability to sustain growth. In addition, the founders of the TEVs would be negotiated to provide commitment to the venture through additional personal equity investments and sharing certain power in governance; the new investor might be given the veto power in important operational and strategic decisions. At times, the venture capitalists would demand priority returns in their investment schemes.

For instance they might request early realisation of their investment returns through priority sales of their shares in an initial public offer.

Monitoring of continuing performance was maintained through regular review of financial statements. In particular, the venture capitalist paid a lot of attention to how the equity capital was utilised in various areas of development. Annual budget was initially reviewed and approved by the board of directors with actual expenditures reviewed on a quarterly basis. Such request for and implementation of formal financial reporting was previously not present or delivered in a non-regular basis as the ventures did not have designated staff to take care of the accounting/finance duties. Lacking resources was apparently an excuse for neglecting the financial reporting duties.

Between the quarterly reviews, the firm would require meetings with the senior executives to understand the latest progress, particularly in development of new products and acquisitions of new customers, which were perceived as critical non-financial information that could unveil underlying risks and opportunities within an emerging technology company. Especially during a venture's early stage, uncertain factors were more apparent than its later expansion-stage of charted growth; its investors would require frequent updates to reveal the latest developments. This phenomenon reinforced the opinions about the importance of formal meetings with the management reflected in the survey.

Regarding the types of resources required, the venture capitalist pointed out talented management was the core asset within a venture. Initial funding was largely used to maintain the core management team. The initial periods of development and growth depended greatly on the founding executives' ability to execute the business plan effectively and efficiently. The founding executives needed to utilise the limited resources carefully and to demonstrate their ability to deliver performance before additional equity funding or debt financing could be granted. For the same reason, it was inevitable that the TEV had to maximise the resource utilization within the young organisation through active coordination and focusing on the core objectives. Acquisitions of other resources, such as infrastructure, facilities, system development, would have to be delayed until the time when they became a necessity to the operations in serving the customers. In fact, it was suggested that these expenditures in substantial amounts should only be acquired when noticeable growth was observed; funding from the next round of expansion financing could be used for such asset acquisitions crucial for scalable growth.

Subsequently, an interview was launched with a senior manager in a wireless technology venture of early-stage development. When asked about the most important type of resources for the company, he pointed out two elements which were urgently needed. Additional talented staff in the research and development was much needed by the young organisation for future growth. He noted that timely delivery of reliable and innovative solutions to his clients was very critical to his business. However, it would take time to train up a development engineer; alternatively, it was expensive to recruit an experienced one from the job market. To facilitate a flexible solution for growth, he then emphasised the importance of having additional financial capital as the resource to acquire other forms of recurring resource, particularly Human Capital.

As a senior executive, he had been involved in activities related to investor relationship management and formulating plans for additional equity financing for business expansion. He remarked that he had been an executive of multi-disciplines, handling issues from technology management, operations, to working capital management. As his TEV had been growing steadily, he needed additional executives to focus on functional responsibilities and therefore allowed him to spend time in strategic level of management activities, such as planning for the company's future. Furthermore, he intended to have the additional financial capital to acquire certain computer facilities which became increasingly necessary for an expanded scale of operations, in order to safeguard the company's proprietary software and systems.

4.4 Cases of Expansion-Stage

In this section, two groups of cases, each comprising six TEVs that had gone through the expansion-stage, were introduced. These cases were analysed in-depth in terms of resource allocation through longitudinal analysis. Research method utilised in this study was regarded as case studies, based on a series of data analysis of disclosed qualitative and quantitative information in the annual reports that provided relevant data about the emphasises on resources based on the same set of PIs adopted earlier. Analysis of the two selected groups of companies was performed with a combination of evidence, based on both financial and non-financial disclosures of these publicly listed companies. Specifically, the study evaluated the qualitative disclosures of relevant matters and flow of specific resources as provided in the samples' historical financial statements against their business performance in revenue generation during a prescribed period, which passed through the point of IPO in order to examine any possible correlations existing among the critical factors under evaluation.

4.4.1 The Case of Wireless Technology Companies

Introduction

The first case study was based on critical review of the disclosed financial information of six selected wireless technology companies in Canada, where clusters of successful wireless technology ventures were nurtured. These companies were considered successful examples in their early growth and development as all of them had gone through IPO. The information utilised in the analysis comprised quantitative data from published financial disclosures of these companies and qualitative materials extracted from their 10-k reports. The initiative was to investigate the disclosure patterns and resources allocation in accordance to the key component categories of intellectual capital as specified in the PI taxonomy in Section 3.3. Data were collected systematically according to predetermined proxies for each PI in order to examine the disclosure patterns.

Development of Wireless Technologies

During the 1990s, the liberalisation of the mobile telecommunication industry and continuously improved capability of wireless data transmission created opportunities for new technology-based ventures among wireless software developers that provided innovative applications to end-users. Constant growth was projected in usage of wireless devices by the consumers as well as corporate users in the coming years; such projected strong growth in this emerging sector was in turn expected to create an emerging, critical value-chain in the wireless industry (Gulati, Sawhney and Paoni 2003). In light of this development potential for growth, new entrants had been participating actively in building up this newly created value-chain since the late 1990s. This particular emerging technology sector, demanding timely, continual technological innovation and intellectual capital, provided a relevant case of study about the phenomenon of resources management and dynamic flow of intellectual capital that could influence the performance of emerging wireless technology companies in terms of sustainable growth during the expansion-stage.

In Canada, research and development in information and communications technologies had been supported strongly by the government with tax incentives as well as programmes that attracted foreign investors in the sector (Industry Canada 2005). Clusters of wireless technology companies emerged in Vancouver, Calgary and Toronto areas. Local research projects advocated innovation in broadband wireless access, smart antennas, software radio, "last mile" solutions and wideband orthogonal frequency division multiplexing (OFDM). Both university and government collaborations enabled development of global standard of excellence. The Wireless and Inter-Networking Systems Experimentation Laboratory established to test new wireless concepts, prototypes and products and to facilitate international co-operations in mobile systems, broadcasting and coding as well as broadband and network protocols.

The Selected Companies

The sample of the first case was composed of six selected wireless technology companies in Canada. They were listed companies recognised as among the 20 most successful examples in the industry by the Brampton Group[49], an independent industry researcher and consultancy company based in Toronto. It was however difficult to estimate the population of wireless technology-based companies as a large number of start-ups in their early stage of development might not be widely and formally recognised. Nor was there a database that systematically reported on their population in the industry and their continuity.

Disclosures of the selected companies' annual reports and attached financial statements were obtained through their respective corporate websites as well as respective security exchanges that provided online research facilities to the public. In addition, up to four years of 10-k and annual reports from each of these publicly listed companies were reviewed, particularly notes to the financial statements. Relevant data was extracted from these listed technology companies' respective annual reports, reported financial statements, including Income Statements, Balanced Sheets and Cash Flow Statements.

[49] Brampton Group is a private organisation based in Canada that regularly publishes listing of outstanding companies in the country.

Disclosures Analysis

To explore the disclosures pattern of the six wireless technology communication companies, proxies were adopted for each of the PIs under the fours components of IC. The data collection and analysis method was simulated on the content analysis approach previously utilised by Abeysekera and Guthrie (2004), which examined the frequency of disclosures based on the line count technique. Furthermore, limited quantitative analysis of three reported financial accounts – research and development expenditures, capital expenditures and revenues generated in a fiscal year was performed to complement the content analysis. The aim was to review the amount of internal financial resources allocated into the former two items that mainly represented the utilization for the development of Innovation Capital and Structural Capital respectively. For the amount of revenues generated within the year, it represented the successful completion of transactions of sales of products and services to the customers, which inherently represented effective acquisition of Customer Capital. The following table provides a summary of the disclosures analysis for the wireless communication companies over their four years of post-IPO expansion operations. Details of individual firms' data can be found in the

Appendix D.

Code	FIt	Proxy	Year-1 Disclosures	Year-1 Index	Year-2 Disclosures	Year-2 Index	Year-3 Disclosures	Year-3 Index	Year-4 Disclosures	Year-4 Index
H1	Founders and Senior Management's experience in industry	Average years of senior management's experience in industry/indexed	62	1.00	74	1.20	76	1.23	72	1.16
H2	Education/ qualification	Median -- Disclosure about education/qualification (0=no, 1=yes)	0		0		0		0	
H3	Staff retention policy	Median -- Disclosure about staff retention (0=no, 1=yes)	0		0		0		0	
H4	Stock options	Median – Availability to management and staff (0=nil, 1=key management, 2=other staff)	2		2		2		2	
H5	Training and development	Total Frequency of Disclosure	2		3		3		1	
H6	Multidisciplinary team	Total Frequency of Disclosure	14		12		11		8	
I1	Research and development capability	Total Frequency of Disclosure/Average Change in Expenditures (indexed)	34	1.64	43	1.88	33	2.46	41	2.92
I2	New product development cycle	Total Frequency of Disclosure	16		18		17		19	
I3	Innovation culture	Total Frequency of Disclosure	8		11		7		13	
I4	Generation and execution of new ideas	Total Frequency of Disclosure	0		1		0		0	
I5	Responsiveness to market changes	Total Frequency of Disclosure	91		118		143		124	
I6	Absorption capacity for emerging technologies	Total Frequency of Disclosure	21		24		26		18	
S1	Establishment of infrastructure	Total frequency of disclosure/ capital expenditures (indexed)	13	1.12	16	1.02	19	3.13	12	1.73
S2	Enterprise resource planning system or similar information system	Total Frequency of Disclosure	17		22		19		15	
S3	Administrative / organizational policy	Total Frequency of Disclosure	6		6		10		9	
S4	Supply chain management system	Total Frequency of Disclosure	1		1		2		4	
S.5	Quality management system (including manufacturing activities as appropriate)	Total Frequency of Disclosure	6		7		12		9	
		Total Frequency of Disclosure	0		0		0		0	
C.1	Established customer and related relationship management	Total Frequency of Disclosure	103		88		124		119	
C.2	Customer relationship management system	Total Frequency of Disclosure	4		4		4		6	
C.3	Delivery of products, services and solutions to customers	Financial information on generation of sales (indexed)	n.a	1.96	n.a	2.19	n.a	2.38	n.a	2.47
C.4	Acquisition of customers, market channel development,	Merged with C.1								
C.5	Handling customer complaints	Total Frequency of Disclosure	0		0		0		0	

Table-11: Disclosures analysis for the wireless technology cases [50]

[50] The numbers represent the means of each indicator, except for H2, H3 and H4 which are represented by their medians.

Human Capital

The first Human Capital PI provided the indication about the gradual growth in average years of experience of the key management team members during the beginning few years. The growth however appeared to slow down in the later years. Some of them had even reduced the number of key management staff in their disclosures causing a decrease in the total number of years of experience of the senior executives reported. It was also noted that less than half of the selected companies had reported the education and qualification of their senior executives but their prior industry experience.

All of the companies implemented a stock option plan for their management and some of them also made the plan available for other qualified employees. On the other hand, there was few of them that mentioned about presence of any staff retention policy and training and development activities among the staff. The emphasis of team or teamwork was reported more frequently in the earlier years but seemed to diminish in the later years.

Innovation Capital

The most frequently disclosed items among the wireless communication companies were related to issues about market development and the companies' responding measures to the market changes. There was evidence about the strong emphasis on research and development activities representing the second highest frequency among other Innovation Capital PIs, next to the disclosures about activities that were driven to matters in response to the market changes. Such evidence was complemented with the steadily increasing amounts of financial resources allocated into research and development expenditures. Most of these companies had consistent expenditures in research and development activities, primarily related to salaries of technical staff, engineering materials for prototype development, software tools, information system infrastructure support as well as sub-contracted research and development costs. Some of them received government funding for specific research and development activities.

There were also steady reports on new product development throughout the initial post-IPO years. Discussion about emerging technologies was another area that constantly appeared in the annual reports; there were relatively less disclosures about the concept of innovation and the generation of new ideas for the business. The most frequently disclosed items among the wireless communication companies were related to issues about market development and the companies' responding measures to the market changes.

Structural Capital

Emphasis on development of infrastructure and systems seemed to increase gradually in the early years but reached its high in the third year. Disclosures about capital expenditures for new facilities, computer systems and other fixed assets also substantiated the frequency of disclosures about the infrastructure and management system developments. There were growing disclosures about internal policy, supply chain management and quality management systems. The emphases on supply chain management and quality management issues tended to become steady in the later years after initial escalation.

Customer Capital

While it was difficult to differentiate among the different PIs under Customer Capital in the annual report disclosures, the analysis had focused on the frequency of disclosures about activities and initiatives to acquire customers, to enhance products for customers and to improve services to customers, etc. Such disclosures were as frequent as those regarding market changes under Innovation Capital. The growth in discussion about customers was quite steady and reflected the management's consciousness about the importance of paying strong attention to the market and end customers during the expansion phase of their companies. Under this category, sales revenues generated in the periods were also collected in order to reveal the performance in completing sales transactions to their customers.

To further unveil the key resources allocated into Human Capital, Innovation Capital and Structural Capital in relation to revenue generation in each year post-IPO, the following line chart is plotted using the respective reported figures on the average years of experience of an executive team, research and development expenditures as well as reported capital expenditures based on an indexation between the current year and the initial year data.[51]

[51] Emory and Cooper (1991) noted that it might be desirable to combine different measures into a single index when there were several dimensions of a concept. The graphical presentation aims to enable comparisons of the changes in emphasis of resources during the expansion period.

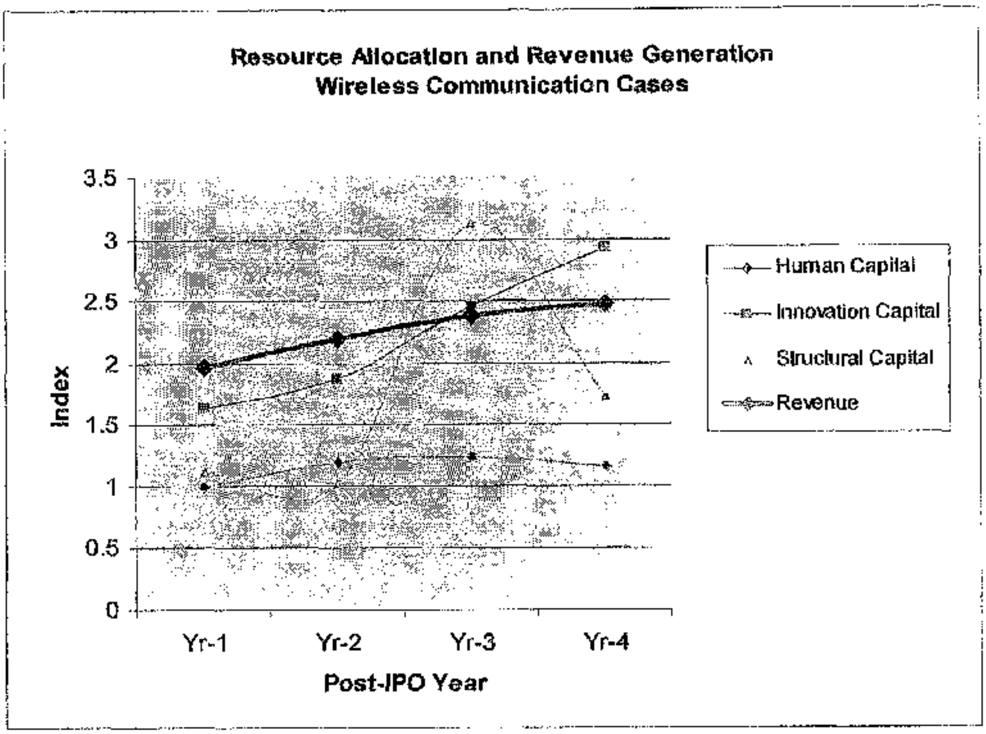

Figure-23: Resource allocation and revenue generation for the wireless technology cases

Significance of results

This above analysis revealed the underlying relationship between their respective emphasis on the components of intellectual capital and their business growth and performance during expansion. It demonstrated an emerging pattern of resource varying emphasis among the fast growing technological innovators under technological change and uncertainty within an emerging technology sector. Such an emerging pattern enabled understanding of the resource allocation processes in which investments in Human Capital were in fact maintained and complemented with Innovation Capital and Structural Capital. It noted the prominence of proper infrastructure and facilities during the early period of expansion. The dynamic requirements in the type of resources for TEVs during expansion appeared to be rationalised given the availability of additional financial capital available through the IPO equity raising exercise.

Research and development expenditures as the key association with Innovation Capital were found to be consistently applied during the period to enable development of new products and services. During the prescribed expansion period, it was frequently reported about the business activities involving the development of new products and services in scalable terms that were facilitated by adequate investment in infrastructure capital that could enhance systematic delivery of products and services. The wireless communication companies showed the need to invest in development infrastructure and internal systems during their growth. While Innovation Capital alone did not represent a single factor that could positively induce immediate business growth, the cases under study demonstrated the constant allocations into research and development into new products and services. An important observation was that mere focus on allocating resources to Innovation Capital without adequate resources for Structural Capital was not apparent in the organic growth of a wireless communication TEV during the period of expansion despite its early focus on development of software and other intangible assets.

4.4.2 The Case of Semiconductor Companies

Development of Semiconductor Companies

Intensifying competition combined with technological innovation in the semiconductor industry had continuously altered the landscape of the semiconductor industry. The industry espoused the self-fulfilling prophecy of Moore's Law, which stated that the number of transistors that could be engaged onto a silicon slice would double every one to two years. Not only would the size of transistors become smaller and smaller, but the speed of microprocessors would also surge with better system reliability and lower drive on power consumption, as time moved forward (Gulati, Sawhney and Paoni 2003). Moore's Law had explained the pace of introduction of new microprocessors and related computer products and facilities. This constant progress was expected to extend in a continuous cycle for the semiconductor industry and the future trend would be driven by the desire for miniaturization of computer products and the continuously increasing computer power.

Looking ahead at the future development of the semiconductor industry, researchers were concerned about the challenges for semiconductor companies from disruptive factors that would create obstacles to their sustainable growth. First of all, there were four key technological challenges for the on-going size miniaturization of transistors: (i) limitation caused by CMOS transistor gate oxide, (ii) maximum limit to the use of dopants in chips, (iii) transistor interconnectivity problems, and (iv) lithography limits. To deal with these major technological challenges, it would require tremendous efforts by scientists and engineers to work on respective technological solutions through research and development activities. Semiconductors companies were compelled to put resources to research and development for technological innovation; however, at the same time, they needed to be aware of the increasing costs associated with research and development. Moore's Second Law suggested that the cost of manufacturing chips would double every four years, creating a financial constraint to the pace of technological progress. In fact, it was revealed that the industry's research and development investments had amounted to about 13 percent of sales per year for the next generation of products to be delivered in two to three years (Gulati, Sawhney and Paoni 2003).

The researchers predicted that there would be uncertainties associated with the future development of semiconductor sector. The sector would be further complicated by disruptive technologies, such as quantum computer, DNA computing as well as nano-technology. Individual companies had to rationalise the utilisation of limited internal resources to effectively deal with the dynamic outcomes from the unpredictable future, which could be led by non-linear growth and strategic points of inflection (Grove 2001).

The Selected Companies

The sample of the second group of cases was composed of the six selected semiconductor companies, all of them based in the U.S. These six companies were constituent entities of the Philadelphia Semiconductor Sector (SOX), a price-weighted index composed of 18 companies primarily involved in the design, distribution, manufacture, and sale of semiconductors. These six companies in SOX were selected for their IPO listing in the mid 1990s and their growth experience in going through the expansion stage with substantial amount of capital raised from the capital market.

Disclosures of the selected companies' financial information were obtained through their respective corporate websites as well as respective securities exchange that provided online research database to the public. In addition, initial five years of 10-k and annual reports of each of these publicly listed companies were reviewed, particularly on the section of Management Discussion & Analysis and notes to the financial statements. The initiative was to investigate the disclosure patterns and resources allocation in accordance to the key component categories of intellectual capital as specified in the PI taxonomy in Section 3.3. Data were collected systematically according to predetermined proxies for each PI in order to examine the disclosure patterns.

Disclosures Analysis

To explore the disclosures pattern of the six semiconductor companies, proxies were adopted for each of the PIs under the fours components of IC. The data collection and analysis method was simulated on the content analysis approach previously utilised by Abeysekera and Guthrie (2004), which examined the frequency of disclosures based on the line count technique. Furthermore, limited quantitative analysis of three reported financial accounts – research and development expenditures, capital expenditures and revenues generated in a fiscal year was performed to complement the content analysis. The aim was to review the amount of internal financial resources allocated into the former two items that mainly represented the utilization for the development of Innovation Capital and Structural

Capital respectively. For the amount of revenues generated within the year, it represented the successful completion of transactions related to sales of products and services to the customers, which inherently represented effective acquisition of Customer Capital. The following table provides a summary of the disclosures analysis for the semiconductor companies over their four years of post-IPO expansion operations. Details of individual firms' data can be found in the Appendix D.

Code	PIs	Proxy	Year-1 Disclosures	Year-1 Index	Year-2 Disclosures	Year-2 Index	Year-3 Disclosures	Year-3 Index	Year-4 Disclosures	Year-4 Index
H1	Founders and Senior Management's experience in industry	Average years of senior management's experience in industry/Indexed	125	1.00	136	1.09	147	1.17	152	1.22
H2	Education/ qualification	Median – Disclosure about education/qualification (0=no, 1=yes)	0		0		0		0	
H3	Staff retention policy	Median -- Disclosure about staff retention (0=no, 1=yes)	0		0		0		0	
H4	Stock options	Median – Availability to management and staff (0=nil, 1=key management, 2=other staff)	2		2		2		2	
H5	Training and development	Total Frequency of Disclosure	2		2		2		3	
H6	Multidisciplinary team	Total Frequency of Disclosure	6		1		2		2	
I1	Research and development capability	Total Frequency of Disclosure/Average Change in Expenditures (indexed)	67	1.59	56	2.45	71	3.29	66	3.73
I2	New product development cycle	Total Frequency of Disclosure	51		68		64		62	
I3	Innovation culture	Total Frequency of Disclosure	7		12		14		11	
I4	Generation and execution of new ideas	Total Frequency of Disclosure	0		0		0		0	
I5	Responsiveness to market changes	Total Frequency of Disclosure	116		132		152		158	
I6	Absorption capacity for emerging technologies	Total Frequency of Disclosure	59		69		71		82	
S1	Establishment of infrastructure	Total frequency of disclosure/ capital expenditures (indexed)	15	2.05	18	2.92	14	2.72	14	2.38
S2	Enterprise resource planning system or similar information system	Total Frequency of Disclosure	75		78		93		94	
S3	Administrative / organizational policy	Total Frequency of Disclosure	17		17		11		15	
S4	Supply chain management system	Total Frequency of Disclosure	26		30		29		30	
S.5	Quality management system (including manufacturing activities as appropriate)	Total Frequency of Disclosure	40		55		52		57	
		Total Frequency of Disclosure	0		0		0		0	
C.1	Established customer and related relationship management	Total Frequency of Disclosure	102		121		135		107	
C.2	Customer relationship management system	Total Frequency of Disclosure	6		10		11		11	
C.3	Delivery of products, services and solutions to customers	Financial information on generation of sales (indexed)	0	1.70	0	2.54	1	2.57	0	2.97
C.4	Acquisition of customers, market channel development	Merged with C.1	[redacted]							
C.5	Handling customer complaints	Total Frequency of Disclosure	0		0		0		0	

Table-12: Disclosures analysis for the semiconductor cases [52]

[52] The numbers represent the means of each indicator, except for H2, H3 and H4 which are represented by their medians.

Human Capital

The first Human Capital PI provided the indication about the gradual growth in average years of experience of the key management team members during the beginning few years. The growth was steady in the earlier years but appeared to slow down in the later years. Some of them had adjusted the number of key management staff in their disclosures suggesting that there might be an optimal number of years of experience of to be found among the semiconductor cases. Resembling the other technology sector, it was also noted that less than half of the selected companies had reported the education and qualification of their senior executives but their prior industry experience.

All of the companies implemented a stock option plan for their management and some of them also made the plan available for other qualified employees. However, there was only a minority that mentioned the presence of any existing staff retention policy and or training and development activities among the staff. Similar to the wireless communication cases, the emphasis of team or teamwork was reported more frequently in the earlier years but seemed to diminish in the later years.

Innovation Capital

The most frequently disclosed items among the semiconductor companies were related to issues about global market development and the companies' responding measures to the market changes. Such disclosures continue to increase in the later years. There was evidence about the strong emphasis on research and development activities representing the third highest frequency among other Innovation Capital PIs, next to the disclosures about emerging technologies and activities that were driven to matters in response to the market changes. Such evidence was complemented with the steadily increasing amounts of financial resources allocated into research and development expenditures. Most of these companies had consistent expenditures in research and development activities, primarily related to salaries of technical staff, prototype development, hardware and software development, information system infrastructure support as well as sub-contracted research and development costs.

There were also frequent reports on new product development throughout the initial post-IPO years. It was clear that continuous new product development was critical among the semiconductor cases. Discussion about emerging technologies was another area that constantly appeared in the annual reports; however, there were relatively less disclosures about the concept of innovation and the generation of new ideas for the business.

The most frequently disclosed items among the semiconductor companies were related to issues about global market development and the companies' responding measures to the market changes. Such disclosures continue to increase in the later years.

Structural Capital

Emphasis on development of infrastructure and systems seemed to increase gradually in the early years but reached its high in the second year. These companies also showed increased capital expenditures in manufacturing facilities, production capacities and computer equipment during the beginning two years and slowed down thereafter. Disclosures about capital expenditures for new facilities, computer systems and other fixed assets also substantiated the frequency of disclosures about the infrastructure and management system developments. There were growing disclosures about internal policy, supply chain management and quality management systems. The emphases on supply chain management and quality management issues tended to become steady in the later years after initial escalation. Quality management system was an area demonstrated to be increasingly emphasised by the semiconductor companies during their expansions.

Customer Capital

As it was difficult to differentiate among the different PIs under Customer Capital in the annual report disclosures, the analysis had focused on the frequency of disclosures about activities and initiatives to acquire customers, to enhance products for customers and to improve services to customers, etc. Such disclosures were nearly as frequent as those regarding market changes under Innovation Capital. The growth in discussion about customers was quite steady and reflected the management's consciousness about the importance of paying strong attention to the market and end customers during the expansion phase of their companies. Customer relationship management activities were also constantly disclosed in the annual reports. Under this category, sales revenues generated in the periods were also collected in order to reveal the performance in completing sales transactions to their customers.

To further unveil the key resources allocated into Human Capital, Innovation Capital and Structural Capital in relation to revenue generation in each year post-IPO, the following line chart is plotted based using the respective reported figures on average executive team's experience, research and development expenditures as well as reported capital expenditures based on an indexation between the current year and the initial year data.[53]

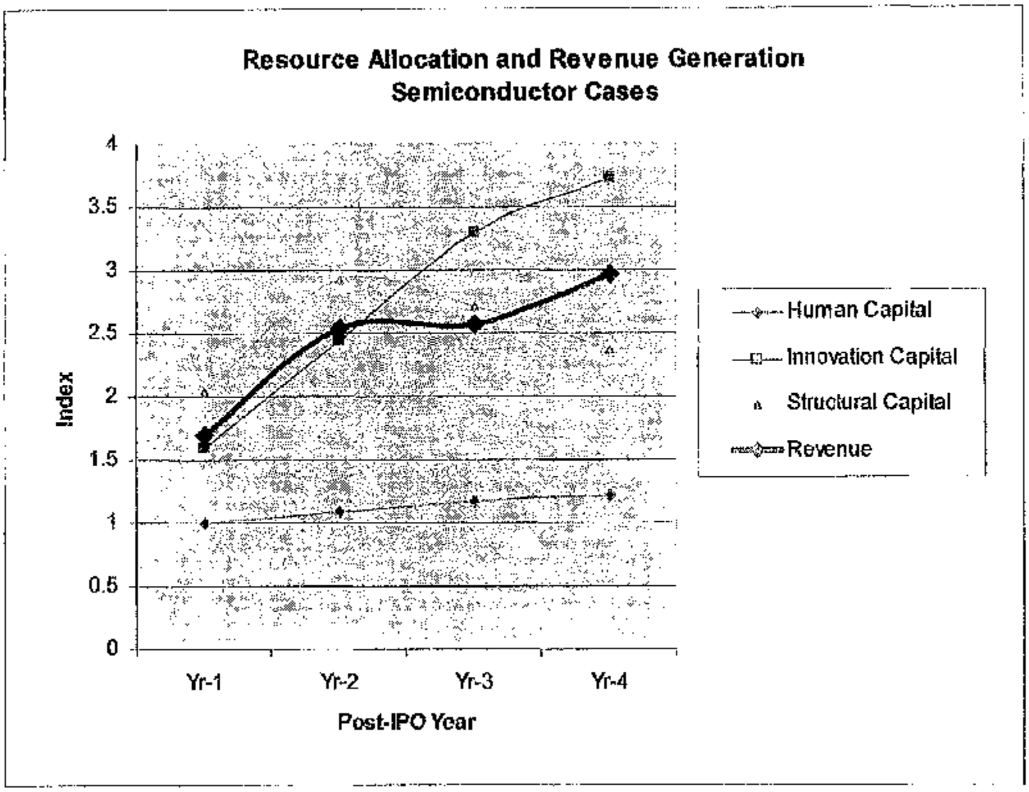

Figure-24: Resource allocation and revenue generation for the semiconductor cases

[53] Emory and Cooper (1991) noted that it might be desirable to combine different measures into a single index when there were several dimensions of a concept. The graphical presentation aims to enable comparisons of the changes in emphasis of resources during the expansion period.

Significant of results

The above analysis revealed the underlying association between the TEVs' respective emphasis on the respective components of intellectual capital and their business growth and performance during expansion. It unveiled an emerging pattern of resource distribution among the fast growing technological innovators under technological change and uncertainty within an emerging technology sector. Such an emerging pattern during the expansion years enabled understanding of the fundamental concept in resource allocation in which investments in Human Capital needed to be maintained and complemented with Innovation Capital and Structural Capital. Resembling the other technology sector, it indicated the prominence of proper infrastructure and facilities especially for the semiconductor companies' requirements of internal production capacities. The dynamic requirements in resources for TEVs during expansion needed to be rationalised in order to sustain growth.

As suggested in prior research, research and development activities were given strong emphasis due to the perceived impact on market value of the company through creation of strategic options for growth (Lev 1999). During the prescribed expansion-growth period, critical activities involving the development of new products and services in scalable terms appeared to be facilitated by adequate investment in infrastructure capital that could enhance systematic delivery of products and services. The semiconductor companies showed the need to development infrastructure and internal systems to a certain level. While Innovation Capital alone did not represent a single factor that could positively induce immediate business growth, the cases under study demonstrated their constant and increasing allocation into research and development into new products and services. The analysis suggested that mere focus on allocating resources to Innovation Capital without adequate resources for Structural Capital was not apparent in the organic growth of a TEV during the period of expansion. While Innovation Capital alone did not represent a single factor that could positively induce immediate business growth, the cases under study demonstrated their constant and increasing allocation into research and development into new products and services. Continuous resource allocation into Innovation Capital was demonstrated to be indispensable among these growing TEVs.

4.4.3 Similarities and Differences Between the Two Sectors

Despite the fact that both wireless application and semiconductor companies required timely technological innovation, companies in these two sectors tended to have differences in their resource allocation processes into the three observed components of intellectual capital – Human Capital, Innovation Capital and Structural Capital. Semiconductors had a relatively more significant emphasis of financial resources on Structural Capital than wireless communication applications largely due to the requirements of large-scale manufacturing facilities for the necessary production capacity. Semiconductor companies also tended to allocate resources into Structural Capital in a faster pace after the point of IPO.

Continuous allocation into Innovation Capital was found significant in both semiconductor and wireless communication application companies and appeared unavoidable for competition in sustaining technological innovation with new product development and advancement. In particular, it was observed that semiconductor companies' complementary resources with Innovation Capital were necessary for their organic growth during the earlier years, demonstrating the importance of both tangible and intangible assets. Similar combined effect was reflected in the case of wireless communication companies despite the expected variations in the process of technological innovation and differences in product lifecycles. In absolute terms, despite wireless communication companies' significantly less investments in Structural Capital, their organic growth seemed to be complemented by gradual emphasis on Structural Capital that facilitated development of systems and infrastructure required for delivery of solutions. In assessing the characteristics of Innovation Capital, it was quite obvious that companies of both sectors demonstrated their increasing emphasis on the sensitivities to external market development and the emerging technologies that were relevant to their new product development. Semiconductor firms appeared to pay an even higher attention to such external development that the wireless communication application companies under this study.

In both cases, the companies demonstrated that Human Capital was a critical resource for business growth. Companies in both sectors constantly built up its senior management team with multidisciplinary functions during the expansion years. However, these companies tended to adjust the composition of senior management team during the later years suggesting an optimal level of Human Capital in terms of total years of experience and diversity in functions. All in all, in order to maintain steady business growth, these emerging technology companies showed that consistent injections of external resources into the three components of intellectual capital at stages was needed to sustain their organic growth. This disclosures analysis of these cases reflected the importance of maintaining certain balanced approach of resource injection in recurring Human Capital, Innovation Capital with the combined effort from Structural Capital.

With respect to Customer Capital, it was observed that the incremental focuses on dealing with existing customers and acquisition of new customers were found in the disclosures. There was however difficulty in identifying resources allocated into development of Customer Capital but the generation of revenues itself which represented the completion of sales transactions with customers in a growth pattern – a perceived outcome of steady emphasis on other intellectual capital components.

Chapter 5

5. FINDINGS AND CONCLUSIONS

5.1 Introduction

This Chapter provides a summary of the key findings in this research from the independent sources of evidence, consisting of both complementary and contradictory points of view and facts, in search of the resulting conclusions for the research questions. In particular, the triangulation approach was revisited in analysing the main sources of data and the communal areas that would augment the validity and reliability of the results in this research. The following section first of all provides a summary of evidence from the independent sources, followed by individual addresses to the main research questions. Discussion and conclusions are delineated at the end of this Chapter.

5.2 Summary of Evidence

The evidence collected from independent sources contained primarily survey, interviews, company visits, internal documents, company brochures, and other published information. The secondary data was publicly available financial information. Such financial information, largely audited financial statements, was obtained in annual reports and annual filings to the stock exchange regulator. Notes to the financial statements were reviewed in order to understand the type of assets and resources associated with particular capital expenditures and the assumptions for recording specific transactions. Additional qualitative information was obtained from press releases, the Management Discussion and

Analysis section from the annual reports, as well as respective corporate websites that disclosed corporate information and scope of business.

Evidence for the first main research question relied mainly on results from the survey complemented with interviews to find out further details and possible rationale behind the consensus from the survey. Specific views were collected through the survey to explore attitudes of venture capital and private equity firms about their current practice in performance management of TEVs. The research and data analysis approach adopted in tackling the second and third research questions was based on the triangulation of evidence to search for the converging results from the independent sources of evidence.

5.3 Key Findings

This section provides a detailed analysis of the key findings, which address the three main research questions raised in Section 3. These questions are reiterated as follows:

Part-1

a. For equity stakeholders and key resource providers in technology-exploiting ventures (TEVs), what is the current practice in monitoring performance of their portfolio companies?

b. What are the attitudes of venture capital and private equity firms towards monitoring performance of their portfolio TEVs? [54]

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[54], [16] Balanced scorecard was recognized as an effective management tool for performance management of organisations (Kaplan and Norton 1996). Technology-exploiting ventures, however, might require different perspectives and modifications from the conventional framework and performance indicators. In particular, Neely discussed about changes in environment and conditions that would alter the performance requirements as an organisation continues to

Part-2

a. Given the importance of resource allocation and requirements of intellectual capital for TEVs, how could resource allocation, in consideration of the *priority*, be made effective for growth and development of the TEVs? [55]

b. What should be the relevant key PIs among TEVs during early stage and expansion stage? [56]

Part-3

a. To optimise business performance from resource allocation, what should be the components and appropriate mix of resources (or components of intellectual capital) at early stage and expansion stage of growth and development of the TEVs?

b. How would timing and sequence of allocation of external resources affect the growth and business performance of such new ventures and provide any possible predictability of generation of revenues? [57]

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develop (Kennerley and Neely 2002, 2003). Other researchers in the field of business venturing discussed about the uncertainty during a venture's growth at different stages (Shane 2004). Resource-based view shared the concerns about resources requirements for the growth of a firm. (Penrose 1959). However, there have been few studies about performance measurement system for technology-exploiting ventures.

[55] Contemporary research on intellectual capital has argued about how different components of intellectual capital, namely human capital, innovation capital, structural capital and customer capital, among other resources, could affect performance of an organisation (Chen and Xie 2004) (Wang and Chang). Other researchers have explored the interrelationship among these components. While these studies had also been focused on the cause-effect analogy, there was insufficient analysis on the sequential combination of resources allocated to the corresponding components of intellectual capital and the resulting effect on performance and in particular the growth of a technology-exploiting venture, given the limited resources available. This question would be explored in association with the question raised in Part-2.b. on PIs.

The following three respective sections were the key findings summarised in response to the above three main research questions, making use of multiple sources of evidence based on the triangulation approach proposed in Section 3.5.5.

5.3.1 Current Practice of Venture Capital Firms' Performance Management and Pertinent Attitudes

In response to Part-1 of the research question, the results of the survey as detailed in Section 4.2 unveiled the current practice in performance management, adequacy of information received, critical PIs and perception about possible improvement. The equity stakeholders who maintained the immediate economic interests about delivery of performance from their invested ventures were expected to reflect their pragmatic opinion about ways to monitor performance in an effective manner. As reinforced by the interview with the venture capitalists, the key equity stakeholders, it was noted that time was a constraint for the professional investment managers to exercise performance monitoring and control as they were typically responsible for a portfolio of investee companies. Traditional monitoring through reviewing financial and management reports from the invested TEVs was realised as a common practice among the respondents. In order to complement with the historical financial information, meetings were arranged with

[57] Although prior studies on intellectual capital and performance measurement explored the dynamics among the components of intellectual capital, the dimension of time was not taken into as a critical factor in considering the effect on performance as an output (Wang and Chang 2005). This research question attempted to find out how external resource allocated into components of intellectual capital would affect performance taking into the dimension of time.

executive of TEVs to extract qualitative and other relevant business and management information from the ventures.

It was found in the survey that, despite the equity stakeholders' satisfaction with the level of information available for review, the equity stakeholders were keen to improve from the current practice of reporting with additional elements to potentially enhance the quality of information, including the possible implementation of a Balanced Scorecard system.

Intrinsically, information asymmetry, as discussed in Section 2.28, would cause ineffectiveness and inefficiency in performance monitoring of TEVs for the stakeholders, similar to the phenomenon observed in the financial capital market. As suggested in research on information asymmetry associated with ventures, investors of ventures would need to deal with the agency risks due to lack of timely and adequate information (Reid and Smith 2002). Executives of the TEVs, as agents, to the shareholders, might not have the incentives to provide timely and complete information in their financial and management reporting. This discrepancy in information appeared to be comparable in the situation of TEVs, which could be complicated by uncertainties created by emerging technologies and issues related to growth and development.

In fact, the respondents concurred to the potentials of using a performance measurement system to improve from the current performance management and control effectiveness despite the present practice (Section 4.2.1). Currently majority of the participants felt that there was sufficient information available with their TEVs and they tended to monitor performance through regular review of financial statements and management reports from their portfolio companies. Additional monitoring was implemented through formal meetings with the senior executives of the TEVs. Nevertheless, to improve the efficiency in managing the portfolio companies given the time constraint in the work of a professional investment manager, over one-third of the professional investment managers were attracted to the implementation of a Balanced Scorecard or performance measurement system that extracted critical information and delivered critical performance indicators.

On the other hand, the respondents strongly indicated the importance of maintaining a board seat in the board of directors to enhance performance monitoring. As discussed in Section 4.2.1, the use of board seat reflected the concurrence to the importance of corporate governance in a TEV, which would enhance the authority of an equity stakeholder. As a board member, authority could be exercised through board resolutions or through disapproval of execution of certain material business transactions. Nevertheless, it was seen that performance management and control could also be enhanced through the board. The maintenance of a board would secure the necessary authority and power to formalise the demand of timely reporting of business information that was critical and relevant to growth and development of a TEV, as pointed out in a supplementary interview. As such, risks associated with information asymmetry could be mitigated with timely and relevant information about the performance of TEVs. This observation about sharing certain governing power through the board echoed the research on venture governance, which suggested that ventures that were willing to invite directors from external source and to share some of the governing control could enhance their strategic development and business performance (Daily and Dalton 1992).

The use of board seat in combination with a customised performance measurement system represented an opportunity for the equity stakeholders to improve from the current performance monitoring and control of TEVs. The use of board seat was seen by majority of the respondents as positive force to augment performance management of TEVs. Supplementary interview revealed that this combined approach could enhance the current practice of monitoring TEVs provided that a cost-effective implementation of such a system could be achieved. A relevant performance measurement system designed to enhance the role of the board of directors in monitoring key performance drivers and enablers could potentially reduce some of the risks caused by information asymmetry among venture investments. This combined approach was consistent with the prior research in venture governance in which the venture capitalists were found to implement monitoring of their portfolio companies the most at times of uncertainty with the information exchange aiming to mitigate agency risks (Sapienza, Manigart and Vermeir 1999); the result implied the potential of using a performance measurement system to improve from the current practice among the venture capitalists, who were under pressure to operate efficiently and effectively.

5.3.2 Resources Allocation within TEVs

This section provides analysis of the collected evidence in connection with the research question in Part-2 a. In the survey with the equity stakeholders, the respondents expressed their view about the requirements in resources between early-stage and expansion-stage TEVs as provided in Section 4.2.2. The respondents suggested that Human Capital was the most important type of resources needed for business performance and growth in both stages. However, for expansion-stage TEVs, acquisition of experienced executives was found to be more critical as a form of Human Capital than existing internal management, whereas early-stage TEVs would need to maximise the utilisation of their internal existing Human Capital. Financial capital was agreed to be the second most important resource required for growth and development next to Human Capital -- particularly the availability of experienced managers and executives. Infrastructure and development of management systems were suggested to be of lesser importance in comparison with Human Capital and financial capital. This result supported the point of view that Human Capital remained as the leading resource for development of new ventures (Pena 2002), whereas financial capital as the much needed resource for successive development of ventures (Cassar 2004).

Through the in-depth case studies, it was revealed that the early growth and development of TEVs tended to rely heavily on the ability of the founders and senior management to effectively utilise and coordinate the internal resources. These resources of Human Capital, which was led by entrepreneurs with deep and lead-edge industry experience. These individuals provided the leadership and expertise on two main fronts. First of all, they pioneered the development and execution of a business plan that exploited emerging technologies for new business opportunities that had not been fully explored in the past. It was found in these cases that the senior executives needed to involve actively in development of new products and services with the emerging technologies. The development process involved close liaison with the potential end customers who were the ultimate driver for generation of new businesses. Secondly, the senior executives were the main resource coordinator who strived to maximise the usage of existing internal resources and to acquire additional external resources that would facilitate the growth and development of their TEVs. This particular observation reflected similar conclusions from prior research about the importance of resource coordination led by the management (Mills, Platts and Bourne 2003).

The fact of limited resources within TEVs was exposed as the common constraint among the four cases under study. TEVs with effective growth and development processes were found to be capable of acquiring additional resources for expansion. Two most important additional resources were observed to be external "network" and financial resources. External network-based resources were associated with the fact that the founders/executives were able to demonstrate their ability to collaborate with the key industry players through their prior in-depth industrial experience. Such experience and networking ability in the industry allowed them to understand the current technological advancements in the industry and the key strategic players participating in the process.

They demonstrated the ability to promptly execute the business plans with acquisition of new customers for their newly developed products and services. This early proven execution ability enabled them at the same time to gain credibility from suppliers and new potential customers. More importantly, their track record of past performance was proven to be critical information regarding credibility of the management in effectively converting financial resources into intellectual capital that facilitated generation of revenues. Such credit information empowered them to approach new potential investors for the next stage of financing requirements. This finding was consistent with prior research on technology entrepreneurial firms' reliance on internal and external resources, including the use of external networks and social communities, for effective growth and development (Wilson and Appiah-Kubi 2002).

With additional financial capital, these early-stage TEVs tended to take steps in acquiring certain facilities and equipment that were necessary for enhancement of business activities. While some of them would use the additional resources to strengthen their research and development facilities, others would acquire production facilities for the anticipated growth in demand for their new products. Only few of them seemed to pay a great deal of attention to the development of an internal management system yet.

The experiences observed among the four selected cases demonstrated that the two cases of allocating resources - largely financial capital, significantly and constantly into research and development facilities and Innovation Capital for new products and services built up the ability to sustain business growth. With the additional resources, these two cases continued to explore the technological advancement and related applications that were critical to their new products. While they maintained and continued to build the core management team during the early-growth, investments in fixed assets were taken by stages and some of the production/operation-related facilities were outsourced to the extent that they were not so critical to the domain knowledge of the core business. For instance, A.S.2 would maintain all the research and development work as well as quality assurance functions in house; mass production for components of its products would be outsourced to external vendors. However, these early-stage TEVs did not expend significantly into management systems until a later stage in which certain administrative procedures and modules of enterprise resource planning management system were developed. Such systems were seen to be necessary only when a TEV approached the stage of scaling operations at its early slope of significant expansion.

Through longitudinal case studies, the patterns of utilisation and emphases of resources were reviewed among the expansion-stage TEVs. The patterns demonstrated that there was plausibility between the magnitude of resources allocated into the three components of intellectual capital and the amount of revenues generated. For both wireless communication application and semiconductor companies, it was observed that there was recurring resources required to support business growth as well as staged resources that would produce positive impact. Human Capital resembled the recurring resource needed to sustain business performance. This type of resource was used to maintain employees of various functional groups within a TEV. Staged resources were largely composed of

Innovation Capital and Structured Capital. Despite wireless communication application companies' less reliance on fixed assets and production facilities than semiconductor firms, it was revealed that investments in tangible assets, such as computer systems and facilities, which were essential to delivery of products and services to end customers, would still have a significant effect for their business growth at certain stages. The selected wireless communication application companies were found to allocate resources consistently into research and development of new software products and solutions for their end customers. This continual requirement for Innovation Capital did not preclude them from the demand for development of computer facilities, systems and infrastructure to support their business growth and delivery of solutions. In addition, it was observed increasing attention to serving external customers, exploring new customers as well as the emerging technologies that were pertinent to core competence among the TEVs during the period of expansions.

The development of heterogeneous resources was unveiled among the two technology sectors based on the respective analyses. As these TEVs went through stages of expansion, combination of critical resources had a positive impact on business growth significantly not only for the current year but also for a prolonged business cycle. It was also observed that these TEVs tended to continue their allocation of financial resources into Innovation Capital and Structural Capital in a rather expansionary pattern. This particular finding was consistent with the prior research from the domain of resource-based view, emphasising the importance of both intangibles and tangible assets in enhancing organic growth of a firm (Penrose 1959) as well as the development of heterogeneous resources for strategic advantage (Barney 1991).

5.3.3 Performance Indicators for TEVs

With reference the Part-2 b research question, there were three main sources of evidence utilised to analyse the aspects of performance indicators for TEVs, namely opinions from the equity stakeholders, in-depth analysis of the four cases, and results from the longitudinal analysis of secondary data of the two technology sectors. The following sections were organised to review the findings of the key performance indicators as evident from the independents sources for the two stages of development in TEVs. Subsequently comparative analyses were made to explore the differentiations between the two stages as well as commonalities between the two selected technology sectors.

5.3.3.1 Early-Stage TEVs

Through the results obtained in the survey with the equity stakeholders as analysed in Section 4.2., particular opinions were collected towards the importance of a set of performance indicators categorised under the four components of intellectual capital. For early-stage TEVs, the equity stakeholders tended to place strong emphasis on the PIs under Human Capital and Innovation Capital. The experience of the senior executives available with a TEV was found to be the most important indicator, while their prior education was seen as one of the least important factors. There were four performance indicators under

Innovation Capital considered as some of the most important ones, including (i) timely new product development cycle, (ii) culture of innovation, (iii) responsiveness to market, and (iv) ability to generate and execute new ideas. Several performance indicators under Customer Capital, being related to acquisitions of new customers and delivery of effective solutions to the customers, were also given high ratings for the early-stage TEVs. Nevertheless, the equity stakeholders opined that the PIs under the Structural Capital category, such as internal management systems and facilities for operations, were of lesser importance.

Through the in-depth case studies based on the taxonomy of the four components of intellectual capital as documented in Section 4.3, the growth experience of early-stage TEVs was observed to comprehend the array of resources acquired. Among the four TEVs, the prior industrial experience of the founders/senior executive demonstrated to be a very important core competence for these ventures, as a form of Human Capital, to swiftly commence their initiative corporate development, new products and services development, and acquisition of new customers. The Human Capital factor was shown to be the driving force for the ventures to develop into the stage of scalable expansion. Given the limited internal resource and financial capital, the founders/executives needed to be effective in coordinating available resources, internally and externally. Internally, they led and motivated staff to work towards the business goal within a young organisation, making sure their abilities could be fully utilised. With limited budget, the executives were under pressure to ensure that the research and development for new products and services could be completed in a timely fashion. Externally, the founders/executives exploited their prior experience and network in the field to keep up with the latest intelligence about current development in the industry. More importantly, they needed to understand technological advancement and competition in the marketplace. All in all, they had to ensure that their new products and services would be purchased by the targeted end customers. Two of the TEVs, which were able to move closely to the next stage of expansion, acquired at least a major customer account with satisfactory returns.

In addition to Human Capital, the early-stage TEVs allocated significant amount of resources into research and development activities with focused technical teams. In order to support continual product innovation, the TEVs continued to acquire new staff for the function of research and development and to train up new ones in cases where specialists in a particular field were rare. The ventures of successive growth were able to turn emerging technologies into products and solutions for specific customers within a period of time and in a progressive manner. However, the ventures that were able to generate revenues and sustain growth did not tend to invest immediately in mass facilities with external financial capital. Instead, these ventures would gradually acquire new facilities at stages, incrementally. In one particular example, the necessary production processes were outsourced to a third party.

Complementing the in-depth case studies, interview was conducted with the venture capitalists who possessed direct investment experience in TEVs. It was elaborated that the decision to invest was to a significant extent affected by the quality of Human Capital available within a venture. Despite the board seat granted to the venture capital firm to institute influence through corporate governance, it was commented that the experience, capability and "track-record" of the founding executives were imperative to initiate and drive a TEV's growth. For an emerging technology sector, the executives especially needed to understand the dynamics in the marketplace and to actively manage the risks involved. With respect to the resources required for development of Structural Capital, it was expressed that additional financial capital could be raised to allow acquisitions of necessary infrastructure and facilities. It was remarked that the focus for early-stage TEVs in a pre-operational mode was to demonstrate the success in developing innovative products and acquiring anchor customers in a timely fashion.

5.3.3.2 Expansion-Stage TEVs

Through the results obtained in the survey with the equity stakeholders as previously analysed in Section 4.2, similar opinions were collected towards the importance of a same set of performance indicators categorised under the four components of intellectual capital, for expansion-stage TEVs. The equity stakeholders maintained strong emphasis on the PIs under Human Capital but slightly less on Innovation Capital. The experience of the senior executives available with a TEV was found to the most important indicator, while their prior education was again seen as one of the least important factors. Four performance indicators under Innovation Capital remained as some of the most important ones, including (i) timely new product development cycle, (ii) culture of innovation, (iii) responsiveness to market, and (iv) absorption capacity for emerging technologies. Performance indicators under Customer Capital, related to acquisitions of new customers and delivery of effective solutions to the customers, were given stronger ratings for the expansion-stage TEVs than those under the early stage. Nevertheless, the equity stakeholders expressed that the performance indicators under the Structural Capital category became more important during the expansion stage than in the early stage. Performance indicators, which were most prominent, were associated with establishment of appropriate infrastructure and facilities, as well as internal management information systems, such as ERP system and quality management system.

The longitudinal analysis based on the 12 TEVs during the period of expansions showed significant plausibility of financial resources allocated to the three components of intellectual capital with their organic growth. The results suggested these TEVs required a distinctive combination of intellectual capital to effect and sustain business growth. Such formulated resources would enable the TEVs to produce prolonged effect on their expansion. The pattern of resource allocation matched with management's emphasis on specific composition of intellectual capital suggested the significance of balanced resources allocated during the expansion phase of TEVs and the role of infrastructure in facilitating growth to another level. Although specific PIs were not identified from this source of evidence, the demonstrated correlation confirmed a strong linkage between business performance output and intellectual capital. Such relationship could be further measured in respect of the performance drivers and enablers when attached with the corresponding resources.

Complementary interview with the venture capitalists provided insights about the expectation from the equity stakeholders with respect to business performance of expansion-stage TEVs. As early-stage TEVs had gone through a period of rapid development driven by experience-rich founders/executives, it was pointed out that their growth could be limited by scalability in both operations and delivery of products and services in large volume. Positioning for scalable expansions, expansion-stage TEVs needed to acquire computer facilities and systems that were critical for their core competence. More importantly, these TEVs were at their advantage in building up market share for their new products and services as new competitors might emerge to challenge the new opportunities under target. Necessary facilities and infrastructure, strategic to a TEV's expansion, were acquired in a timely manner to support rapid business growth with efficiency in operations.

5.3.3.3 Differentiating Performance Indicators (PIs)

The results from the survey reflected that certain PIs were perceived to be more important in the early stage than in the expansion stage, and vice versa, as discussed in Section 4.2.2.2. The framework that incorporated the taxonomy of intellectual capital components was demonstrated to be relevant in categorising the key PIs into areas of similar nature. Based on the four components of the intellectual capital, it was apparent that early-stage TEVs would need to be monitored in areas of Human Capital and Innovation Capital development in order to enhance growth. For the expansion stage, Human Capital was observed to be similarly important for sustaining growth. Experienced executives were shown to be even more critical as a resource in demand during the stage of expansion than in the prior stage. Formal policy for staff, performance incentive, retention policy and continuing education and training for staff, was perceived to be more important during expansion stage than in early stage. This particular observation was consistent with the TEVs in the in-depth case studies which reflected a gradual emphasis on the implementation of formal human resources policy. For the cases under expansion, it was seen that stock options and other equity-based incentive programmes were critical to be in place in order to stimulate performance of the senior executives.

Among the Human Capital PIs, education of the executives was not evaluated as very critical consideration for both stages. Despite this opinion from the equity stakeholders, the cases from both early-stage and expansion-stage tended to have founders and executive with their first degrees or even graduate studies completed. Most of these executives had well over 10 years of experience in a related industry. Opinion from the equity stakeholders might have rated the importance of education in relative terms to that of experience.

PIs under Innovation Capital were in general founded to be relatively less critical during the expansion stage in comparison with that of the early stage. The particular indicator perceived to be more critical during expansion was the technology absorption capability. Absorption capability reflected the TEV's ability to take up new emerging technologies into product development in a timely and effectively manner. It was inevitable that early-stage TEVs needed to focus on product innovation through exploitation of emerging technologies during their early growth to ensure delivery of business results as early as possible. For expansion-stage TEVs, they further needed to maintain agile in capturing any potential disruptive technologies that would create challenges to their current position. As reflected in the expansion cases, they had invested continuously into research and development activities for areas that would enable them to innovate with the latest technological advancement. Moreover, TEVs in both stages revealed that their responsiveness to market changes was a very critical factor throughout their early growth and subsequent expansion. This finding was observed from both the survey and the in-depth cases.

For the fourth component of intellectual capital, it was identified that PIs embedded in Structural Capital would be more critical for the development of TEVs during expansion-stage than in the former stage. All of the five indicators under this category demonstrated significantly higher ratings for TEVs under expansion. These five indicators included (i) establishment of appropriate infrastructure and facilities, (ii) existence of enterprise resource planning system or management information system, (iii) existence of administrative / organisational policy, (iv) existence of supply chain management system, and (v) existence of quality management system. The difference was the most significant for the first and the fourth indicators.

Reviewing the case studies of early-stage TEVs, it was noted that these TEVs did not pay a great deal of attention on building up infrastructure and systems for the organisation until a later stage when business growth had commenced gradually. The founding management team was mainly responsible for actively maintaining and coordinating a rather flexible internal management system in an unstructured environment in order to fully utilise available resources. Financial resource was frequently viewed as an economic constraint in acquisitions of tangible assets for development of Structural Capital. On the other hand, TEVs during expansion were active in allocating resources to building infrastructure, facilities and systems as reflected in their flow of capital. The importance of quality management system was also noted in the disclosures analysis.

For Customer Capital, the survey results showed that there was a slight increase in the ratings in terms of importance from early stage to expansion stage. Two of the more significant ones were (i) established customer base and related relationship management and (ii) existence of customer relationship management system. This finding reflected the reality that cases of TEVs needed to allocate further resources to retain a strong customer base as they continued to expand. Proper customer relationship management system would enhance their delivery of services and help ensure customer satisfaction.

In the attempt to validate the range of these PIs and to differentiate the characteristics of PIs between the two stages through the independent sources of evidence, it was observed that these PIs possessed the following three main characteristics:

- **Resource-sensitivity.** These PIs under the four components of intellectual capital were proven to be enabled by availability and effectiveness of certain types of resource, namely external financial capital and internal resource coordination, as identified under Section 3.3. For instance, when a TEV reached the stage of expansion, it would require the development of a quality management system to enhance its delivery of products and services to the customers. This would in turn require external financial capital for purchase of necessary information system as well as expertise from management for the system development involved. Other PIs needed to be driven by development of adequate administrative procedures to facilitate performance of management. For example, a TEV would have to set up and formulate the necessary guidelines, procedures and documents, including stock option agreement, which were critical for the performance of Human Capital. This finding about the criticalness of resources to performance was consistent with the prior research from the resource-based view school of thoughts (Penrose 1959, Barney 1991).
- **Time/stage-sensitivity.** These PIs as reflected in the analysis in this section demonstrated to be of varied importance between early-stage and expansion-stage. As a TEV continued to grow and develop, the stakeholders might have to alter the areas of emphasis in evaluating its performance. When a TEV reached the stage of expansion, for instance, the stakeholders would have to look into PIs under Structural Capital as these indicators became more critical for enhancement of

growth than in the past. This notion of differentiating PIs was in fact a resonance of the recent research regarding how different factors would affect the evolution of performance measurement system (Kennerley and Neely 2002, 2003).

- **Interrelationship of factors for performance.** Through the independent sources of evidence, it was found that there were interrelated factors that would affect the organic growth of the TEVs. These factors of individually characterised resource, including elements within the defined structure of intellectual capital, needed to be combined with resource of another type in a different component of intellectual capital, in order to facilitate business growth. The particular combination of heterogeneous resources did not appear to be identical between one firm to another, even for the same emerging technology sector. These heterogeneous resources however should mainly be composed of Human Capital, Innovation Capital and Structural Capital, which altogether would in turn facilitate the development of Customer Capital and consequently completion of business transactions for revenue generation. These characteristics were consistent with the prior studies about resource-based view and the predictive performance of intellectual capital under Section 2.2.6.

5.3.3.4 Observation of the Findings Between the Two Technology Sectors

The two technology sectors under examination in the case studies were wireless communication application and semiconductor at both early and expansion stages. Despite their differences in the market dynamics and technological development processes, certain similarities were observed. For early-stage TEVs in both sectors, their reliance on Human Capital and the background of founding executives resembled each other. These founding executives had substantial prior industry experience in specific areas that were acquainted with the emerging technology sector under development. The successful cases had executives with specific technical background in an engineering field who were previously employed in a large firm with international exposures. These TEVs also tended to build a multidisciplinary team steadily. Their research and development staffing was especially outstanding with capability in delivering new products and services within a timeframe. Semiconductor TEVs seemed to put a strong allocation into research and development for new products. Wireless communication application ones consistently sought innovative, customised solutions for their corporate customers; however, this variation did not preclude wireless communication application TEVs from having consistent investments in research and development activities, especially during the stage of expansion.

With respect to Structural Capital development, semiconductor TEVs made more substantial capital investments in facilities during expansion in comparison with their counterpart. Despite the fact that successful early-stage semiconductor TEVs tended to outsource the production process to a third-party and to focus on design, the more mature ones appeared to maintain their own facilities and continued to build their own infrastructure during expansion. For wireless communication application TEVs, their resources allocated into Structural Capital were in a significantly smaller scale; however, such allocation into elements of Structural Capital was found to be steady during the expansion years. Through the disclosures and resource allocation analysis, it was observed that there was certain relationship between the resource allocated process for Structural Capital and Innovation Capital, and organic growth in both types of TEVs.

5.3.4 Towards an Optimal Resource Allocation Strategy

To explore the issue of optimal allocation strategy for the growth and development of TEVs as stated in Part-3 of the research question, it was necessary to identify and understand various critical factors that would affect such outcome. Evidence collected throughout this research that was useful for this aspect of exploration included opinions from the equity stakeholders, the growth and development experiences of TEVs from the case studies, longitudinal analysis of expansion cases, and supplementary interviews. Utilising such evidence, the following critical factors that enhanced optimal resource allocation for growth were identified and analysed:

- **Constraints of resources.** Given the limited financial capital available with TEVs, they were compelled to fully utilise the resources available internally in order to facilitate growth. Human Capital was usually the core resources relatively more available within an early-stage TEV than the other components. The founding executives in successful TEVs were found to be the prime element of Human Capital that possessed in-depth industry experience, external networks with potential business partners and customers, latest technological development and its implication, and very importantly acting as leadership and building a team. The founding executives took up the role of actively coordinating limited available resources.

- **Differentiating performance enablers and drivers.** It was revealed that PIs would vary in terms of their importance to growth and development of TEVs at the two prescribed different stages of development. Such evolution in performance measurement suggested repositioning by the TEVs with respective changes in allocation of resources required to enable and drive particular performance. Appropriate arrangement of heterogeneous resources was found to be critical to their growth. TEVs did not seem to be capable of sustaining growth with a single focus on one component of intellectual capital. While this observation reinforces the contemporary studies about the necessary development of a dynamic performance measurement system that ought to be modified in responses to the changes in the environment, traditional Balanced Scorecard for organisations in stable operations would require modification in order to be effective for ventures under growth and development.
- **Heterogeneous intellectual capital.** To facilitate growth and development of TEVs, Human Capital was demonstrated to be the leading resource to augment a sustainable process. Human Capital was found to be a dominant factor in both stages; TEVs in the expansion stage had strong dependence on experienced management and executives. Nevertheless, the other two components of

intellectual capital, Innovation Capital and Structural Capital, demonstrated to be significant forces. Innovation Capital would enhance TEVs' future growth through continuous development of new products and capturing emerging technologies in a predetermined manner. Infrastructure as a key part of Structural Capital would enable necessary scalable operations and effectiveness in delivery of products and services. These combined, heterogeneous resources were time-sensitive with respect to their allocation and subsequent influence to organic growth.

- **Predictive performance.** The analysis of the TEVs provided supportive evidence about evolving patterns of allocation of resources in a particular combination and time sequence to their organic growth. Among the cases under in-depth analysis, it was exposed that Human Capital of strong prior industry experience and thorough execution skills appeared to be the prerequisites for driving the TEVs forward. Innovation Capital was remarked as a factor critical in both stages while Structural Capital emerged with respect to its importance only in a later stage of expansion. In addition, the equity stakeholders expressed comparable inclination of resource requirements through identification of the key PIs. These characteristics indicated potential predictability of performance from deployment of adequate resources. Revisiting the Fishbone Diagram under Section 3.3.5, it was entailed that the specific PIs groups under each intellectual capital would be useful in explaining predicative performance. As elaborated in the same section about the linkage of each specific performance indicator to its required resources, PIs could be examined with the view point of the availability of resources for specific delivery of performance. The studies collectively provided supportive data as well as ethnographic evidence about the underlying relationship. As such, differentiating PIs could be adopted by resource providers to evaluate critical resources that should be deployed to enhance growth.

- **Staged investment approach.** It was observed in the research that allocation of financial capital to various components of intellectual was taken by stages. Unlike traditional capital expenditures in large infrastructure projects with lump sum amounts, direct investments by TEVs tended to be committed incrementally as they continued to expand successive business growth. One TEV case that had invested heavily into manufacturing facilities during its early years experienced constraint of resources required for Innovation Capital. That particular case then fell behind in its technological innovation and new product development. A balanced approach in allocating resources at appropriate stages of growth was demonstrated to be critical in sustaining competitiveness and growth. An implication from this approach is to the calculation of financial return for the equity stakeholders as the discounted cash flow or EVA[58] method is adopted to access the their investment in TEVs. Deferral of unnecessary financial capital outflow and sustained revenue growth would positively improve their estimated net present value based on the discounted cash flow mechanism. A rationalised capital base on the other hand would reduce the

[58] EVA is a trademark owned by Stern, Stewart & Co., a New York based consulting firm. It is a financial performance measure that calculates the economic profit of a business entity after the capital charge.

capital charge on the direct investment of a venture. In terms of the cost of capital, the risk premium imposed on TEVs will be brought down if uncertainty related to financial capital requirement is mitigated.

5.3.5 Enhancement Through Venture Governance

The above section provided a summary of critical factors that would effect optimal resource allocation and growth of TEVs. It demonstrated that a pure quantitative model was insufficient by itself to explain fully the phenomenon of growth among the TEVs. An ethnographic approach would provide additional information about the underlying qualitative factors that influenced the underlying development of events. Human factors were found to be of influential to success and failure of TEVs. The equity stakeholders, as the external financial capital providers, expressed their view on the importance of corporate governance and potential improvement from the current reporting system.

Revisiting the framework illustrated in Figure-2 under Section 3.2, the equity-stakeholders needed to constantly review performance of TEVs periodically to assess their performance. Despite the adequate level of information and the current combined approach in reviewing financial statements and meetings with management, potential improvement from the current approach by implementation of a performance measurement system was identified. More formal meetings with management were preferred by the equity stakeholders. As reflected in the interview with founding executive, implementation of a performance measurement system could be demanded by the board but there was no strong motivation for such implementation given the additional resources required. This particular dilemma could be explained by the concept of information asymmetry and the agency theory as pointed out in Section 2.2.8. To improve optimisation of resource allocation, a performance measurement system with specific PIs and linkages to the pertinent resources would potentially reduce the intrinsic problems with information asymmetry inside TEVs. This system would facilitate an interactive process, providing timely signals of performance during stages of growth and development. Through this process, structured communication focusing on specific performance expectation would be facilitated between management and the board of directors. Equity stakeholders could be better informed about past performance as well as ability of management in business execution before additional financial resources were allocated. It would create the opportunity to improve from the current practice in which alignment of interests between the two parties were unsubstantiated, as transparency of critical information about performance was not in place. Moral hazards, adverse decision and other agency risks related to information asymmetry would otherwise emerge unaffectedly. Nevertheless, successful implementation of this performance measurement system would enable effective decision making of the equity stakeholders especially in cases of potential requirements on additional financial capital resource allocation. The equity stakeholders should include the founding shareholders, which would normally be composed of a founding management team. Their involvement and sharing of power in monitoring performance and control is considered critical to the continuous growth and development of a TEV. A revised framework incorporated with elements of venture governance and the presence of management, as key human factors, is shown in the following figure:

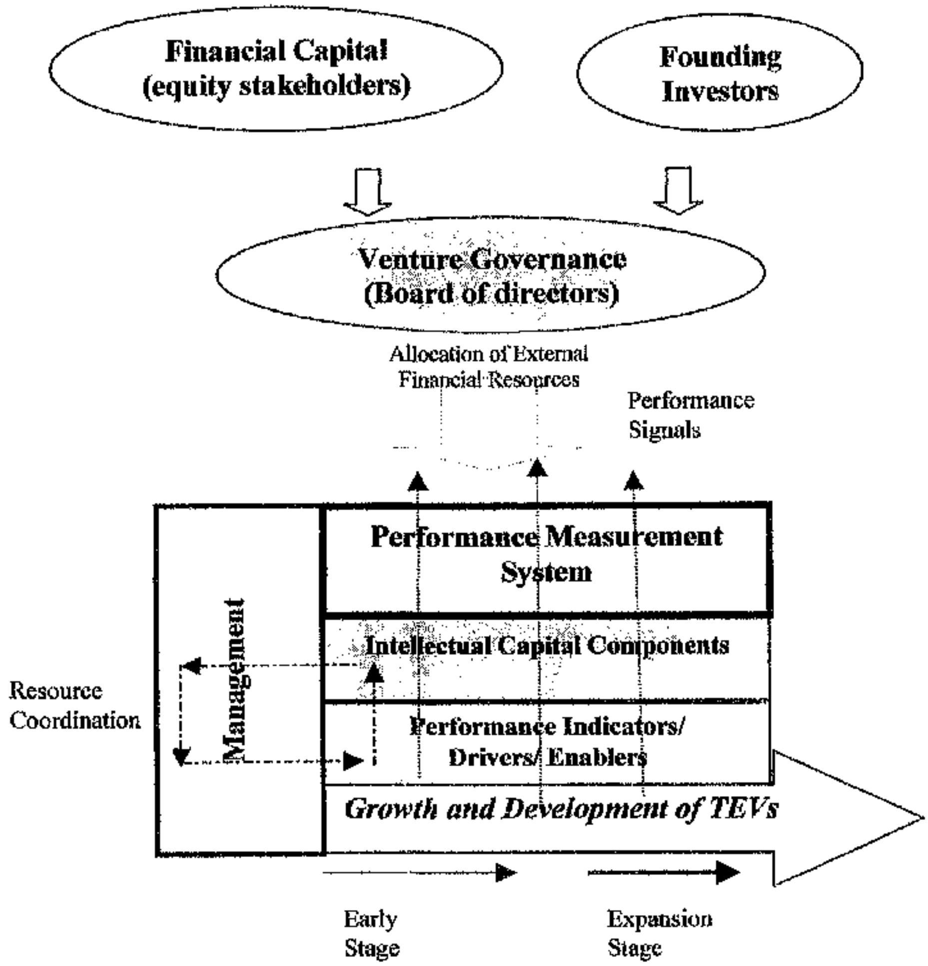

Figure-25: A revised framework of venture governance and resource flow in TEVs

5.4 Conclusions

5.4.1 Main Conclusions

This research study, based on an interdisciplinary approach, examined the growth and development of TEVs from interconnected perspectives. Embracing the contemporary knowledge about performance measurement and management for organisations, this study investigated the characteristics of technology exploiting ventures (TEVs) during their early years of growth and development. The findings of this research provided resonant results with the prior studies on the development and application of performance measurement system. The opinions given by the equity stakeholders were obtained to confirm the importance of specific PIs, which were in turn strengthened by evidence in case studies. The point of view by Neely (2000) regarding the perspective of key stakeholders in development of a performance measurement system, or so-called performance prism, had demonstrated to be essential. Furthermore, this research study revealed the differentiating PIs between early-stage and expansion-stage of TEVs. This particular result provided supporting view on Kennerly and Neely (2002, 2003)'s notion about the evolution of performance measurement systems. They suggested that modification of performance measurement system was necessary for an organisation to deal with changing circumstances, as both internal and external factors would have to be considered for the development of a dynamic and relevant set of performance measures. As such, conventional Balanced Scorecard for organisations in stable operations would require corresponding modifications in order to be effective for ventures under growth and development.

The PIs adopted in this research, collectively organised into the specific components of intellectual capital, were connected to their respective resource characteristics. Utilisation of these resources were analysed and found to be closely related to their performance in organic growth among the cases; significant causal-effect between specific components and business growth was observed for TEVs during the expansion stage. The result demonstrated to be consistent with a series of recent research about intellectual capital and the pertinent concept of predictive performance as specified in Section 2.2.6.

This integrative analysis of performance measurement and intellectual capital suggested that measuring and monitoring PIs that reflected business outcomes and results could be influenced significantly by resource allocation with the prescribed perspectives of intellectual capital. This integration enabled the development of the framework of the performance measurement system designed for TEVs, a key output derived from this research study.

Through this framework, investments in technology-intensive ventures could be augmented with the objective of optimal resource allocation for sustainable growth. Optimal resource allocation that facilitated performance would become the focus for the key stakeholders under this framework. With the differentiation between early-stage and expansion stage, changing requirements on intellectual capital and related resource requirements would be identified. While balanced heterogeneous intellectual capital was proven to be critical, Human Capital remained to be an irreplaceable resource for growth throughout the two stages. Optimal resource allocation, however, needed to consider carefully the three dimensions of resources: types of resources[59], distribution of resources into specific components of intellectual capital, and the timing of allocation. To complement these internal elements, both market forces and disruptive technologies had to be observed cautiously in order to avoid misallocation of resources.

Furthermore, the framework in this study addressed concerns about risks associated with investments in emerging ventures. As pointed out in the literature review, the associated risk factors for TEVs included agency risks, development risks, limited resources, and disruptive technologies. Reid and Smith (2002) in their empirical studies unveiled the three main risks perceived by the venture capitalists, namely agency risk, business risk and innovation risk. Incorporated with specific PIs for TEVs, the proposed framework would be able to deliver signals of performance for the decision makers in evaluation of past performance, effectiveness of resource allocation, execution ability; and then decision for new resources. Through a comprehensive performance measurement system adopted at the corporate governance level, corporate governance concerns caused by information asymmetry could be mitigated with the objectives to set the common objectives. The system would provide the opportunity to reduce potential agency risks and to improve transparency of critical performance-related information, as establishing credit relationship with stakeholders was considered as critical among new ventures (Cassar

[59] Including external financial resources, system-level resources and coordination of resources.

2004). Subsequently, the interactive process of venture governance that aimed to enhance optimal resource allocation and sustainable growth could potentially mitigate the pertinent business risk and innovation risk.

5.4.2 Contribution to Domain Knowledge

With respect to contribution to the domain knowledge of performance measurement and management, this research has explored new knowledge in three critical areas. First of all, this research examined issues related to performance measurement and management of technology-exploiting ventures (TEVs). Venture companies exploiting emerging technology were found to contain their own characteristics and specific factors that could affect their delivery of performance during initial years of growth. A critical phenomenon observed in the current practice was the vulnerable connection existing between venture governance and performance management system, which was identified as an area for improvement by the equity stakeholders. This observation suggested the potentials for a performance management system designed with specific performance indicators (PIs) to mitigate agency risks associated with information asymmetry in the technology sector. An intellectual capital flow framework was designed to exemplify the flow of critical resources. The framework facilitates the TEVs to improve usefulness of information exchange with the equity stakeholders and therefore to enhance both performance monitoring and a resource allocation process that upholds alignment of interests among the stakeholders.

Secondly, this research unveiled evidence through triangulation regarding the linkages between the strategic resources of intellectual capital, growth performance and the dimension of time, enabling the stakeholders to seek optimal resource allocation for TEVs. Building on The Theory of the Growth of the Firm (Penrose 1959), it revealed the characteristics and the underlying relationships among key variables that facilitate growth of TEVs, the contemporary enterprises that grow through technological innovation, as well as the advantage of a staged investment approach. Through the analysis of intellectual capital components and their respective characteristics, this study substantiates the criticalness of heterogeneity of resources in terms of priority and combination to sustaining growth and development of TEVs. It has provided empirical evidence through a structured framework to enable understanding about the resource-based view and the resource allocation process model that required "complementarity seeking research" to provide the missing components as suggested by Bower and Gilbert (2005).[60]

Thirdly, it confirmed the differentiating PIs required for companies at different stages of growth and development, as well as the implied performance measurement and management for the stakeholders involved. Through the collection of opinion from the equity stakeholders and case studies, it enables understanding of the change in significance of specific PIs for a TEV entering a stage of expansion from early growth. This finding supports the prior studies about the importance of maintaining a dynamic performance measurement system to order to cope with changes in the circumstances.

[60] This articulation appeared in the commentary by M. A. Peteraf in the book.

5.5 Future Research

For future research study, the author would propose further study of the development of a comprehensive performance measurement system that would be integrated with the needs of corporate governance for TEVs. Performance measurement system has the potential to be adopted as the tool to manage risks associated with investments in ventures of emerging technologies and as the instrument to sustain their early growth and development. Such implication to the cost of capital of TEVs and to the reduction of information asymmetry, such as moral hazard, is yet to be explored. Intensive quantitative analysis to investigate the stochastic relationship in such a performance measurement system would enable confirmation about predictive performance of dynamic resources.

Similar research can be extended to other knowledge-intensive and new technology driven industries, namely healthcare and renewable energy, which are critical to sustainable development of the global economy.

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APPENDIX A

Survey Questionnaire and Related Analysis

Survey Questionnaire

Part-I

1. As an equity-stakeholder, how important is it for your firm to maintain a monitoring system to regularly review performance of a technology-exploiting venture?

a. Unimportant
b. Not So Important
c. Neutral
d. Quite Important
e. Very Important

2. What is the most important means of performance monitoring that you currently maintain for regular review of your invested companies?

a. Review of financial statements and management reports
b. Implementation of a balanced scorecard system with specific performance indicators
c. Informal discussion or meetings with senior management (non-financial information)
d. Regular formal meetings with senior management (non-financial information)
e. Other, Please Specify

3. Please rank the following arrangements in order of effectiveness in monitoring performance and risk of an invested technology company (on a scale of 1-5, with 5 being the most effective).

☐ Obtaining a board seat
☐ Including specific covenants in the investment agreement
☐ Demanding regular meetings with senior management
☐ Requirement of a budgetary control and management reporting system
☐ Regular review of financial information

4. How would you prefer your invested technology-exploiting ventures to be monitored differently in order to mitigate any potential risk in its growth and development?

a. More frequent submission of financial statements and management reports
b. Implementation of a balanced scorecard or performance measurement system with specific performance indicators
c. More informal discussion or meeting with senior management
d. More formal meetings with senior management
e. Other, Please Specify

5. Do you think the level of information reported to you by your invested ventures is sufficient for monitoring performance?

a. Not at all
b. Not quite sufficient
c. Neutral Quite
d. Sufficient
e. Very sufficient

6. Do you think that maintaining a board seat would facilitate better performance and risk monitoring than without one?

a. Yes
b. No

Part II

7. For an "EARLY-STAGE" technology-exploiting venture, please RANK the following forms of resources in order of their importance to effective growth and development (on a scale of 1-5, with 5 being the most important).

- ☐ Utilisation of existing internal resources, such as human capital and technological know-how
- ☐ Acquisition of more experienced management and executives
- ☐ Development of effective management systems, such as administrative and ERP systems
- ☐ Acquisitions of new facilities and infrastructure for scaling up operations
- ☐ Obtaining additional external financial capital

8. For an "EXPANSION-STAGE" technology-exploiting venture, please RANK the following forms of resources in order of their importance to effective growth and development (on a scale of 1-5, with 5 being the most important).

- ☐ Utilisation of existing internal resources, such as human capital and technological know-how
- ☐ Acquisition of more experienced management and executives
- ☐ Development of effective management systems, such as administrative and ERP systems
- ☐ Acquisitions of new facilities and infrastructure for scaling up operations
- ☐ Obtaining additional external financial capital

9. For an "EARLY-STAGE" technology-exploiting venture, please indicate the importance of each of the suggested performance drivers/indicators (on a scale of 1-5, with 5 being the most important).

Code	PIs	Importance (Scale 1-5, 5 being the most)	
		Early-stage	**Expansion-stage**
H.1	Founders and Senior Management's Experience in industry		
H.2	Education/ Qualification		
H.3	Staff Retention Policy		
H.4	Stock Options		
H.5	Training and Development		
H.6	Multidisciplinary Team		
I.1	Research and Development Capability		
I.2	New Product Development Cycle		
I.3	Innovation Culture		
I.4	Generation and Execution of New Ideas		
I.5	Responsiveness to Market Changes		
I.6	Absorption Capacity for Emerging Technologies		
S.1	Establishment of infrastructure		
S.2	Enterprise resource planning system or similar information system		
S.3	Administrative / organisational policy		
S.4	Supply chain management system		
S.5	Quality management system (including manufacturing activities as appropriate)		
C.1	Established customer and related relationship management		
C.2	Customer relationship management system		
C.3	Delivery of products, services and solutions to customers		
C.4	Acquisition of customers, market channel development, sales closures, loyalty		
C.5	Handling customer complaints		

10. For an "EXPANSION-STAGE" technology-exploiting venture, please indicate the importance of each of the suggested performance drivers/indicators (on a scale of 1-5, with 5 being the most important).

Code	PIs	Importance (Scale 1-5, 5 being the most)	
		Early-stage	**Expansion-stage**
H.1	Founders and Senior Management's Experience in industry		
H.2	Education/ Qualification		
H.3	Staff Retention Policy		
H.4	Stock Options		
H.5	Training and Development		
H.6	Multidisciplinary Team		
I.1	Research and Development Capability		
I.2	New Product Development Cycle		
I.3	Innovation Culture		
I.4	Generation and Execution of New Ideas		
I.5	Responsiveness to Market Changes		
I.6	Absorption Capacity for Emerging Technologies		
S.1	Establishment of infrastructure		
S.2	Enterprise resource planning system or similar information system		
S.3	Administrative / organisational policy		
S.4	Supply chain management system		
S.5	Quality management system (including manufacturing activities as appropriate)		
C.1	Established customer and related relationship management		
C.2	Customer relationship management system		
C.3	Delivery of products, services and solutions to customers		
C.4	Acquisition of customers, market channel development, sales closures, loyalty		
C.5	Handling customer complaints		

APPENDIX B

Results of t-Test: Paired Two Sample for Means of the 22 PIs between Early-Stage and Expansion-Stage

t-Test: Paired Two Sample for Means H1

	Variable 1	*Variable 2*
Mean	4.814814815	4.740740741
Variance	0.233618234	0.276353276
Observations	27	27
Pearson Correlation	0.409260727	
Hypothesized Mean Difference	0	
df	26	
t Stat	0.700404196	
P(T<=t) one-tail	0.244947817	
t Critical one-tail	1.705616341	
P(T<=t) two-tail	0.489895634	
t Critical two-tail	2.055530786	

t-Test: Paired Two Sample for Means H2

	Variable 1	*Variable 2*
Mean	2.925925926	2.851851852
Variance	0.84045584	1.438746439
Observations	27	27
Pearson Correlation	0.794097414	
Hypothesized Mean Difference	0	
df	26	
t Stat	0.527328044	
P(T<=t) one-tail	0.301218498	
t Critical one-tail	1.705616341	
P(T<=t) two-tail	0.602436997	
t Critical two-tail	2.055530786	

t-Test: Paired Two Sample for Means H3

	Variable 1	Variable 2
Mean	2.814814815	3.185185185
Variance	1.07977208	0.925925926
Observations	27	27
Pearson Correlation	0.612600257	
Hypothesized Mean Difference	0	
df	26	
t Stat	-2.178193184	
P(T<=t) one-tail	0.019325025	
t Critical one-tail	1.705616341	
P(T<=t) two-tail	0.03865005	
t Critical two-tail	2.055530786	

t-Test: Paired Two Sample for Means H4

	Variable 1	Variable 2
Mean	4.074074074	4.444444444
Variance	0.532763533	0.564102564
Observations	27	27
Pearson Correlation	0.709380511	
Hypothesized Mean Difference	0	
df	26	
t Stat	-3.406925719	
P(T<=t) one-tail	0.001073477	
t Critical one-tail	1.705616341	
P(T<=t) two-tail	0.002146954	
t Critical two-tail	2.055530786	

t-Test: Paired Two Sample for Means H5

	Variable 1	Variable 2
Mean	3.148148148	3.666666667
Variance	0.9002849	0.846153846
Observations	27	27
Pearson Correlation	0.719758542	
Hypothesized Mean Difference	0	
df	26	
t Stat	-3.848889903	
P(T<=t) one-tail	0.000346244	
t Critical one-tail	1.705616341	
P(T<=t) two-tail	0.000692487	
t Critical two-tail	2.055530786	

t-Test: Paired Two Sample for Means H6

	Variable 1	Variable 2
Mean	3.555555556	3.814814815
Variance	0.871794872	0.849002849
Observations	27	27
Pearson Correlation	0.660653979	
Hypothesized Mean Difference	0	
df	26	
t Stat	-1.762758371	
P(T<=t) one-tail	0.044847015	
t Critical one-tail	1.705616341	
P(T<=t) two-tail	0.08969403	
t Critical two-tail	2.055530786	

t-Test: Paired Two Sample for Means I1

	Variable 1	*Variable 2*
Mean	3.962962963	3.62962963
Variance	0.883190883	0.472934473
Observations	27	27
Pearson Correlation	0.513559816	
Hypothesized Mean Difference	0	
df	26	
t Stat	2.081665999	
P(T<=t) one-tail	0.023679529	
t Critical one-tail	1.705616341	
P(T<=t) two-tail	0.047359058	
t Critical two-tail	2.055530786	

t-Test: Paired Two Sample for Means I2

	Variable 1	*Variable 2*
Mean	4.296296296	4.185185185
Variance	0.754985755	0.464387464
Observations	27	27
Pearson Correlation	0.683237359	
Hypothesized Mean Difference	0	
df	26	
t Stat	0.901387819	
P(T<=t) one-tail	0.187828314	
t Critical one-tail	1.705616341	
P(T<=t) two-tail	0.375656628	
t Critical two-tail	2.055530786	

t-Test: Paired Two Sample for Means 13

	Variable 1	Variable 2
Mean	4.259259259	3.814814815
Variance	0.814814815	0.541310541
Observations	27	27
Pearson Correlation	0.53837379	
Hypothesized Mean Difference	0	
df	26	
t Stat	2.88444102	
P(T<=t) one-tail	0.003888382	
t Critical one-tail	1.705616341	
P(T<=t) two-tail	0.007776764	
t Critical two-tail	2.055530786	

t-Test: Paired Two Sample for Means 14

	Variable 1	Variable 2
Mean	4.148148148	3.62962963
Variance	0.515669516	0.396011396
Observations	27	27
Pearson Correlation	0.636758405	
Hypothesized Mean Difference	0	
df	26	
t Stat	4.646850583	
P(T<=t) one-tail	4.26902E-05	
t Critical one-tail	1.705616341	
P(T<=t) two-tail	8.53804E-05	
t Critical two-tail	2.055530786	

t-Test: Paired Two Sample for Means 15

	Variable 1	Variable 2
Mean	4.666666667	4.666666667
Variance	0.384615385	0.307692308
Observations	27	27
Pearson Correlation	0.447213595	
Hypothesized Mean Difference	0	
df	26	
t Stat	0.000	
P(T<=t) one-tail	0.5	
t Critical one-tail	1.705616341	
P(T<=t) two-tail	1	
t Critical two-tail	2.055530786	

t-Test: Paired Two Sample for Means

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	Variable 1	Variable 2
Mean	3.703703704	3.925925926
Variance	0.524216524	0.60968661
Observations	27	27
Pearson Correlation	0.367880749	
Hypothesized Mean Difference	0	
df	26	
t Stat	-1.362770288	
P(T<=t) one-tail	0.092321345	
t Critical one-tail	1.705616341	
P(T<=t) two-tail	0.184642691	
t Critical two-tail	2.055530786	

t-Test: Paired Two Sample for Means S1

	Variable 1	Variable 2
Mean	3	3.814814815
Variance	0.692307692	1.156695157
Observations	27	27
Pearson Correlation	0.601721668	
Hypothesized Mean Difference	0	
df	26	
t Stat	-4.818476126	
P(T<=t) one-tail	2.71319E-05	
t Critical one-tail	1.705616341	
P(T<=t) two-tail	5.42639E-05	
t Critical two-tail	2.055530786	

t-Test: Paired Two Sample for Means S2

	Variable 1	Variable 2
Mean	2.444444444	3.518518519
Variance	1.487179487	0.720797721
Observations	27	27
Pearson Correlation	0.437523729	
Hypothesized Mean Difference	0	
df	26	
t Stat	-4.89115667	
P(T<=t) one-tail	2.2394E-05	
t Critical one-tail	1.705616341	
P(T<=t) two-tail	4.47879E-05	
t Critical two-tail	2.055530786	

t-Test: Paired Two Sample for Means S3

	Variable 1	Variable 2
Mean	2.888888889	3.481481481
Variance	1.102564103	1.259259259
Observations	27	27
Pearson Correlation	0.66733279	
Hypothesized Mean Difference	0	
df	26	
t Stat	-3.466185285	
P(T<=t) one-tail	0.000924087	
t Critical one-tail	1.705616341	
P(T<=t) two-tail	0.001848173	
t Critical two-tail	2.055530786	

t-Test: Paired Two Sample for Means S4

	Variable 1	Variable 2
Mean	2.518518519	3.259259259
Variance	0.951566952	0.968660969
Observations	27	27
Pearson Correlation	0.816056075	
Hypothesized Mean Difference	0	
df	26	
t Stat	-6.475761258	
P(T<=t) one-tail	3.64951E-07	
t Critical one-tail	1.705616341	
P(T<=t) two-tail	7.29903E-07	
t Critical two-tail	2.055530786	

t-Test: Paired Two Sample for Means S5

	Variable 1	Variable 2
Mean	3	3.666666667
Variance	0.923076923	0.692307692
Observations	27	27
Pearson Correlation	0.529237747	
Hypothesized Mean Difference	0	
df	26	
t Stat	-3.949683532	
P(T<=t) one-tail	0.000266493	
t Critical one-tail	1.705616341	
P(T<=t) two-tail	0.000532987	
t Critical two-tail	2.055530786	

t-Test: Paired Two Sample for Means C1

	Variable 1	Variable 2
Mean	3.518518519	4.222222222
Variance	1.336182336	0.487179487
Observations	27	27
Pearson Correlation	0.328396464	
Hypothesized Mean Difference	0	
df	26	
t Stat	-3.215121212	
P(T<=t) one-tail	0.001735059	
t Critical one-tail	1.705616341	
P(T<=t) two-tail	0.003470118	
t Critical two-tail	2.055530786	

t-Test: Paired Two Sample for Means C2

	Variable 1	*Variable 2*
Mean	3.222222222	4.037037037
Variance	0.794871795	0.575498575
Observations	27	27
Pearson Correlation	0.499160906	
Hypothesized Mean Difference	0	
df	26	
t Stat	-5.078078893	
P(T<=t) one-tail	1.36756E-05	
t Critical one-tail	1.705616341	
P(T<=t) two-tail	2.73512E-05	
t Critical two-tail	2.055530786	

t-Test: Paired Two Sample for Means C3

	Variable 1	*Variable 2*
Mean	4.407407407	4.444444444
Variance	0.789173789	0.564102564
Observations	27	27
Pearson Correlation	0.69814443	
Hypothesized Mean Difference	0	
df	26	
t Stat	-0.296374489	
P(T<=t) one-tail	0.384649322	
t Critical one-tail	1.705616341	
P(T<=t) two-tail	0.769298643	
t Critical two-tail	2.055530786	

t-Test: Paired Two Sample for Means C4

	Variable 1	*Variable 2*
Mean	4.481481481	4.444444444
Variance	0.797720798	0.564102564
Observations	27	27
Pearson Correlation	0.700764888	
Hypothesized Mean Difference	0	
df	26	
t Stat	0.296374489	
P(T<=t) one-tail	0.384649322	
t Critical one-tail	1.705616341	
P(T<=t) two-tail	0.769298643	
t Critical two-tail	2.055530786	

t-Test: Paired Two Sample for Means C5

	Variable 1	*Variable 2*
Mean	4.037037037	4.185185185
Variance	0.96011396	0.925925926
Observations	27	27
Pearson Correlation	0.808289906	
Hypothesized Mean Difference	0	
df	26	
t Stat	-1.279763758	
P(T<=t) one-tail	0.105965167	
t Critical one-tail	1.705616341	
P(T<=t) two-tail	0.211930334	
t Critical two-tail	2.055530786	

APPENDIX B

Assessment Of Performance Drivers Of Early-Stage TEVs

Template used for case analysis based on Key Performance Indicators (Early-stage cases)

Code	PIs	Implementation Requirements	Financial Capital (0-2)	System Level (0-2)	Execution Level (0-2)	Evidence
H.1	Founders and Senior Management's Experience in industry	Employment of key staff with recurring resources				
H.2	Education/ Qualification	Employment of key staff with recurring resources				
H.3	Staff Retention Policy	Policy in place				
H.4	Stock Options	Policy in place				
H.5	Training and Development	Policy in place/ Execution of management				
H.6	Multidisciplinary Team	Execution of management				
I.1	Research and Development Capability	Employment of R&D staff with recurring resources; expenditures in development of product prototypes				
I.2	New Product Development Cycle	Execution in development of new products				
I.3	Innovation Culture	Supportive policy in place / Execution of Management				
I.4	Generation and Execution of New Ideas	Supportive culture in place / Execution of Management				
I.5	Responsiveness to Market Changes	Execution of management (market-driven)				
I.6	Absorption Capacity for Emerging Technologies	Execution of management (ability to integrate and				

		absorb new technologies for product innovation)				
S.1	Establishment of infrastructure	Acquisition or instalment of necessary and facilities (financial capital required)				
S.2	Enterprise resource planning system or similar information system	Instalment of necessary software, hardware and system (financial capital required)				
S.3	Administrative / organisational policy	Policy and system in place				
S.4	Supply chain management system	System in place				
S.5	Quality management system (including manufacturing activities as appropriate)	System in place				
C.1	Established customer and related relationship management	Sales and marketing workforce that maintain and build pre-existing customer relationship				
C.2	Customer relationship management system	Policy and system in place				
C.3	Delivery of products, services and solutions to customers	Execution of operations and customer service in delivering products, services and solutions				
C.4	Acquisition of customers, market channel development, sales closures, loyalty	Execution of sales and marketing activities				
C.5	Handling customer complaints	Policy and procedures in place				

Keys: 0 = No commitment; 1 = Certain commitment; 2 = Substantial commitment; N/A = Not applicable

Case analysis in reference to key performance indicators (Early-Stage cases) A.W.1

Code	Performance Drivers/Enablers	Implementation Requirements	Financial Capital (0-2)	System Level (0-2)	Execution Level (0-2)	Observation*
H.1	Founders and Senior Management's Experience in industry	Employment of key staff with recurring resources	1	1	1	▪ Founders and senior executives had good experience in the industry but lack of the range of technological knowledge in development of the required systems.
H.2	Education/ Qualification	Employment of key staff with recurring resources	1	0	1	▪ Founders and senior executives had tertiary education background but education background was not a prerequisite.
H.3	Staff Retention Policy	Policy in place	0	0	0	▪ There was no staff retention policy in place.
H.4	Stock Options	Policy in place	0	1	1	▪ Stock options were confirmed with senior executives but there was no formal execution of pertinent agreement with detailed terms and conditions.
H.5	Training and Development	Policy in place/ Execution of management	1	0	1	▪ There were in-house training and development activities but most of them are done in an ad hoc manner.
H.6	Multidisciplinary Team	Execution of management	0	0	1	▪ Employees of different technical backgrounds seldom met to exchange views and execute plans together.
Average			0.500	0.167	0.833	
I.1	Research and Development Capability	Employment of R&D staff with recurring resources; expenditures in development of product prototypes	1	1	1	▪ There was an R&D team in China; however, the development output seemed to be not very effective with respect to meeting international standards and end users' needs.
I.2	New Product Development Cycle	Execution in development of new products	1	1	1	▪ There is an R&D team in China; however, the development output seemed to be not very effective with respect to meeting international standards and end users' needs.

I.3	Innovation Culture	Supportive policy in place / Execution of Management	0	0	1	▪ The overall corporate culture appeared to be dominated by a few senior executives; there was no supportive policy in place to encourage innovative thinking.
I.4	Generation and Execution of New Ideas	Supportive culture in place / Execution of Management	0	0	1	▪ The overall corporate culture appeared to be dominated by a few senior executives; there was no supportive policy in place to encourage generation of new ideas.
I.5	Responsiveness to Market Changes	Execution of management (market-driven)	0	0	1	▪ Senior executives were eager to be responsive to external changes but do not have the adequate resources to support.
I.6	Absorption Capacity for Emerging Technologies	Execution of management (ability to integrate and absorb new technologies for product innovation)	0	0	1	▪ Senior executives were eager to learn about the latest technologies and related innovation, but there were few internal technical expertises.
Average			0.333	0.333	1.000	
S.1	Establishment of infrastructure	Acquisition or instalment of necessary and facilities (financial capital required)	1	0	1	▪ A call centre had been established; however, the core system that integrated critical operational data has not been fully planned.
S.2	Enterprise resource planning system or similar information system	Instalment of necessary software, hardware and system (financial capital required	0	0	1	▪ Only manual procedures were in place for administrative purposes, with little automation.
S.3	Administrative / organisational policy	Policy and system in place	0	1	1	▪ Only manual procedures were in place for administrative purposes.
S.4	Supply chain management system	System in place	N/A	N/A	N/A	▪ Not applicable
S.5	Quality management system (including manufacturing activities as appropriate)	System in place	N/A	N/A	N/A	▪ Not applicable

Average			0.333	0.333	1.000	
C.1	Established customer and related relationship management	Sales and marketing workforce that maintain and build pre-existing customer relationship	0	1	1	▪ Founders had brought in some customers but still needed to build a base of customers. No specific marketing budget.
C.2	Customer relationship management system	Policy and system in place	0	0	1	▪ Only manual procedures were in place.
C.3	Delivery of products, services and solutions to customers	Execution of operations and customer service in delivering products, services and solutions	0	0	1	▪ Only ad hoc procedures were in place.
C.4	Acquisition of customers, market channel development, sales closures, loyalty and brand management	Execution of sales and marketing activities	0	0	1	▪ Senior executives took the lead in seeking new customers and there was not yet a sales/marketing team delegated to execute sales and marketing activities.
C.5	Handling customer complaints	Policy and procedures in place	0	0	1	▪ Only ad hoc procedures were in place.
Average			0	0.200	1.00	

Keys: 0 = No commitment; 1 = Certain commitment; 2=Substantial commitment (with substantial activities, related programme and or resources allocated to facilitate); N/A = Not applicable

* Source of evidence: business plan, prospectus for equity placement, internal procedure manuals, interview and discussion with advisors and management on Human Capital policy. Information was collected between March 2005 and June 2005. Interviews and discussion were conducted in June and July of 2005.

In summary, the above case analysis demonstrated that A.W.1 had certain commitment of resources in Human Capital and Innovation Capital both of which had been supported by resource coordination and execution by management. Management's prior professional experience and active networking with the clienteles had also substantiated Customer Capital. On the other hand, internal systems seemed to be lacking and external resources were insufficient in supporting the development of Structural Capital.

Case analysis based on Key Performance Indicators (Early-Stage cases) A.W.2

Code	Performance Drivers/Enablers	Implementation Requirements	Financial Capital (0-2)	System Level (0-2)	Execution Level (0-2)	Observation*
H.1	Founders and Senior Management's Experience in industry	Employment of key staff with recurring resources	2	1	2	▪ Founders and senior executives of the core management team possess in-depth industry experience. All of them were full-time employees with the company.
H.2	Education/ Qualification	Employment of key staff with recurring resources	1	1	2	▪ Founders and senior executives had tertiary education background; good education background of staff is preferred by the company.
H.3	Staff Retention Policy	Policy in place	0	0	2	▪ While there was no staff retention policy in place, the senior management promotes loyalty and continuity of engagement.
H.4	Stock Options	Policy in place	0	1	1	▪ Stock options were confirmed with senior executives but there was not yet formal execution of pertinent agreement with detailed terms and conditions.
H.5	Training and Development	Policy in place/ Execution of management	1	0	1	▪ There were in-house training and development activities but most of them were done in an ad hoc manner.
H.6	Multidisciplinary Team	Execution of management	0	1	2	▪ Employees of different technical backgrounds often met to exchange views and execute plans together; however, there was no formal policy to support that.
Average			0.667	0.667	1.667	
I.1	Research and Development Capability	Employment of R&D staff with recurring resources; expenditures in development of product prototypes	2	1	2	▪ Strong core R&D team since commencement of operations; financial resources were added continuously to support development of new, internationally competitive solutions.

I.2	New Product Development Cycle	Execution in development of new products	2	1	2	▪ Strong core R&D team since commencement of operations; financial resources were added continuously to support development of new products and services in a swift manner.
I.3	Innovation Culture	Supportive policy in place / Execution of Management	0	1	2	▪ The senior management team supported innovative thinking for new solutions and encourages staff participations and communication. The company maintained a flat organisation. However, there was not much systematic approach nor financial resources specifically targeted for this.
I.4	Generation and Execution of New Ideas	Supportive culture in place / Execution of Management	0	0	2	▪ The senior management team supported innovative thinking for new solutions and encourages staff to suggest new ideas. However, there wais not much systematic approach nor financial resources specifically targeted for this.
I.5	Responsiveness to Market Changes	Execution of management (market-driven)	0	0	2	▪ Senior executives were responsive to external changes and development in the telecom industry. However, there was neither a system nor separate resources to provide support.
I.6	Absorption Capacity for Emerging Technologies	Execution of management (ability to integrate and absorb new technologies for product innovation)	0	1	2	▪ Due to their strong technical background, senior executives were able to learn quickly about the latest technologies and related innovation for implication to new product development. However, there was neither a system nor separate resources to provide support.
Average			0.667	0.667	2.000	
S.1	Establishment of infrastructure	Acquisition or instalment of necessary and facilities (financial capital required)	1	1	2	▪ A development centre and data management facilities had been established to support current operations. The facilities were ready for

						scalable expansions.
S.2	Enterprise resource planning system or similar information system	Instalment of necessary software, hardware and system (financial capital required	1	1	1	▪ Mostly manual procedures were in place for administrative purposes, with some automation in the accounting function.
S.3	Administrative / organisational policy	Policy and system in place	1	1	1	▪ Manual procedures were in place for administrative purposes with some support of computer system.
S.4	Supply chain management system	System in place	N/A	N/A	N/A	▪ Not applicable
S.5	Quality management system (including manufacturing activities as appropriate)	System in place	N/A	N/A	N/A	▪ Not applicable
Average			1.000	1.000	1.333	
C.1	Established customer and related relationship management	Sales and marketing workforce that maintain and build pre-existing customer relationship	0	1	2	▪ Founders had brought in some customers but still needed to build a broader base of customers. No specific marketing budget.
C.2	Customer relationship management system	Policy and system in place	0	1	1	▪ Basic CRM system was in place.
C.3	Delivery of products, services and solutions to customers	Execution of operations and customer service in delivering products, services and solutions	1	1	2	▪ Operations staff was experienced with procedures in delivery of solutions and there was supporting system in place.
C.4	Acquisition of customers, market channel development, sales closures, loyalty and brand management	Execution of sales and marketing activities	1	1	1	▪ Senior executives took the lead in seeking new customers and there was plan in place to execute sales and marketing activities.
C.5	Handling customer complaints	Policy and procedures in place	0	1	1	▪ Ad hoc procedures were in place.
Average			0.400	1.000	1.400	

Keys: 0 = No commitment; 1 = Certain commitment; 2=Substantial commitment (with substantial activities, related programme and or resources allocated to facilitate); N/A = Not applicable

* Source of evidence: business plan, prospectus for equity placement, internal procedure manuals, corporate brochures, interview and discussion with advisors and management on Human Capital policy. Information was collected between April 2005 and July 2005. Interviews and discussion were conducted in June and July of 2005.

The above case analysis demonstrated that A.W.2 had strong commitment of resources in the four types of intellectual capital. Especially on Innovation Capital, the company had built a culture that embraced new product development through a market-driven approach and close monitoring of customers' demand. Structural Capital of A.W.2 seemed adequate based on active resource coordination and allocation of resources in acquisition of necessary equipment and systems. Management's prior professional experience and active networking with the clienteles had also strengthened Customer Capital. With respect to Human Capital, it was an area enriched with managers of in-depth industry experience and track records.

Case analysis based on Key Performance Indicators (Early-Stage cases) A.S.1

Code	Performance Drivers/Enablers	Implementation Requirements	Financial Capital (0-2)	System Level (0-2)	Execution Level (0-2)	Observation*
H.1	Founders and Senior Management's Experience in industry	Employment of key staff with recurring resources	2	1	2	▪ Founders and senior executives of the core management team possessed in-depth industry experience. All of them were full-time employees with the company.
H.2	Education/ Qualification	Employment of key staff with recurring resources	1	1	1	▪ Founders and senior executives had tertiary education background. Although good education background of staff was preferred by the company, there wais inconsistency in requirements with the local production staff.
H.3	Staff Retention Policy	Policy in place	0	0	1	▪ While there was no staff retention policy in place, the senior management attempts to promote loyalty and continuity of engagement.
H.4	Stock Options	Policy in place	1	1	1	▪ Stock options were confirmed with senior executives; there were some formal executions of pertinent agreement with detailed terms and conditions.
H.5	Training and Development	Policy in place/ Execution of management	2	1	1	▪ There were in-house training and development activities. While some of them were done in an ad hoc manner, financial resources were pulled in for housing and training of local assembly line staff.
H.6	Multidisciplinary Team	Execution of management	0	1	1	▪ Employees of different technical backgrounds sometimes met to exchange views and execute plans together; however, there was no specific

						financial resource to support that.
Average			1.000	0.833	1.167	
I.1	Research and Development Capability	Employment of R&D staff with recurring resources; expenditures in development of product prototypes	1	1	1	▪ Core R&D team in place since commencement of operations; however, there seemed to be lacking of continuous resources to support new development efforts.
I.2	New Product Development Cycle	Execution in development of new products	1	1	1	▪ Core R&D team since commencement of operations; however, there was insufficient, timely market orientation in development of new products and services.
I.3	Innovation Culture	Supportive policy in place / Execution of Management	1	1	1	▪ While the senior management team supports innovative thinking for new products and encourages staff participations and communication, the company seemed to have certain hierarchies between senior management between operations staff.
I.4	Generation and Execution of New Ideas	Supportive culture in place / Execution of Management	1	1	1	▪ While the senior management team supports innovative thinking for new solutions and encourages staff to suggest new ideas, there was not much systematic approach nor financial resources specifically targeted for this.
I.5	Responsiveness to Market Changes	Execution of management (market-driven)	0	0	1	▪ Senior executives were aware of market changes; however, there was neither a system nor separate resources to provide support.
I.6	Absorption Capacity for Emerging Technologies	Execution of management (ability to integrate and absorb new technologies for product innovation)	1	1	1	▪ The R&D team possesses strong technical background; however, resources seem to be insufficient for developing the next generation of technology fast enough in comparison with competitors.
Average			0.833	0.833	1.000	

S.1	Establishment of infrastructure	Acquisition or instalment of necessary and facilities (financial capital required)	2	1	2	▪ Production facilities with advanced equipment had been purchased to enable mass productions. The facilities were ready for scalable expansions.
S.2	Enterprise resource planning system or similar information system	Instalment of necessary software, hardware and system (financial capital required	2	2	2	▪ A computerized ERP system is in place and further upgrade of the system was being planned.
S.3	Administrative / organisational policy	Policy and system in place	1	1	1	▪ Manual procedures were in place for administrative purposes with some support of computer system.
S.4	Supply chain management system	System in place	1	1	1	▪ Supply chain management was embedded with its current ERP system but supply chain management with external parties was in manual mode.
S.5	Quality management system (including manufacturing activities as appropriate)	System in place	2	2	2	▪ Quality management system, including testing equipment, was in place to minimize defects of its output.
Average			1.600	1.400	1.600	
C.1	Established customer and related relationship management	Sales and marketing workforce that maintain and build pre-existing customer relationship	2	1	1	▪ Founders had brought in some customers but still needed to build a broader base of customers. Marketing budget was in place to support international promotion and marketing activities.
C.2	Customer relationship management system	Policy and system in place	1	1	1	▪ Basic CRM system was in place.
C.3	Delivery of products, services and solutions to customers	Execution of operations and customer service in delivering products, services and solutions	1	1	1	▪ Operations staff was experienced with procedures in delivery of solutions and there was supporting system in place.
C.4	Acquisition of customers, market channel development, sales closures, loyalty	Execution of sales and marketing activities	1	1	1	▪ Senior executives took the lead in seeking new customers and there

	and brand management					was plan in place to execute sales and marketing activities.
C.5	Handling customer complaints	Policy and procedures in place	1	1	1	▪ Procedures were in place.
Average			1.200	1.000	1.000	

Keys: 0 = No commitment; 1 = Certain commitment; 2=Substantial commitment (with substantial activities, related programme and or resources allocated to facilitate); N/A = Not applicable

* Source of evidence: business plan, prospectus for equity placement, internal procedure manuals, corporate brochures, interview and discussion with advisors and management on Human Capital policy. Information was collected between April 2005 and July 2005. Interviews and discussion were conducted in June and July of 2005.

The above case analysis demonstrated that A.S.1 had very strong commitment on resources for Structural Capital, followed by Human Capital and Customer Capital. On Structural Capital, the company managed to inject substantial resources to build up its own production capacity and other equipment and infrastructure to enable manufacturing of precisions. Innovation Capital seemed to an area that relatively fell behind, especially in the area of new product development and responsiveness to market changes.

Case analysis based on Key Performance Indicators (Early-Stage cases) A.S.2

Code	Performance Drivers/Enablers	Implementation Requirements	Financial Capital (0-2)	System Level (0-2)	Execution Level (0-2)	Observation*
H.1	Founders and Senior Management's Experience in industry	Employment of key staff with recurring resources	2	1	2	▪ Founders and senior executives of the core management team possessed in-depth industry experience. All of them were full-time employees with the company.
H.2	Education/ Qualification	Employment of key staff with recurring resources	2	1	2	▪ Founders and senior executives had tertiary education background. Good education background of staff was emphasized by the company.
H.3	Staff Retention Policy	Policy in place	2	2	2	▪ Senior management promotes staff loyalty and continuity of employment. The company also had incentives that help retain technical staff.
H.4	Stock Options	Policy in place	2	2	2	▪ Stock options were confirmed with senior executives; there were formal executions of pertinent agreement with detailed terms and conditions.
H.5	Training and Development	Policy in place/ Execution of management	2	1	2	▪ There were in-house training and development activities and budget allocated for R&D staff.
H.6	Multidisciplinary Team	Execution of management	0	2	2	▪ Employees of different technical backgrounds often met to exchange views and executed plans together; there was no specific financial resource to support that.
Average			1.667	1.500	2.00	
I.1	Research and Development Capability	Employment of R&D staff with recurring resources; expenditures	2	2	2	▪ Core R&D team in place since commencement of operations; there was constant increase in resources to support

		in development of product prototypes				new development efforts.
I.2	New Product Development Cycle	Execution in development of new products	2	1	2	▪ Core R&D team since commencement of operations; there was strong and timely market orientation in development of new products and services.
I.3	Innovation Culture	Supportive policy in place / Execution of Management	1	2	2	▪ While the senior management team supported innovative thinking for new products and encouraged staff participations, the company attempted to provide adequate communication between senior management between operations staff in an opened management culture.
I.4	Generation and Execution of New ideas	Supportive culture in place / Execution of Management	2	2	2	▪ While the senior management team supports innovative thinking for new solutions and encourages staff to suggest new ideas, there were active research and development activities that explored new application opportunities in the marketplace.
I.5	Responsiveness to Market Changes	Execution of management (market-driven)	1	2	2	▪ Senior executives kept closely to development in the market and this initiative was supported by the development staff.
I.6	Absorption Capacity for Emerging Technologies	Execution of management (ability to integrate and absorb new technologies for product innovation)	2	1	2	▪ The R&D team possessed strong technical background; resources were added periodically to the development team in exploration of emerging technology. ▪
Average			1.667	1.667	2.000	
S.1	Establishment of infrastructure	Acquisition or instalment of necessary and facilities (financial	1	2	2	▪ Production facilities were mostly outsourced, but the company maintained the quality assurance and supply chain

		capital required)				management functions in-house with systems in place to support.
S.2	Enterprise resource planning system or similar information system	Instalment of necessary software, hardware and system (financial capital required	1	1	1	▪ A basic ERP system was in place and further upgrade of the system was being planned.
S.3	Administrative / organisational policy	Policy and system in place	1	1	1	▪ Manual procedures were in place for administrative purposes with some support of computer system.
S.4	Supply chain management system	System in place	1	1	2	▪ Supply chain management system was being upgraded.
S.5	Quality management system (including manufacturing activities as appropriate)	System in place	2	2	2	▪ Quality management system, including testing equipment, was in place to minimize defects of its output.
Average			1.200	1.400	1.600	
C.1	Established customer and related relationship management	Sales and marketing workforce that maintain and build pre-existing customer relationship	2	1	2	▪ Founders had brought in some customers but still needed to build a broader base of customers. Marketing budget was in place to support international promotion and marketing activities.
C.2	Customer relationship management system	Policy and system in place	1	1	1	▪ Basic CRM system was in place.
C.3	Delivery of products, services and solutions to customers	Execution of operations and customer service in delivering products, services and solutions	1	1	2	▪ Operations staff was experienced with procedures in delivery of solutions and there was supporting system in place.
C.4	Acquisition of customers, market channel development, sales closures, loyalty and brand management	Execution of sales and marketing activities	1	1	1	▪ Senior executives took the lead in seeking new customers and there was plan in place to execute sales and marketing activities.

C.5	Handling customer complaints	Policy and procedures in place	1	1	1	▪ Procedures were in place.
Average			1.200	1.000	1.400	

Keys: 0 = No commitment; 1 = Certain commitment; 2=Substantial commitment (with substantial activities, related programme and or resources allocated to facilitate); N/A = Not applicable

* Source of evidence: business plan, prospectus for equity placement, internal procedure manuals, corporate brochures, press releases, financial statements, powerpoint presentation by management and discussion with advisors Human Capital policy. Information was collected between April 2005 and July 2005. Interviews and discussion were conducted in June of 2005.

The above case analysis demonstrated that A.S.2 had strong commitment of resources in Innovation Capital, followed with Human Capital. Structural Capital seemed to an area that relatively fell behind, especially in the area of new capital expenditures in production and manufacturing facilities. Customer Capital of the company was an area that had gained its character early as a result of the founder's prior experience in the industry.

APPENDIX C

Disclosures Analysis of Expansion-Stage TEVs

Case B.W.1 MDSI

Code	PIs	Proxy	Year-1 Disclosures	Year-1 Financial Data	Year-2 Disclosures	Year-2 Financial Data	Year-3 Disclosures	Year-3 Financial Data	Year-4 Disclosures	Year-4 Financial Data
H.1	Founders and Senior Management's Experience in industry	Estimated years of senior management's experience in industry	47		57		67		72	
H.2	Education/ Qualification	Disclosure about education/qualification (0=no, 1=yes)	0		0		0		0	
H.3	Staff Retention Policy	Disclosure about staff retention (0=no, 1=yes)	0		0		0		0	
H.4	Stock Options	Availability to management and staff (0=nil, 1=key management, 2=other staff)	1		1		1		1	
H.5	Training and Development	Disclosure Frequency	1		2		0		0	
H.6	Multidisciplinary Team	Disclosure Frequency	0		1		1		0	
E.1	Research and Development Capability	Disclosure frequency; pertinent expenditures	5	8.235	6	7.258	5	5.506	7	5.513
E.2	New Product Development Cycle	Disclosure frequency	4		4		5		7	
E.3	Innovation Culture	Disclosure frequency	1		1		1		1	
E.4	Generation and Execution of New Ideas	Disclosure frequency	0		0		0		0	
E.5	Responsiveness to Market Changes	Disclosure frequency	32		38		45		49	
E.6	Absorption Capacity for Emerging Technologies	Disclosure frequency	7		8		2		3	
S.1	Establishment of infrastructure	Disclosure frequency; capital expenditures	4	5.393	3	1.346	1	2.178	2	0.919
S.2	Enterprise resource planning system or similar information system	Disclosure frequency	2		4		6		7	
S.3	Administrative / organizational policy	Disclosure frequency	1		1		4		3	
S.4	Supply chain management system	Disclosure frequency	0		0		2		3	
S.5	Quality management system (including manufacturing activities as appropriate)	Disclosure frequency	3		3		4		3	
C.1	Established customer and related relationship management	Disclosure frequency	18		20		29		26	
C.2	Customer relationship management system	Disclosure frequency	2		1		2		2	
C.3	Delivery of products, services and solutions to customers	Financial information on generation of sales	0	40.664	0	31.577	0	24.677	0	28.931
C.4	Acquisition of customers, market channel development, sales	Merged with C.3								
C.5	Handling customer complains	Disclosure frequency	0		0		0		0	
Growth Performance (revenue growth per annum):				4%		-22%		-22%		17%

Case B.W.2 RIM

Code	PIs	Proxy	Year-1 Disclosures	Year-1 Financial Data	Year-2 Disclosures	Year-2 Financial Data	Year-3 Disclosures	Year-3 Financial Data	Year-4 Disclosures	Year-4 Financial Data
H.1	Founders and Senior Management's Experience in industry	Estimated years of senior management's experience in industry	120		125		97		89	
H.2	Education/ Qualification	Disclosure about education/qualification (0=no, 1=yes)	0		0		0		0	
H.3	Staff Retention Policy	Disclosure about staff retention (0=no, 1=yes)	1		1		0		0	
H.4	Stock Options	Availability to management and staff (0=nil, 1=key management, 2=other staff)	2		2		2		2	
H.5	Training and Development	Disclosure Frequency	0		0		0		0	
H.6	Multidisciplinary Team	Disclosure Frequency	4		1		0		2	
I.1	Research and Development Capability	Disclosure frequency, pertinent expenditures	9	18.3	12	37.4	9	55.9	14	62.64
I.2	New Product Development Cycle	Disclosure frequency	2		2		4		5	
I.3	Innovation Culture	Disclosure frequency	3		5		4		8	
I.4	Generation and Execution of New Ideas	Disclosure frequency	0		0		0		0	
I.5	Responsiveness to Market Changes	Disclosure frequency	11		16		21		22	
I.6	Absorption Capacity for Emerging Technologies	Disclosure frequency	6		6		8		6	
S.1	Establishment of infrastructure	Disclosure frequency, capital expenditures	5	54	6	73.9	11	39.7	8	21.8
S.2	Enterprise resource planning system or similar information system	Disclosure frequency	8		5		6		5	
S.3	Administrative / organizational policy	Disclosure frequency	1		0		1		2	
S.4	Supply chain management system	Disclosure frequency	1		1		0		1	
S.5	Quality management system (including manufacturing activities as appropriate)	Disclosure frequency	2		2		3		3	
C.1	Established customer and related relationship management	Disclosure frequency	16		17		28		32	
C.2	Customer relationship management system	Disclosure frequency	2		2		1		3	
C.3	Delivery of products, services and solutions to customers	Financial information on generation of sales	0	221	0	294	0	306	0	594.6
C.4	Acquisition of customers, market channel development, sales	Merged with C.1								
C.5	Handling customer complaints	Disclosure frequency	0		0		0		0	
Growth Performance (revenue growth per annum):				160%		33%		4%		94%

Case E.W.3 Infowave

Code	PA	Proxy	Year-1 Disclosures	Year-1 Financial Data	Year-2 Disclosures	Year-2 Financial Data	Year-3 Disclosures	Year-3 Financial Data	Year-4 Disclosures	Year-4 Financial Data
H.1	Founders and Senior Management's Experience in industry	Estimated years of senior management's experience in industry	62		92		100		67	
H.2	Education/ Qualification	Disclosure about education/qualification (0=no, 1=yes)	0		0		0		0	
H.3	Staff Retention Policy	Disclosure about staff retention (0=no, 1=yes)	0		0		0		0	
H.4	Stock Options	Availability to management and staff (0=nil, 1=key management, 2=other staff)	2		2		2		2	
H.5	Training and Development	Disclosure Frequency	0		0		2		0	
H.6	Multidisciplinary Team	Disclosure Frequency	1		2		3		0	
I.1	Research and Development Capability	Disclosure frequency; pertinent expenditures	2	2.2	13	2.9	8	3.5	5	5.4
I.2	New Product Development Cycle	Disclosure frequency	1		5		3		0	
I.3	Innovation Culture	Disclosure frequency	2		4		0		3	
I.4	Generation and Execution of New Ideas	Disclosure frequency	0		0		0		0	
I.5	Responsiveness to Market Changes	Disclosure frequency	8		32		35		11	
I.6	Absorption Capacity for Emerging Technologies	Disclosure frequency	2		7		11		6	
S.1	Establishment of infrastructure	Disclosure frequency, capital expenditures	0	0.397	2	0.64	3	2.9	0	2.2
S.2	Enterprise resource planning system or similar information system	Disclosure frequency	2		3		2		2	
S.3	Administrative / organizational policy	Disclosure frequency	0		2		2		1	
S.4	Supply chain management system	Disclosure frequency	0		0		0		0	
S.5	Quality management system (including manufacturing activities as appropriate)	Disclosure frequency	3		1		3		1	
C.1	Established customer and related relationship management	Disclosure frequency	8		12		16		19	
C.2	Customer relationship management system	Disclosure frequency	0		1		1		0	
C.3	Delivery of products, services and solutions to customers	Financial information on generation of sales	0	9.5	0	7.5	0	1.5	0	3.2
C.4	Acquisition of customers, market channel development, sales	Merged with C.3								
C.5	Handling customer complaints	Disclosure frequency	0		0		0		0	
Growth Performance (revenue growth per annum):				171%		-21%		-80%		113%

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Case B.W.4 724

Code	PIs	Proxy	Year-1		Year-2		Year-3		Year-4	
			Disclosures	Financial Data	Disclosures	Financial Data	Disclosures	Financial Data	Disclosures	Financial Data
H.1	Founders and Senior Management's Experience in industry	Estimated years of senior management's experience in industry	58		72		60		63	
H.2	Education/ Qualification	Disclosure about education/qualification (0=no, 1=yes)	1		1		1		1	
H.3	Staff Retention Policy	Disclosure about staff retention (0=no, 1=yes)	0		0		0		0	
H.4	Stock Options	Availability to management and staff (0=nil, 1=key management, 2=other staff)	2		2		2		2	
H.5	Training and Development	Disclosure Frequency	1		1		1		1	
H.6	Multidisciplinary Team	Disclosure Frequency	2		2		1		1	
I.1	Research and Development Capability	Disclosure frequency; pertinent expenditures	3	39	3	16.6	2	9.4	2	6.3
I.2	New Product Development Cycle	Disclosure frequency	3		2		2		1	
I.3	Innovation Culture	Disclosure frequency	0		2		0		0	
I.4	Generation and Execution of New Ideas	Disclosure frequency	0		0		0		0	
I.5	Responsiveness to Market Changes	Disclosure frequency	18		15		13		10	
I.6	Absorption Capacity for Emerging Technologies	Disclosure frequency	2		3		4		2	
S.1	Establishment of infrastructure	Disclosure frequency; capital expenditures	4	12	5	0.5	4	0.1	2	1
S.2	Enterprise resource planning system or similar information system	Disclosure frequency	2		3		2		1	
S.3	Administrative / organizational policy	Disclosure frequency	2		1		1		1	
S.4	Supply chain management system	Disclosure frequency	0		0		0		0	
S.5	Quality management system (including manufacturing activities as appropriate)	Disclosure frequency	1		1		2		1	
C.1	Established customer and related relationship management	Disclosure frequency	16		26		24		15	
C.2	Customer relationship management system	Disclosure frequency	0		0		0		0	
C.3	Delivery of products, services and solutions to customers	Financial information on generation of sales	0	43.8	0	20.7	0	12.8	0	15
C.4	Acquisition of customers, market channel development, sales	Merged with C.1								
C.5	Handling customer complaints	Disclosure frequency	0		0		0		0	
Growth Performance (revenue growth per annum):				109%		-53%		-38%		17%

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Case B.W.5 01 Communique

Code	PIs	Proxy	Year-1 Disclosures	Year-1 Financial Data	Year-2 Disclosures	Year-2 Financial Data	Year-3 Disclosures	Year-3 Financial Data	Year-4 Disclosures	Year-4 Financial Data
H.1	Founders and Senior Management's Experience in industry	Estimated years of senior management's experience in industry	50		67		83		73	
H.2	Education/ Qualification	Disclosure about education/qualification (0=no, 1=yes)	0		0		0		0	
H.3	Staff Retention Policy	Disclosure about staff retention (0=no, 1=yes)	0		0		0		0	
H.4	Stock Options	Availability to management and staff (0=nil, 1=key management, 2=other staff)	1		2		2		0	
H.5	Training and Development	Disclosure Frequency	0		0		0		0	
H.6	Multidisciplinary Team	Disclosure Frequency	2		4		4		2	
I.1	Research and Development Capability	Disclosure frequency, pertinent expenditures	3	1	4	0.82	2	1.56	1	1.83
I.2	New Product Development Cycle	Disclosure frequency	1		4		1		1	
I.3	Innovation Culture	Disclosure frequency	1		0		0		0	
I.4	Generation and Execution of New Ideas	Disclosure frequency	0		1		0		0	
I.5	Responsiveness to Market Changes	Disclosure frequency	14		9		10		9	
I.6	Absorption Capacity for Emerging Technologies	Disclosure frequency	0		0		1		1	
S.1	Establishment of infrastructure	Disclosure frequency, capital expenditures	0	0.0107	0	0.003	0	0.177	0	0.045
S.2	Enterprise resource planning system or similar information system	Disclosure frequency	2		2		2		0	
S.3	Administrative / organizational policy	Disclosure frequency	0		0		0		0	
S.4	Supply chain management system	Disclosure frequency	0		0		0		0	
S.5	Quality management system (including manufacturing activities as appropriate)	Disclosure frequency	0		0		0		0	
C.1	Established customer and related relationship management	Disclosure frequency	5		4		7		1	
C.2	Customer relationship management system	Disclosure frequency	0		0		0		0	
C.3	Delivery of products, services and solutions to customers	Financial information on generation of sales	0	4	0	7	0	12	0	4.6
C.4	Acquisition of customers, market channel development, sales	Merged with C.1								
C.5	Handling customer complaints	Disclosure frequency	0		0		0		0	
Growth Performance (revenue growth per annum):				126%		75%		71%		-62%

Case B.W.6 Zi

Code	FIs	Proxy	Year-1 Disclosures	Year-1 Financial Data	Year-2 Disclosures	Year-2 Financial Data	Year-3 Disclosures	Year-3 Financial Data	Year-4 Disclosures	Year-4 Financial Data
H.1	Founders and Senior Management's Experience in industry	Estimated years of senior management's experience in industry	33		31		49		65	
H.2	Education/ Qualification	Disclosure about education/qualification (0=no, 1=yes)	1		1		1		5	
H.3	Staff Retention Policy	Disclosure about staff retention (0=no, 1=yes)	0		0		0		0	
H.4	Stock Options	Availability to management and staff (0=nil, 1=key management, 2=other staff)	2		2		2		2	
H.5	Training and Development	Disclosure Frequency	0		0		0		0	
H.6	Multidisciplinary Team	Disclosure Frequency	5		2		2		3	
I.1	Research and Development Capability	Disclosure frequency; pertinent expenditures	12	3.7	5	2.8	7	2.1	12	2.3
I.2	New Product Development Cycle	Disclosure frequency	5		1		2		5	
I.3	Innovation Culture	Disclosure frequency	1		1		2		1	
I.4	Generation and Execution of New Ideas	Disclosure frequency	0		0		0		0	
I.5	Responsiveness to Market Changes	Disclosure frequency	8		8		21		23	
I.6	Absorption Capacity for Emerging Technologies	Disclosure frequency	4		0		0		0	
S.1	Establishment of infrastructure	Disclosure frequency; capital expenditures	0	1.2	0	0.9	0	0.13	0	0.12
S.2	Enterprise resource planning system or similar information system	Disclosure frequency	1		1		1		1	
S.3	Administrative / organizational policy	Disclosure frequency	2		2		2		2	
S.4	Supply chain management system	Disclosure frequency	0		0		0		0	
S.5	Quality management system (including manufacturing activities as appropriate)	Disclosure frequency	0		0		0		1	
C.1	Established customer and related relationship management	Disclosure frequency	40		9		25		26	
C.2	Customer relationship management system	Disclosure frequency	0		0		0		1	
C.3	Delivery of products, services and solutions to customers	Financial information on generation of sales	0	5.1	0	8.4	0	10.6	0	13.4
C.4	Acquisition of customers, market channel development, sales	Merged with C.1								
C.5	Handling customer complaints	Disclosure frequency	0		0		0		0	
Growth Performance (revenue growth per annum):				9%		65%		26%		26%

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Case B.S.1 Altera

Code	PI	Proxy	Year-1 Disclosures	Year-1 Financial Data	Year-2 Disclosures	Year-2 Financial Data	Year-3 Disclosures	Year-3 Financial Data	Year-4 Disclosures	Year-4 Financial Data
H.1	Founders and Senior Management's Experience in industry	Estimated years of senior management's experience in industry	110		130		140		126	
H.2	Education/ Qualification	Disclosure about education/qualification (0=no, 1=yes)	0		0		0		0	
H.3	Staff Retention Policy	Disclosure about staff retention (0=no, 1=yes)	0		0		0		0	
H.4	Stock Options	Availability to management and staff (0=nil, 1=key management, 2=other staff)	2		2		2		2	
H.5	Training and Development	Disclosure Frequency	0		0		0		0	
H.6	Multidisciplinary Team	Disclosure Frequency	0		0		0		0	
I.1	Research and Development Capability	Disclosure frequency; pertinent expenditures	5	33.7	6	49.5	8	54.4	7	59.9
I.2	New Product Development Cycle	Disclosure frequency	8		10		8		9	
I.3	Innovation Culture	Disclosure frequency	1		1		1		1	
I.4	Generation and Execution of New Ideas	Disclosure frequency	0		0		0		0	
I.5	Responsiveness to Market Changes	Disclosure frequency	16		20		23		24	
I.6	Absorption Capacity for Emerging Technologies	Disclosure frequency	19		21		16		23	
S.1	Establishment of infrastructure	Disclosure frequency; capital expenditures	0	45.8	0	45.2	0	80.9	0	24
S.2	Enterprise resource planning system or similar information system	Disclosure frequency	9		1		6		6	
S.3	Administrative / organizational policy	Disclosure frequency	3		3		2		2	
S.4	Supply chain management system	Disclosure frequency	3		6		8		9	
S.5	Quality management system (including manufacturing activities as appropriate)	Disclosure frequency	1		6		1		1	
C.1	Established customer and related relationship management	Disclosure frequency	10		14		16		17	
C.2	Customer relationship management system	Disclosure frequency	1		3		3		4	
C.3	Delivery of products, services and solutions to customers	Financial information on generation of sales	0	401.6	0	497.7	0	631.1	0	654.3
C.4	Acquisition of customers, market channel development, sales	Merged with C.3	0							
C.5	Handling customer complaints	Disclosure frequency	0		0		0		0	
Growth Performance (revenue growth per annum):				102%		24%		27%		4%

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Case B.S.2 Broadcom

			Year-1		Year-2		Year-3		Year-4	
Code	PIs	Proxy	Disclosures	Financial Data	Disclosures	Financial Data	Disclosures	Financial Data	Disclosures	Financial Data
H.1	Founders and Senior Management's Experience in industry	Estimated years of senior management's experience in industry	60		63		80		95	
H.2	Education/ Qualification	Disclosure about education/qualification (0=no, 1=yes)	1		1		1		1	
H.3	Staff Retention Policy	Disclosure about staff retention (0=no, 1=yes)	1		0		0		0	
H.4	Stock Options	Availability in management and staff (0=nil, 1=key management, 2=other staff)	1		2		2		2	
H.5	Training and Development	Disclosure Frequency	0		0		0		0	
H.6	Multidisciplinary Team	Disclosure Frequency	1		1		1		2	
I.1	Research and Development Capability	Disclosure frequency; pertinent expenditures	15	108.6	11	250.7	14	446.7	13	461.8
I.2	New Product Development Cycle	Disclosure frequency	12		16		14		13	
I.3	Innovation Culture	Disclosure frequency	3		4		5		3	
I.4	Generation and Execution of New Ideas	Disclosure frequency	0		0		0		0	
I.5	Responsiveness to Market Changes	Disclosure frequency	25		38		45		47	
I.6	Absorption Capacity for Emerging Technologies	Disclosure frequency	7		8		8		9	
S.1	Establishment of infrastructure	Disclosure frequency; capital expenditures	13	29.2	15	80.7	12	71.4	10	75.2
S.2	Enterprise resource planning system or similar information system	Disclosure frequency	23		27		32		30	
S.3	Administrative / organizational policy	Disclosure frequency	3		2		2		2	
S.4	Supply chain management system	Disclosure frequency	6		7		7		6	
S.5	Quality management system (including manufacturing activities as appropriate)	Disclosure frequency	10		12		13		16	
C.1	Established customer and related relationship management	Disclosure frequency	26		30		35		3	
C.2	Customer relationship management system	Disclosure frequency	3		4		3		3	
C.3	Delivery of products, services and solutions to customers	Financial information on generation of sales	0	518.2	0	1096	0	961.8	0	1083
C.4	Acquisition of customers, market channel development, sales	Merged with C.1								
C.5	Handling customer complaints	Disclosure frequency	0		0		0		0	
Growth Performance (revenue growth per annum):				139%		112%		-12%		13%

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Case B.S.3 Linear

Code	PIs	Proxy	Year-1 Disclosures	Year-1 Financial Data	Year-2 Disclosures	Year-2 Financial Data	Year-3 Disclosures	Year-3 Financial Data	Year-4 Disclosures	Year-4 Financial Data
H.1	Founders and Senior Management's Experience in industry	Estimated years of senior management's experience in industry	160		170		178		185	
H.2	Education/ Qualification	Disclosure about education/qualification (0=no, 1=yes)	1		1		1		1	
H.3	Staff Retention Policy	Disclosure about staff retention (0=no, 1=yes)	0		0		0		0	
H.4	Stock Options	Availability to management and staff (0=nil, 1=key management, 2=other staff)	2		2		2		2	
H.5	Training and Development	Disclosure Frequency	0		0		0		0	
H.6	Multidisciplinary Team	Disclosure Frequency	2		0		1		0	
I.1	Research and Development Capability	Disclosure frequency; pertinent expenditures	9	23.9	5	31.1	6	35.4	5	46.2
I.2	New Product Development Cycle	Disclosure frequency	2		2		2		2	
I.3	Innovation Culture	Disclosure frequency	1		1		1		1	
I.4	Generation and Execution of New Ideas	Disclosure frequency	0		0		0		0	
I.5	Responsiveness to Market Changes	Disclosure frequency	18		12		13		12	
I.6	Absorption Capacity for Emerging Technologies	Disclosure frequency	2		2		1		3	
S.1	Establishment of infrastructure	Disclosure frequency; capital expenditures	0	22	1	70.4	0	21.9	0	24.4
S.2	Enterprise resource planning system or similar information system	Disclosure frequency	7		10		12		8	
S.3	Administrative / organizational policy	Disclosure frequency	1		1		1		1	
S.4	Supply chain management system	Disclosure frequency	1		1		1		1	
S.5	Quality management system (including manufacturing activities as appropriate)	Disclosure frequency	7		10		8		6	
C.1	Established customer and related relationship management	Disclosure frequency	16		19		17		16	
C.2	Customer relationship management system	Disclosure frequency	0		1		1		1	
C.3	Delivery of products, services and solutions to customers	Financial information on generation of sales	0	265	0	377.8	0	379.3	0	434.8
C.4	Acquisition of customers, market channel development, sales	Merged with C.3								
C.5	Handling customer complaints	Disclosure frequency	0		0		0		0	
Growth Performance (revenue growth per annum):				32%		43%		0%		26%

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Case B.S.4 Maxim

Code	PIs	Proxy	Year-1 Disclosures	Year-1 Financial Data	Year-2 Disclosures	Year-2 Financial Data	Year-3 Disclosures	Year-3 Financial Data	Year-4 Disclosures	Year-4 Financial Data
H.1	Founders and Senior Management's Experience in industry	Estimated years of senior management's experience in industry	180		195		210		225	
H.2	Education/ Qualification	Disclosure about education/qualification (0=no, 1=yes)	0		0		0		0	
H.3	Staff Retention Policy	Disclosure about staff retention (0=no, 1=yes)	0		0		0		0	
H.4	Stock Options	Availability to management and staff (0=nil, 1=key management, 2=other staff)	2		2		2		2	
H.5	Training and Development	Disclosure Frequency	1		1		1		2	
H.6	Multidisciplinary Team	Disclosure Frequency	3		0		0		0	
I.1	Research and Development Capability	Disclosure frequency; pertinent expenditures	9	42.4	7	47.5	8	51.3	7	72.2
I.2	New Product Development Cycle	Disclosure frequency	0		7		6		9	
I.3	Innovation Culture	Disclosure frequency	0		5		5		5	
I.4	Generation and Execution of New Ideas	Disclosure frequency	0		0		0		0	
I.5	Responsiveness to Market Changes	Disclosure frequency	13		13		15		19	
I.6	Absorption Capacity for Emerging Technologies	Disclosure frequency	9		12		14		12	
S.1	Establishment of infrastructure	Disclosure frequency; capital expenditures	0	35.6	0	75	0	44.2	0	109.4
S.2	Enterprise resource planning system or similar information system	Disclosure frequency	1		1		4		4	
S.3	Administrative / organizational policy	Disclosure frequency	3		2		4		6	
S.4	Supply chain management system	Disclosure frequency	2		3		5		4	
S.5	Quality management system (including manufacturing activities as appropriate)	Disclosure frequency	8		9		9		10	
C.1	Established customer and related relationship management	Disclosure frequency	13		15		18		19	
C.2	Customer relationship management system	Disclosure frequency	1		1		2		1	
C.3	Delivery of products, services and solutions to customers	Financial information on generation of sales	0	250.8	0	421.6	0	455.7	0	560.2
C.4	Acquisition of customers, market channel development, sales	Merged with C.1								
C.5	Handling customer complaints	Disclosure frequency	0		0		0		0	
Growth Performance (revenue growth per annum):				63%		68%		3%		29%

Case B.S.5 Novellus

Code	PIs	Proxy	Year-1 Disclosures	Year-1 Financial Data	Year-2 Disclosures	Year-2 Financial Data	Year-3 Disclosures	Year-3 Financial Data	Year-4 Disclosures	Year-4 Financial Data
H.1	Founders and Senior Management's Experience in industry	Estimated years of senior management's experience in industry	165		176		187		197	
H.2	Education/ Qualification	Disclosure about education/qualification (0=no, 1=yes)	0		0		0		0	
H.3	Staff Retention Policy	Disclosure about staff retention (0=no, 1=yes)	0		0		0		0	
H.4	Stock Options	Availability to management and staff (0=nil, 1=key management, 2=other staff)	2		2		2		2	
H.5	Training and Development	Disclosure Frequency	1		1		1		1	
H.6	Multidisciplinary Team	Disclosure Frequency	0		0		0		0	
I.1	Research and Development Capability	Disclosure frequency; pertinent expenditures	13	53.9	12	89.8	17	106.5	18	119.7
I.2	New Product Development Cycle	Disclosure frequency	12		14		10		10	
I.3	Innovation Culture	Disclosure frequency	0		0		1		0	
I.4	Generation and Execution of New Ideas	Disclosure frequency	0		0		0		0	
I.5	Responsiveness to Market Changes	Disclosure frequency	25		27		30		35	
I.6	Absorption Capacity for Emerging Technologies	Disclosure frequency	9		12		16		20	
S.1	Establishment of infrastructure	Disclosure frequency; capital expenditures	2	35.3	1	36.2	1	36	3	28.8
S.2	Enterprise resource planning system or similar information system	Disclosure frequency	20		25		27		30	
S.3	Administrative / organizational policy	Disclosure frequency	4		7		0		2	
S.4	Supply chain management system	Disclosure frequency	3		8		2		4	
S.5	Quality management system (including manufacturing activities as appropriate)	Disclosure frequency	12		15		18		21	
C.1	Established customer and related relationship management	Disclosure frequency	23		27		30		35	
C.2	Customer relationship management system	Disclosure frequency	1		1		1		1	
C.3	Delivery of products, services and solutions to customers	Financial information on generation of sales	0	461.7	0	534	0	519	0	593
C.4	Acquisition of customers, market channel development, sales	Merged with C.1								
C.5	Handling customer complaints	Disclosure frequency	0		0		0		0	
Growth Performance (revenue growth per annum):				24%		16%		-3%		14%

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Case B.S.6 Xilinx

Code	FIs	Proxy	Year-1 Disclosures	Year-1 Financial Data	Year-2 Disclosures	Year-2 Financial Data	Year-3 Disclosures	Year-3 Financial Data	Year-4 Disclosures	Year-4 Financial Data
H.1	Founders and Senior Management's Experience in industry	Estimated years of senior management's experience in industry	75		80		85		90	
H.2	Education/ Qualification	Disclosure about education/qualification (0=no, 1=yes)	0		0		0		0	
H.3	Staff Retention Policy	Disclosure about staff retention (0=no, 1=yes)	0		0		0		0	
H.4	Stock Options	Availability to management and staff (0=nil, 1=key management, 2=other staff)	1		2		2		2	
H.5	Training and Development	Disclosure Frequency	0		0		0		0	
H.6	Multidisciplinary Team	Disclosure Frequency	0		0		0		0	
I.1	Research and Development Capability	Disclosure frequency; pertinent expenditures	16	64.6	15	71.1	18	80.5	16	90.9
I.2	New Product Development Cycle	Disclosure frequency	17		19		24		19	
I.3	Innovation Culture	Disclosure frequency	2		1		1		1	
I.4	Generation and Execution of New Ideas	Disclosure frequency	0		0		0		0	
I.5	Responsiveness to Market Changes	Disclosure frequency	19		22		26		21	
I.6	Absorption Capacity for Emerging Technologies	Disclosure frequency	13		14		16		15	
S.1	Establishment of infrastructure	Disclosure frequency; capital expenditures	0	60.5	1	25.8	1	29.7	1	40.9
S.2	Enterprise resource planning system or similar information system	Disclosure frequency	15		14		12		16	
S.3	Administrative / organizational policy	Disclosure frequency	3		2		2		2	
S.4	Supply chain management system	Disclosure frequency	11		5		6		6	
S.5	Quality management system (including manufacturing activities as appropriate)	Disclosure frequency	2		2		3		3	
C.1	Established customer and related relationship management	Disclosure frequency	14		16		19		17	
C.2	Customer relationship management system	Disclosure frequency	0		0		1		1	
C.3	Delivery of products, services and solutions to customers	Financial information on generation of sales	0	560.8	0	568.1	1	613.6	0	662
C.4	Acquisition of customers, market channel development, sales	Merged with C.1								
C.5	Handling customer complaints	Disclosure frequency	0		0		0		0	
Growth Performance (revenue growth per annum):				58%		1%		6%		8%

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APPENDIX D

Ethics Guidelines

Principles of Ethical Research

1. In all forms of research conducted in the Department we will operate with as full a consideration as possible of the consequences of our work for society at large and groups within it.

2. We will handle all confidential information with appropriate levels of discretion and compliance with the law and with due diligence as to the security of that data. We will normally prevent the publication or use of data in any way that could compromise the subject's confidentiality or identity.

3. Any material being prepared for publication both inside and outside of examination purposes will be produced in such a way as to reduce the possibility of breaches of confidentiality and / or identification. If necessary, this process will be subject to a written statement as to agreed process between any sponsors of research, research subjects and the Department.

4. We will try to avoid overburdening subjects, causing them inconvenience and intruding into their private and personal domains.

5. Subjects will be informed as to the purpose and nature of any inquiry in which they are being asked to participate.

6. We will avoid misleading subjects or withholding material facts about the research of which they should be aware.

7. Where the research methodology allows for it, a research subject will be expected to be provided with a copy of these Statements of Principles along with a consent form which will also indicate a subject's right of referral and appeal to a higher authority in the Department and through Faculty to the University Ethics Committee.

8. Where the research methodology suggests that a different kind of consent is the only one possible this will be made clear in the ethical approval form but subjects will be referred to departmental web pages or made aware of these principles by the researcher in order to understand the issues as at paragraph 7 above.

9. All staff, researchers and their supervisors are required, before the project begins, to submit to the chair of the departmental ethics committee, either a short-form or a long form ethical approval form. Only on formal approval by the ethics committee will the project be permitted to begin.

10. In the situations listed in the following subsections, staff, researchers and their supervisors must produce a justified case using a standard Application Form for Ethical Approval.

a. When the research methods employed might be regarded by the lay public to have delicate or controversial elements or when the research might be considered to give rise to adverse publicity for the University.

b. When the research involves the use of individual medical records

c. Where there might be difficulties in obtaining the subject's informed consent. This to include but not be limited to the following examples: with vulnerable people, including children; and those with learning difficulties; when proposing to use covert observation; or when employing a methodology in which the practicalities of obtaining signed consent forms are infeasible.

Only if and when the Departmental or subsequently the Faculty Ethics Committee has approved the research can it commence.

11. All members of staff and all student at all levels are required to read and agree to comply with these statements and to operate them in the full spirit in which they are written. Failure to comply with these statements will be regarded as a disciplinary offence.

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12. All researchers and all supervisory staff at all levels must sign an agreement on an annual basis, indicating their acceptance of these Principles.

Source: http://www.gla.ac.uk/departments/businessandmanagement/content/ethics/ethics.htm