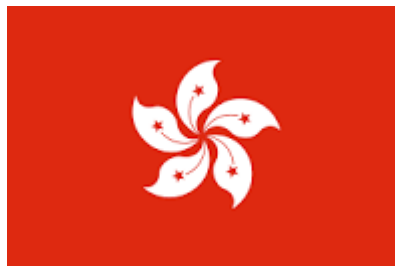


LEVEL 7 ASSESSMENT SPECIFICATION

Student name:	Lau Ching Hoi Patrick	Student ID number:	1916324
Programme:	DBA		
Module:	Approaches to Research and Academic Communication		
Module code:	HKBM7000	Contribution to Overall Module Assessment (%):	60%
Lecturer:	Dr. Luk Chung Leung	Internal Verifier:	
Assignment Title:	Research Proposal	Word count (or equivalent):	5,577 words
Submission deadline:	3 August 2020	Return date of provisional marks & written feedback:	7 September 2020
Submission method:	All written assessments, where practical and possible, must be submitted via Turnitin unless otherwise instructed by the Lecturer. (Please DO NOT put this assessment specification into Turnitin or it will match many similarities with other students' submissions.) Alternative submission method (if applicable): Late submission of the assessment will result in a late penalty mark. Penalties for late submission: Up to one week late, maximum mark of 50%. Over one week late, 0%. Only the Extenuating Circumstances Panel may approve a change to submission dates.		
Academic honesty / referencing:	Academic honesty is required. In the main body of your submission you must give credit to authors on whose research and ideas your work is based. Append to your submission a reference list that indicates the books, articles, etc. that you have used, cited or quoted in order to complete this assessment.		
Module Learning Outcomes (from module syllabus)			
By the end of this module the student should be able to: 1. Critically reflect on the role of theory, epistemology, ontology and axiology in shaping and interpreting research; 2. Critically discuss approaches to reliability, validity and bias in social research; 3. Examine fully the ethical considerations in social research and develop research designs that meet a high standard of ethical practice; and 4. Critically analyse communications and communicate scholarship effectively.			

Research Title

Examine the Relationships between Research and Development Investment Factors and the Success and Sustainability of High Technology Companies in Hong Kong as it Enters Industry 4.0



Abstract

Objectives

Hong Kong is facing an enormous challenge to make a successful transition into the Industry 4.0 era based on local technologies due to the low and continuously declining level of research and development investment in local High-Tech industries. Hence, this study seeks to comprehend if there are certain method of R&D investment allocation and investment related factors that exist which can enable local companies with limited R&D investment resources to remain successful and sustainable.

Literature Review and Reference to Past studies

Studies from both Ernest & Young (Heidenreich, M; Miller, R.J.; Martin, R; Valsan, A; Huthwaite, B; Grant, R; Carter, J; Dharmani, S. 2016) [9] and PwC (Jaruzelski B; Robert Chwalik R; and Goehle B October 2018) [7] concluded that there is no strong correlation between innovation investment and financial performance. In fact, in one PwC's analysis [7], the 10 most innovative companies outperformed the 10 biggest R&D spenders on revenue growth, gross margin, and market cap growth. Another PwC study (Strategy& | PwC 2018) [10] discovered that there are close relationship between growth of company revenue and when executive team is involved in R&D investment and strategy.

Other studies done for East Asian countries like Taiwan (Xu J; Sim J.W. August 2018) [4] & Korea and China (Chen T.C; Guo D.Q.; Chen H.M. and Wei T.T. August 2019)[5], also tried to correlate R&D intensity and investment level with the financial performance of companies in high tech and manufacturing background. Although there is an indication that R&D investment has a positive impact on firm performance in the case of China and Korea, the impact of R&D investment on firm performance is different in China and South Korea (Xu J; Sim J.W. (August 2018) [4] which clearly supports the need of a separate study for Hong Kong. Nonetheless, results from all these previous researches will contribute to the foundation of our Hong Kong specific research study.

Based on the findings from these studies, there is also indication of confounding and moderating factors being responsible for the financial performance of companies instead of simply related to the R&D dollars spent. Hence, our research will attempt to identify these confounding factors.

Methodologies

By using previous studies as the foundation, this research will formulate a number of hypotheses which is an extension of these studies. Subsequently, the next step is to identify major R&D investment metrics, which form the basis of independent variables, and company performance metrics, which are the major contributors of dependent variables. Moderators such as CEO education level and Board of Director connections with the industries will also be captured where possible for further analysis. Collection of data in a three year time interval which align with R&D product cycle will form the basis of study. Additional annualized data collected will be added if it is relevant.

A small number of interviews will be carried out, as pilot research, with CEOs, Country Managers and Division Heads to see if the hypotheses derived are reflective of their company growth strategies both in past, present or future. Hypotheses modification and retesting will be done if results from data analysis indicate there is significant deviation from original hypotheses.

Large scale collection will commence after the design and creation of an appropriate questionnaire, which will then be distributed to representatives of candidate companies in Hong Kong High Tech industries. The collected data will then be analysed both quantitatively and qualitatively to identify any correlation between inputs and the corresponding outputs.

Expected Results

This study will serve as a starting point for identifying successful R&D investment model and the corresponding resource investment approach. From the China and Korea studies, there is a negative correlation between R&D investment and firm size, which implied medium and small-sized firms made more R&D investment as a percentage of spending and we expect similar results in Hong Kong. Nevertheless, we also expect amount of R&D investment will still positively affects firm performance in Hong Kong as they do in China and South Korea. Data models or relationships obtained will hopefully provide insightful information to improve the investment efficiency of High Tech companies in Hong Kong, especially those with limited R&D resources.

According to a European Commission study, which analyze datasets covering over twelve years, done by Izsák, K.; Paresa Markianidou, P.; Radošević, S. and published in June 2013,^[39] “upgrading the innovation performance of a country and how this translates into concrete economic outputs cannot be limited to the sole innovation policy mix. Technology accumulation and innovation are strongly shaped by favorable or less favorable framework conditions and by the broader institutional environment. Workable innovation policy mixes cannot compensate for weaknesses in the framework conditions.” Hence, our research finding can hopefully offer some insight into creating complementary approach and framework to the current Hong Kong government policies.

Background Introduction

As a developed and open economy, Hong Kong has been very successful from a commercial perspective since the end of World War II. In fact, its GDP has reached 2.87 Trillion HKD with a GDP per Capital in excess of HKD 382,000 in 2019 HKSAR Government. (Census and Statistics Department, Dec 2019) [11] Unfortunately, as we enter Industry 4.0, Hong Kong's Research and Development spending has been quite minimal, at only 0.86% of Hong Kong total GDP or at 24 Billion HKD (Science & Technology Statistics Section, Census and Statistics Department, Dec 2019)[12]. This is quite a miserable amount in comparison to real estate spending exemplified by the sale of a plot of land on top of Kowloon MTR station for HKD 42 Billion in 2020. (Wong, N Jan 2020)[13]

The reason of low research and development investment can be explained by a recent Deloitte's survey (Lam, T.; Chan B.; Law, P.; Zhao, J.)[14] where "Only 36 percent of Hong Kong entrepreneurs said their organizations would follow and apply new technologies to achieve cutting-edge innovation, compared with much higher percentages among respondents from Shenzhen (82 percent) and Guangzhou (76 percent)." "Meanwhile, low acceptance of new patterns and emerging technologies among clients, as well as inadequate innovation investment, are seen as the biggest innovation challenges, with both cited by 33 percent of Hong Kong entrepreneurs. Hong Kong also saw the most respondents choose 'absence of an innovation culture' (21 percent), and 'short-sighted planning and opportunism' (17 percent)" when compared to Shenzhen and Guangzhou. This conservative investment approach for innovation clearly put Hong Kong in a disadvantaged position in terms of innovation and hindering its ability to drive and develop its own local research and development ecosystem going forward.

The necessity of a successful transition for Hong Kong into Industry 4.0 through re-industrialization can be summarized by a Legislative Council paper submitted by GS1, stating "We believe the workforce and aging issues can be alleviated with the advent of re-industrialization initiatives, in areas of healthcare, food service, etc. Re-industrialization not only help to reduce labor shortage associated with the labor-intensive industries, but also make the best use of land that produce high value-added, service-oriented product offerings." (GS1 2017-2018)[15].

As a maturing society from both an age and economic development perspective, the slowing growth in Hong Kong means it is in urgent need to discover new ways to stay as a wealthy society and remain competitive. Hong Kong's solution of maintaining its wealth in the longer term can be found from Porter's study, "Wealth is actually created at the microeconomic level of the economy, rooted in the sophistication of actual companies as well as in the quality of the microeconomic business environment in which a nation's firms compete. Unless these microeconomic capabilities improve, macroeconomic, political, legal, and social reforms will not bear full fruit." (Porter, Michael E. 2004)[16]

Hence, the Hong Kong government has made a good and important decision to address the possible economic decline brought by failure to migrate to the fast expanding Industry 4.0 world by improving microeconomic business competitiveness through "committed to promoting innovation and technology (I&T) development in Hong Kong. Over the past two and a half years, the Government has committed over HK\$100 billion to build and enhance the local I&T ecosystem along the eight major areas set out by the Chief Executive in her 2017 Policy Address." (HKSAR Government Dec 2019)[17]

However, there is no clear historical or research reference to advise how the government and local companies can invest its R&D resources to ensure its future success in Hong Kong especially in the High Tech industries. Moreover, "literature often indicates that different technological and institutional environments may respond in different ways to similar incentives and hence an optimal policy mix in one country might not work at all in other countries (Callon and al., 1986)[40]. Hence, a Hong Kong focused research is needed to determine if there is any strong or definitive relationships between various R&D investment factors and actual outcome to ensure all R&D investments are made in the best manner possible especially when most local companies have limited R&D resources for investment.

Context of Research and Related Considerations

General Definition of Industry 4.0

The diagram below from IBM provides a snapshot of architecture for a typical factory operating under Industry 4.0 (Bonnaud, S.; Didier, C.; Kohler, A; Sept 2019)^[20] and it is clear there are lots of technological components involved. The ability to control or master these components is essential for Hong Kong's local industries and from a high tech jobs creation perspective. Many of these components can be apply to non-manufacturing business environment that requires monitoring and control such as building & facilities management, traffic management & even logistics management.

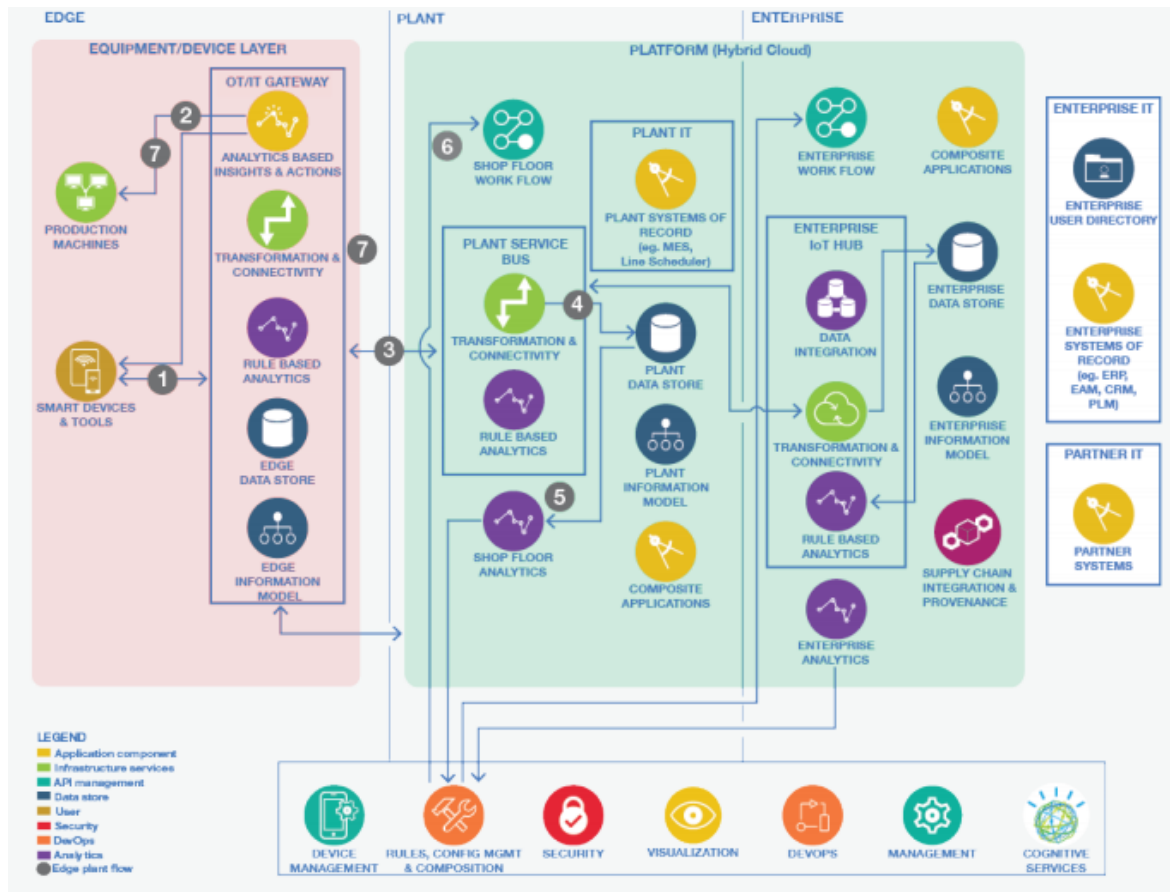


Fig 1. Industry 4.0 architecture pattern. [20]

Why It is Important for Hong Kong to Own Local Technologies in Industry 4.0

The extent of Industry 4.0 is far beyond simple manufacturing as its label suggests. "At the core of Industry 4.0 is data. Through Internet of Things (IoT) technology, data from every step of the whole production cycle, from order placement to procurement, production to shipment, can be collected and analyzed in real time. Resources and production schedules are then adjusted constantly to achieve the goal of producing high-quality products efficiently and at low cost." (Shan, R. June 2018)^[21]. Hence, the ability to understand and control of every component, especially through local development, within of Industry 4.0 is critical for the success of any economies and Hong Kong is no exception.

More importantly, from a social and economic perspective, "Industry 4.0 will provide an exceptional platform and unprecedented opportunities for young people to reshape Hong Kong's economic landscape." especially since "Hong Kong was once famous for its industrial sector, with the manufacturing industry being the main driving force of its economy in the 1960s and '70s. The diminishing manufacturing industry has not only resulted in an evident imbalance in industrial

structure, but also concealed damages, such as the loss or degradation of labor quality, traditional workmanship, craftsmanship, production expertise, supporting industries, and cooperative opportunities between academia and industrial sector." Therefore, the re-industrialization of Hong Kong will serve both the social and economic goals for the new generations. Nonetheless, "Hong Kong has never been short of scientists and business leaders but severely lacks the professional talented workers required for reindustrialization. The success of Hong Kong's Industry 4.0 will largely hinge on the nurturing of adequate amount of professional talents and the revival of the blue-collar working class." Kan, H.Y.; Zhu, Y.; (May 2019) [22]

Considerations beyond Financial Aspects

In a World Bank study through InfoDev[23], it clearly stated "Theoretical frameworks that outline variables linking entrepreneurship and growth are not well developed". Olafsen, E. (Sept 2016)[24] further explained that there is no conclusive argument to support success and financial investment even though "Evidence suggests that mid-career professionals in their late 30s to early 40s are more successful at scaling companies. Individuals with at least seven years of work experience in their sector significantly outperform those who have less experience. Other research points to psychological traits that characterize individuals and teams that drive start-ups to scale, including a higher-than-normal risk appetite, an internal locus of control, and higher-than-average scores for creativity and persistence."

In addition, the Boston Consulting Group (BCG) has surveyed 400 deep-technological start-ups on the issues and challenges they have to deal with and respondents have identified the following area as most frequent, including lengthy time-to-market (27%), high capital intensity (25%), technology risk and complexity (17%), and yet-to-be-developed commercial applications (14%). (de la Tour, A.; Soussan, P.; Harlé, N.; Chevalier, R.; Duportet, X.; 2017) [25] Successful navigation against these challenges clearly requires more than just monetary spending in R&D as shown in the following figure which will require further investigation and research into other area.

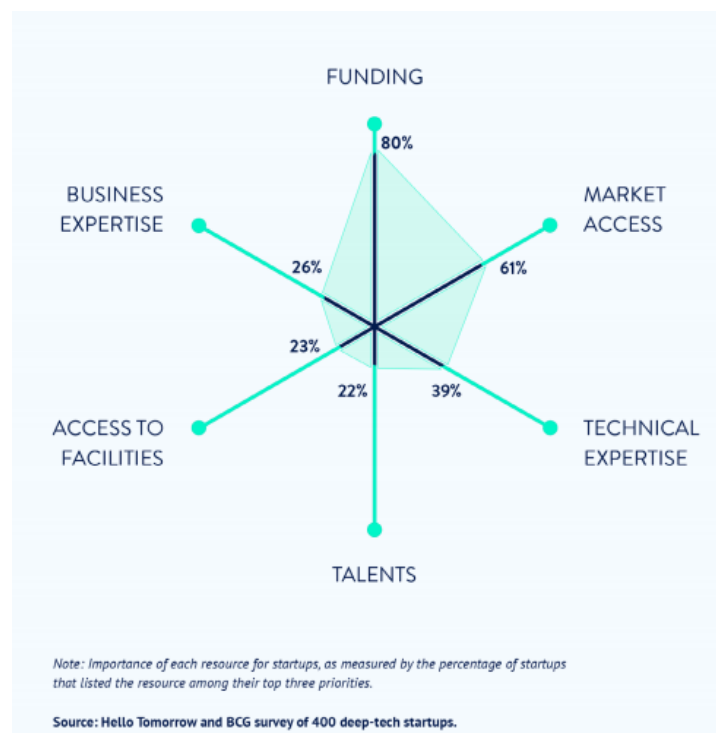


Figure 2 Most critical resources identified by startups for them to succeed.[25]

The Importance of Sustainability

The ability to survive its first few years of business is critical for the longevity and success of any company. In the case of high tech companies with limited resources, infinite amount of investment into R&D as a way to drive growth is simply not sustainable. Although “the visionary companies invested more heavily in R&D as a percentage of sales in every single case”, “real difference between success and failure in a corporation can very often be traced to the question of how well the organization brings out the great energies and talents of its people. And how can it sustain this common cause and sense of direction through the many changes.” (Collins, J.C.; Porras, J.I.; 2002)^[26] Collins and Porras further used Bill Hewlett and Dave Packard as a successful example on how they earned a sustained reputation for great products through “quickly made the transition from designing products to designing an organization— creating an environment—conducive to the creation of great products” (Collins, J.C.; Porras, J.I.; 2002)^[26]

According to a study done by Cbinsights^[27] which tracked over 1,100 tech companies that raised seed rounds in the US in 2008-2010, nearly 67% of startups stall at some point in the VC process and fail to exit or raise follow-on funding, usually around 20 months after first raising financing. The odds of becoming a unicorn remained and hovered around 1% (1.07%). (CBinsights September 2018) ^[27] In its 2019 update, Cbinsights found that shuttered company executives frequently cited common factors like a drop-off in funding and increased competition, especially within emerging industries. (CBinsights October 2019) ^[28]

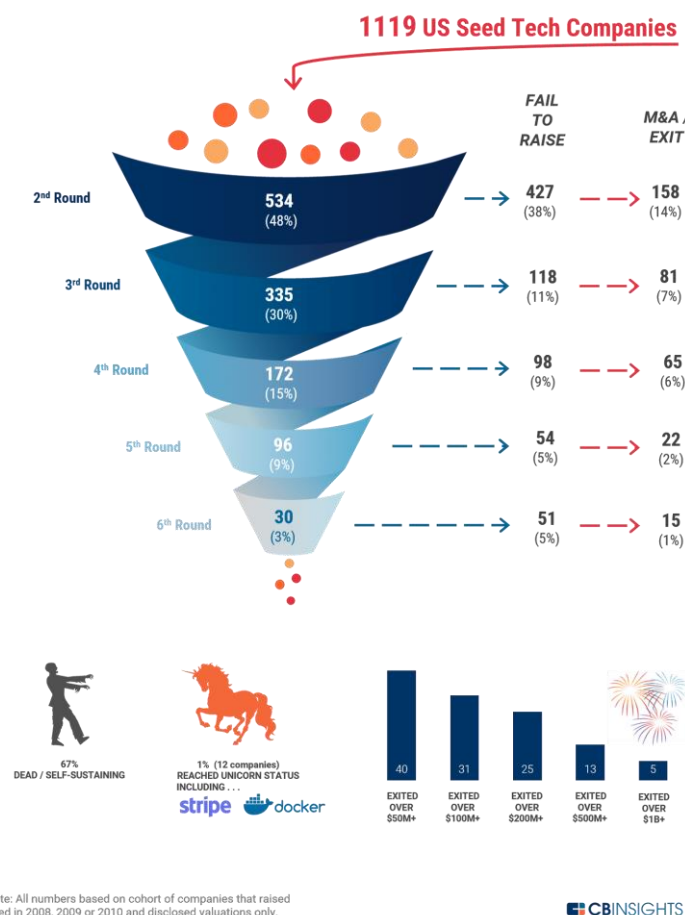


Fig 3 The venture capital funnel highlights the natural selection inherent in the venture capital process ^[27]

Hence, identifying factors that can enable companies to sustain itself beyond the initial period would provide critical insights for Hong Kong High Tech companies to succeed after initial establishment.

Research Objectives Definition

Although Hong Kong's Research and Development spending has been quite minimal, only at 0.86% of Hong Kong total GDP at 24 Billion HKD (Science & Technology Statistics Section, Census and Statistics Department, Dec 2019)^[12], its researchers per million inhabitants ratio is still similar to the ratios enjoyed by developed countries (UNESCO Institute for Statistics Dec 2018)^[3]. This offers hope that Hong Kong is still capable to develop its own niche to enter the era of Industry 4.0.

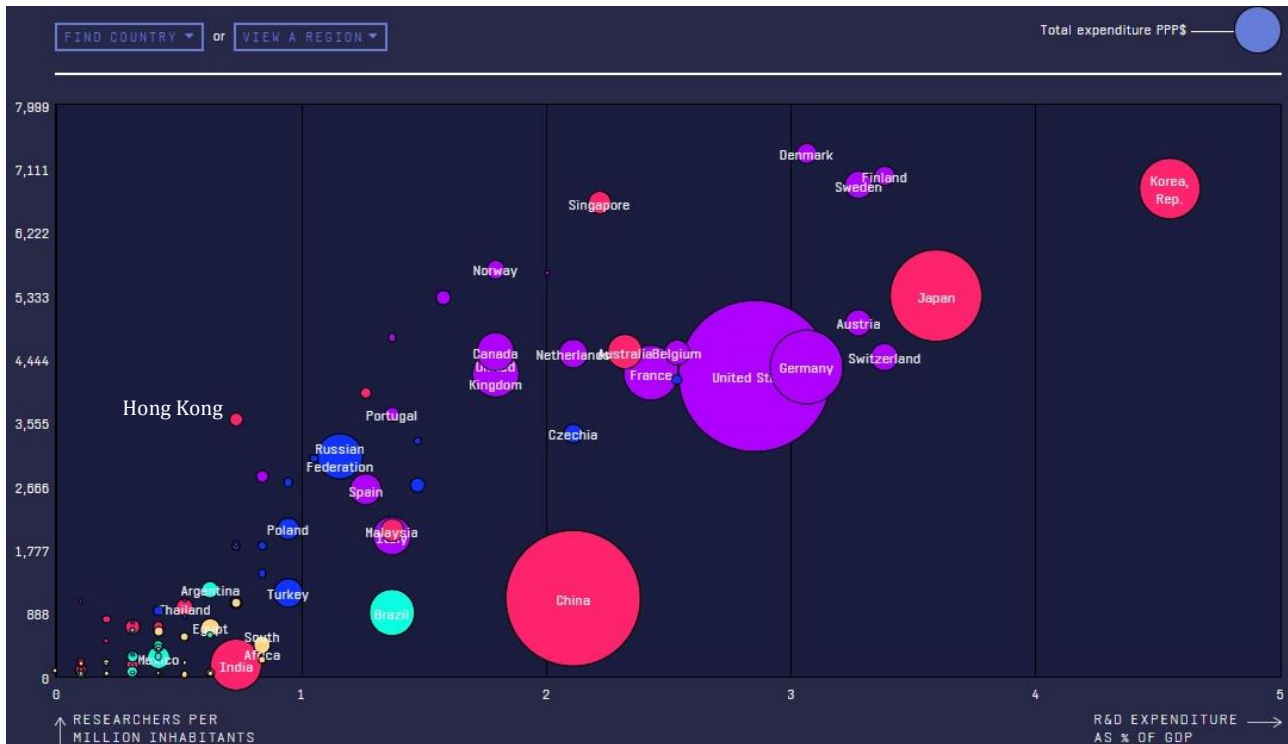


Fig 4 Researchers Density vs R&D Expenditure (UNESCO Institute for Statistics Dec 2018) [3]

While R&D investment has a positive impact on firm performance in the case of China and Korea (Xu J.; Sim J.W. August 2018)^[4], the characteristics of Hong Kong technology entrepreneurs are likely to be different from those in China and Korea. For instance, Tse believes Chinese entrepreneurs “firmly believe that success will come from pushing onward, taking risks, and reacting quickly to opportunities; from constantly searching for small advantages that will allow them to steal a brief march on their immediate competitors, and larger ones that will enable them to enter a new business area” (Tse, E.; 2015)^[18]. On the other hand in Korea, Professor Kae H. Chung (Chung, K.H.; Lee, H.C.; Jung, K.H.)^[19], “mentions that an authority is centered towards the upper level of the managerial hierarchy, suppressing individualism, an important component of entrepreneurship”.

As such, it will be relevant to Hong Kong to conduct its own research aimed at identifying essential R&D investment factors to achieve a successful and sustainable business for local high tech company and this will be the objective of this research. Findings from this research would help local Hong Kong companies and economy to make a successful transition into Industry 4.0 by maximizing the use of local produced technologies.

Literature Review

A number of studies was carried out around high tech industries of East Asia in an attempt to correlate the relationship between R&D spending against company performance and their findings has provided useful insights to be the foundation reference for our research. For instance, a study on the effects of R&D intensity on firms' performance in Taiwan (Chen T.C; Guo D.Q.; Chen H.M. and Wei T.T. August 2019)[5] has found in Taiwan "that significant R&D investments in a given period may reduce business performance in the same period and continue to influence it in the next few periods, thus indicating the presence of a positive and lagged effect of R&D investments in the high-tech industry. Firm size was also found to be positively correlated with business performance, that is, the larger the firm size, the greater is the use of resources for R&D, which, in turn, leads to more sophisticated technologies and profitable outcomes, forming a positive cycle. This indicates that R&D expenditures affect firms' sustainable management."

However, Chen, Guo and Wei did the study for Taiwan because "there are numerous studies on the relationship between R&D investment and business performance in various countries; however, a majority of these studies present diversified results". Hence, it is definitely worth carrying out a separate study for Hong Kong High Tech industries as there may be variations when compared with the more capital intensive Taiwan counterparts.

On the other hand, in an E&Y study (Heidenreich, M; Miller, R.J.; Martin, R; Valsan, A; Huthwaite, B; Grant, R; Carter, J; Dharmani, S. 2016)[9], they found it is difficult to form simple correlation between R&D investment and output globally. "While there may be increased levels of R&D spending across businesses, those investments aren't always productive. In fact, a study involving over 10,000 analyses of R&D spending across the 1,000 largest R&D spenders found no statistical correlation between R&D spending and sales growth, gross profit growth, operating profit growth, operating margin, net profit growth, net margin, market cap growth or total shareholder return". This clearly indicates the presence of local factors will contribute to the business performance results which warrant a research specifically for Hong Kong.

In addition, VanderPal did a study of 103 companies, which registered high values of R&D spending, between 1979 and 2013 and investigates the R&D impact on the financial value of the company (VanderPal, G.A. (2015)[29]. In this study, Vanderpal concluded there is positive relationship between R&D expense and equity, revenue and return on asset. However, the level of research and development investments is negatively correlated with return on equity. So there is definitely a need for further research especially for Hong Kong High Tech industries due to the local financial market emphasis of return on equity based evaluation.

The importance of how government incentives has been used was provided in a European Commission study (Izsák, K.; Paresa Markianidou, P.; Radošević, S.)(39]. It reported government funding that drives innovation for the twelve years prior to 2013 has been dominated by direct business R&D support, direct business innovation support, funding of research for university and public research organizations and collaborative R&D program so this research will also investigate.

Finally, Strategy&, a business unit within PriceWaterhouseCoopers, found out that over a 12 years timeframe, there is no statistically significant relationship between R&D spending and sustained financial performance. Its findings apply to total R&D spend, as well as R&D spending as a percent of revenues. Spending on R&D is not related to growth in sales or profits, increases in market capitalization or shareholder returns. In every single annual report that Strategy& has published, the top 10 most innovative companies are rarely the top 10 spenders on R&D which supports the need of a new research to carry out further investigation. (Jaruzelski B; Robert Chwalik R; and Goehle B October 2018)[7]

Hypothesis Development

From many previous studies done globally by various parties, [4][5][6][7][10] one common conclusion is increase in R&D spending will deliver some level of performance improvement. However, its effectiveness on a major dependent output, represented by company revenue, is not consistent if only the amount of R&D dollar spent is considered.

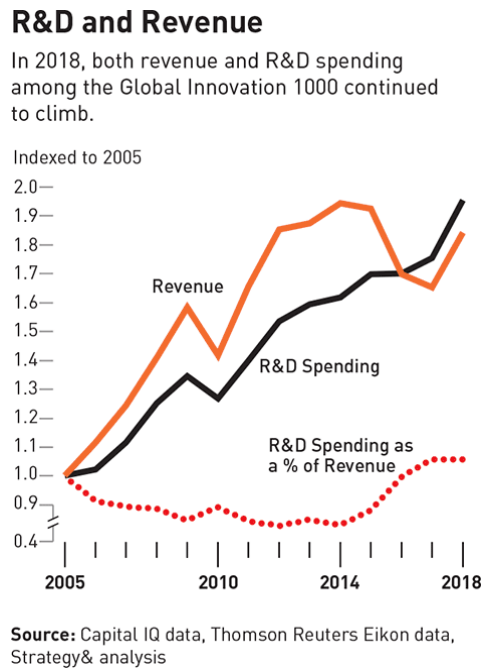


Fig 5 Relationship between Revenue, R&D spending for 1,000 publicly held companies that spend the most on research and development (R&D) [7]

Many of the studies done in this area in Asia are mainly referencing R&D spending against Company performance. However, confounding and moderating factors for qualitative analysis such as qualification of R&D employees and company CEOs as well as government funding impact have not been included. To extend the depth of existing models, our research will try to capture such information from target companies either through survey or interview. Hence, the aim of our hypotheses is to predict the outcome of dependent variables when new moderators and different independent variables previously not considered are included in different scenarios/hypotheses.

Listing of Independent Variables: Input for the analysis

- 1) Company R&D capital spending, (X1)
- 2) R&D manpower related spending, (X2)
- 3) R&D Operation expenses, (X3)
- 4) Number of R&D Staff (X4)
- 5) Qualification of R&D Staff (e.g. Number of Bachelor Degree, Number of Master Degree and Number of PhD (R&D Talent Indicator) (X5)
- 6) Number of non R&D Staff (X6)
- 7) Non R&D capital spending (X7)
- 8) Non R&D operating expenses (X8)

As Qualification is not an actual number, we will use a Five point Likert scale to classify qualification into different intervals. For instance, High Diploma or Below will score 1, Bachelor Degree will score 2, Master will be 3 while PhD will be 4 and Post Doctorate will be 5.

Listing of Dependent Variables: Output for Analysis

- 1) Company Revenue per year (Z1)
- 2) Number of Product Launched per year (Z2)
- 3) Number of Patents generated/applied (IP achievement output) (Z3)
- 4) Number of Company Spin-off attained (if applicable) (Z4)

List of Moderating Variables

- 1) CEO Education Qualification (Same Five point Likert scale as above) (Y1)
- 2) Number of High Tech Industrial Partners working with the Company (Y2)
- 3) Number of Partnership with External not for Profit Industry Related Organization (e.g. IEEE, Hong Kong University, HKPC) (Y3)
- 4) Number of External Board Members Appointment for CEO/BoD/Top Managers (Y4)
- 5) BoD or CEO has been previous employed by Government or Government Sponsored Organizations (Y5)
- 6) Number of Externally Qualified Skill Enhancement Program Undertaken by Employees (Y6)
- 7) Amount of Government Funding being received as part of the Innovation and Technology Funding Program. (Y7)
- 8) Use of other government or related organization facilities as a mean to increase competitiveness (e.g. Testing, Design and Data processing Facilities) (Y8)

1) Hypothesis One (H1)

Company revenue performance (Z1) will increase when company has more qualified R&D staff (X4, X5, X6) due to better capability.

According to Hong Kong government statistics supplied by OGCIO^[35], the Information technology industries in Hong Kong is best represented by staff with only first degree or below. Even R&D organizations in the IT industries has only 11% of their staff with master degree or above. (Fig. 6) NG, T.W.H and FELDMAN, D.C. (2009)^[36] pointed out “the meta-analysis shows that highly educated workers tend to display greater creativity and to demonstrate more citizenship behaviors than less educated workers.

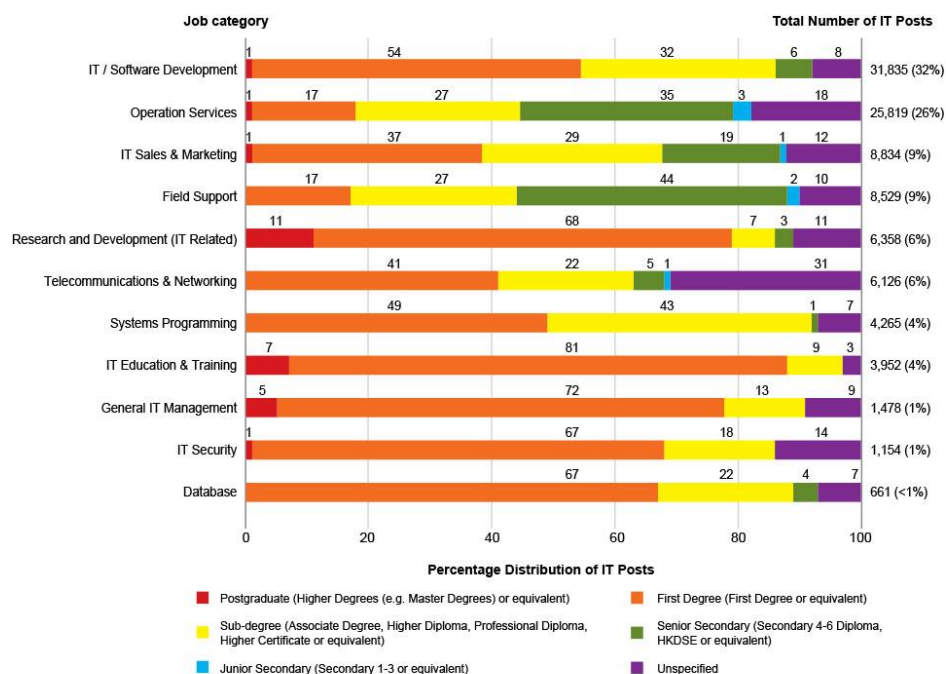


Fig 6 Distribution of Employee Academic Qualifications for Hong Kong IT Companies [35]

Moreover, highly educated workers appear to engage in fewer counterproductive work behaviors like workplace aggression, workplace substance use, and absenteeism.” As creativity is a critical success factor of High Tech Industries, it is definitely a major area our research needs to look at especially for Hong Kong companies.

2) Hypothesis Two (H2)

Company revenue performance (Z1) will be better when company has more academically qualified management team. (Y1)

This hypothesis is based on a Strategy& - PwC studies [10] of 1000 companies in 2018 and compared the revenue growth between different companies which has different level of management involvement in R&D strategy and investment decisions. A natural extension of this research is to investigate if management team is more qualified and through their moderation, Company should be able to make better R&D investment decision and able to achieve a better performance outcome for the company.

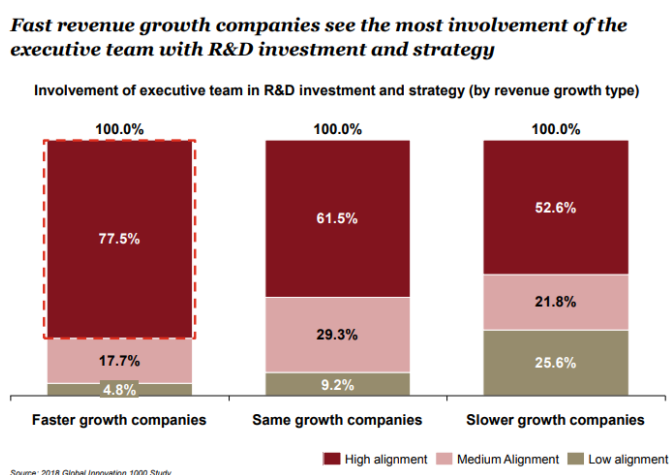


Fig 7 Comparison between Companies of Different Growth Rate due to Executive Involvement [10]

According to a McKinsey study, (Dewar, C.; Hirt, M.; Keller, S. 2019) [37] “containing 25 years’ worth of data on 7,800 CEOs from 3,500 public companies across 70 countries and 24 industries”, it has concluded “Leadership matters—and no leader is more important than the leader of leaders. Executives who are appointed to the top job can boost their leadership capabilities by understanding and adopting the mindsets and practices that define CEO excellence.” (Fig 8) As such, Hong Kong High Tech companies will not be different, thereby supporting the inclusion of CEO characteristics into this research.

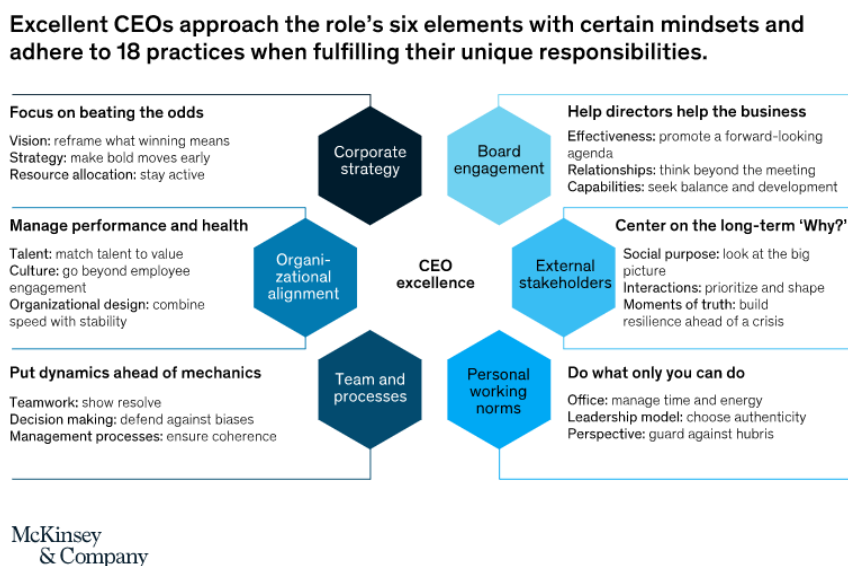


Fig 8 Comparison between Companies of Different Growth Rate due to Executive Involvement [37]

3) Hypothesis Three (H3)

Innovative performance of Company measured by such factors as the number of new products launched (Z2), new IP obtained (Z3) and possible Spin Off (Z4) will be higher when company has more academically qualified staff (X4, X5, X6)

According to the study done by PwC^[10] for 1000 global companies, there is good indication the ability of company to innovate is not dominated by top R&D spenders which contradicts the simple assumption of R&D monetary spending will correlate proportionally to innovation output. The ability and willingness to create innovations may well be driven by dedication and commitment of staff with higher academic qualification.

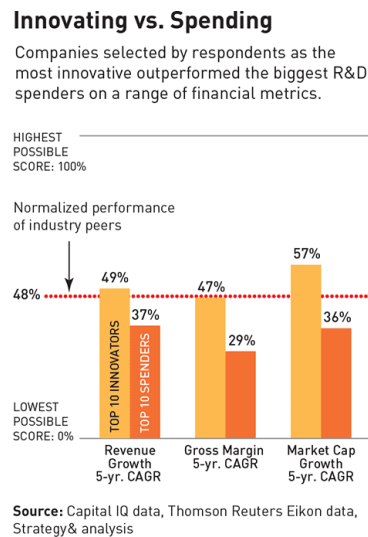


Fig 8 Financial Comparison between Innovative Companies vs Biggest R&D Spenders [10]

4) Hypothesis Four (H4)

Innovative performance of company (Z2, Z3, Z4) will be even higher than scenario described under Hypothesis 3 when company has better academically qualification management team (Y1) along with more academically qualified staff (X4, X5, X6)

The hypothesis here assumes under technically capable leadership, company should be more innovative than those without a technology savvy leader. This hypothesis is drawn from the observation made by another McKinsey study (de la Boutetière, H.; Montagner, A.; and Reich, A.; 2018) ^[38] related to digital transformation within organization. “Nearly 70 percent of all respondents say their organizations’ top teams changed during the transformation—most commonly when new leaders familiar with digital technologies joined the management team. Indeed, adding such a leader is one of the keys to transformation success.” The ability of Top leaders being able to understand and make good use of technologies available is crucial due to the broad spectrum of involvement of new technologies in High Tech projects. (Fig 9) Hence, it is included as one of the hypotheses.

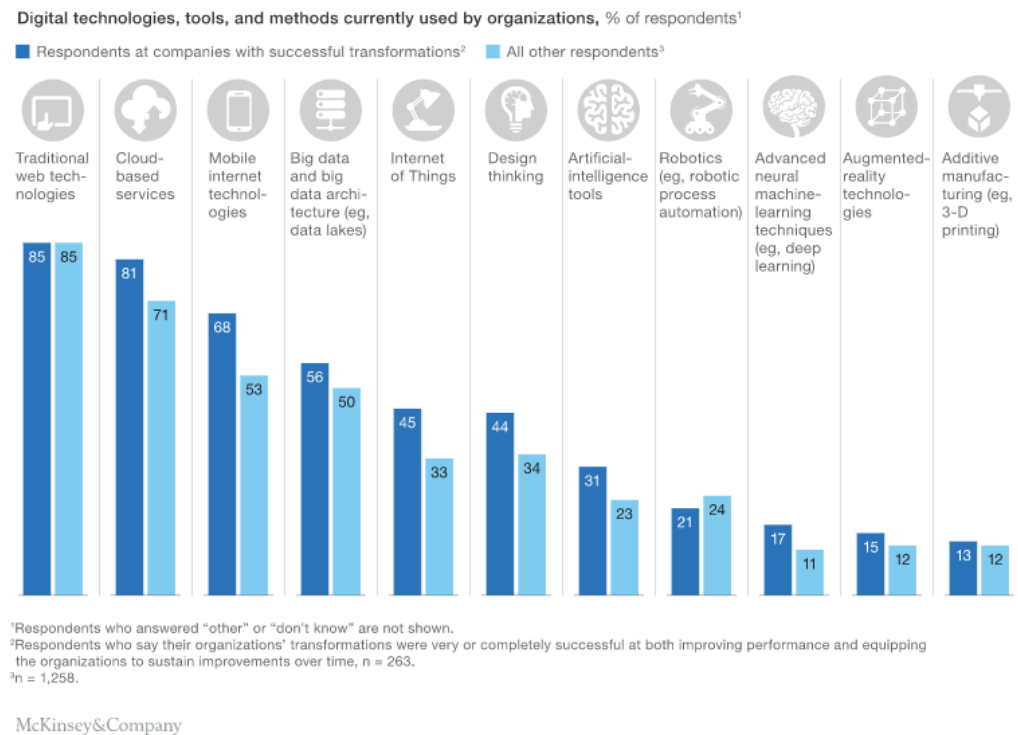


Fig 9 Organizations with successful transformations deploy more technologies than others do [38]

5) Hypothesis Five (H5)

Company revenue performance (Z1) will be higher if the management team has more association or cooperation with external companies (Y2, Y4) and not for profit industrial groups/organizations (Y3, Y5)

The ability to bring in new ideas and knowledge externally has always been critical in enabling innovations to happen within a company. "If the aim of an innovation project is to develop a process or product that is radically different from what is normal in the industry, companies should involve external actors and select research institutions and universities over customers and suppliers. There are several examples of industry-university collaborations that have led to radically new technologies or processes. Several radical innovations within the aviation, med-tech, semiconductor, and oil and gas industries have been developed and launched as a result of close interactions between companies and research institutions" (Lassen, A.H.; Laugen, B.T. 2017)[41]

If management of companies are active participants of industries association, having high exposures and association with other leaders in related industries, the likelihood of them accessing new ideas and technologies will be higher. This could become an important driver for new innovations and thereby creating new revenue for the company. As such, this is being listed as hypothesis 5 in our research.

6) Hypothesis Six (H6)

Company revenue performance (Z1) will be higher if the company is receiving more government assistance or funding (Y7)

As Hong Kong government has setup many technology assistant funding program, (HKSAR Government Dec 2019)[17] it is also worthwhile to investigate the relationship between funding program utilization and actual revenue performance for High Tech companies in Hong Kong

especially in house funding is likely to be limited. According to one McKinsey study (de la Boutetière, H.; Montagner, A.; and Reich, A.; 2018) “we found that companies with winning transformations have a better-funded and more robust approach to talent than others do.”

In the European Commission Study, (Izsák, K.; Paresa Markianidou, P.; Radošević, S.)^[39] it has reported that government funding that drives innovation for the twelve years prior to 2013 has been dominated by direct business R&D support, direct business innovation support, funding of research for university and public research organizations, and collaborative R&D program. Hence, it is important for this research to look for any correlations between company revenue and government funding for the Hong Kong High Tech industries.

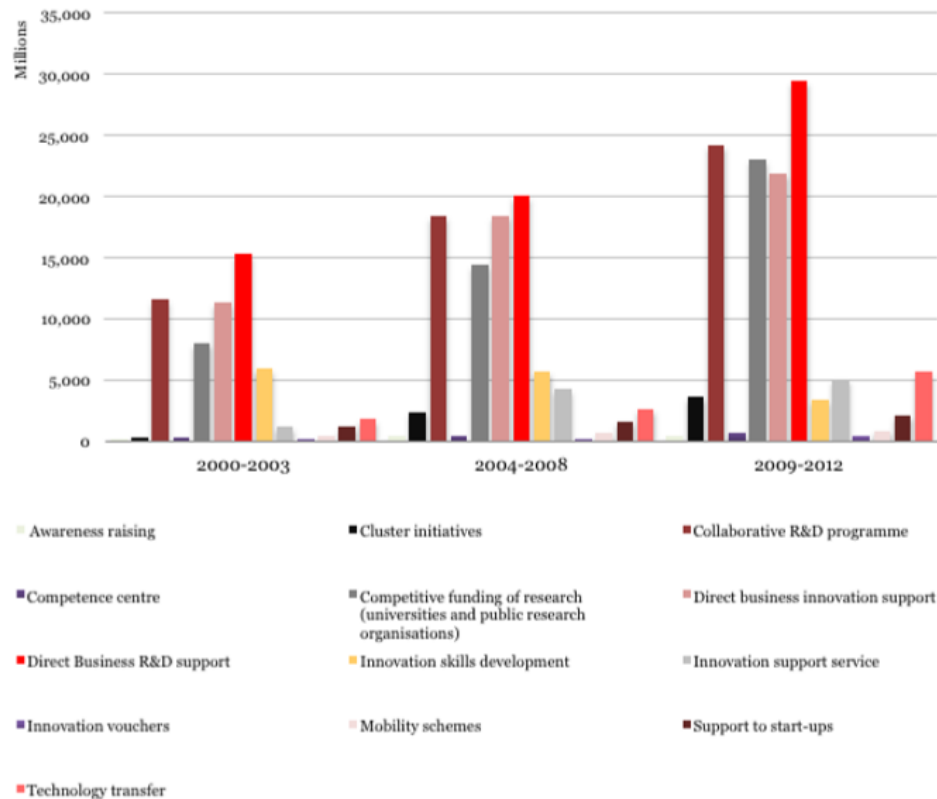


Fig 10 Composition of research & innovation policy funding 1999-2012 in the EU 27 plus Norway & Switzerland [40]

7) Hypothesis Seven (H7)

Company revenue performance (Z1) will be higher if the company use external testing and design facilities as a mean to increase its competitiveness (Y8)

By outsourcing certain non-core process to external firms, companies will not only having the opportunity to access the latest technologies but also reduce the amount of capital spending for non-core investment. Therefore Hypothesis 7 is established to investigate if outsourcing can be reflected in the increase of revenue performance for Hong Kong High Tech companies.

Dependencies on external factors/partners is shown by E&Y study which tried to come up with a comprehensive model where the success of company is indeed depending on the ability to balance a number of factors surrounding R&D itself, including skill set tracking so experts get the assignment most relevant to their expertise. “A key question at many companies is “How can we better leverage our resources around the globe to maximize efficiency and deliver improved R&D outcomes?” This question can’t be answered without a unified way of tracking employees’ skill sets and project staffing” -Rose Martin (Advisory, Performance Improvement E&Y LLP) (Heidenreich, M; Miller, R.J.; Martin, R; Valsan, A; Huthwaite, B; Grant, R; Carter, J; Dharmani, S. (2016) ^[9]

Hence, by identifying the effectiveness of test and design facilities outsourcing, Hypothesis 7 can lay the initial foundation for further study on outsourcing effectiveness for Hong Kong High Tech companies.



Fig 11 Relationship models for different factors that interact to affect R&D investment outcome.[9]

Data Collection, Sampling Design and Analysis Strategy

Target Respondents

As many of the data provided will be sensitive information, especially in the case of Startups and SMEs, the target participants will be CEOs or at least high ranking managers within the organization. For publicly listed companies, cross checking against annual reports or tax department filing could be carried out also.

Sampling Procedure

Due to the details involved, data collection via questionnaire will be the best way to carry out data collection. However, in order to increase the accuracy of responses to sampling questions, they must also be as discrete and precise as possible to eliminate person judgment because “Although certain circumstances may, by chance, dispose us to judge well, we can discover what counts as good judgment only by means of detached reflection” (Sandel, A.A; 2014)^[31]

Questionnaire Design

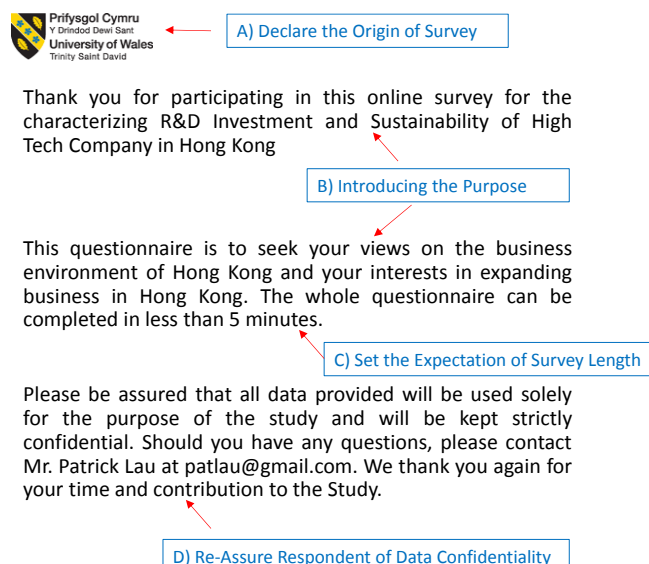
A user friendly questionnaire will be important to gain respondent attention and more likely to get enthusiastic responses. “Trim the fat”, “develop precise questions”, “using neutral language” and “Varying the ordering of options in a list” are all important factors to be included in a good questionnaire design. (Vallee, A. 2017)^[30]

As such, our research will include the following considerations as part of the final questionnaire

- 1) Simple to follow
- 2) Data protection pledge - data governance and privacy consideration
- 3) Direct and concise
- 4) Keep it short to minimize about of time spent by respondent.

Based on the above principles, a sample format has been designed and shown below.

- 1) Declaration page as first page to indicate the origin of the survey, its purpose, the expected duration of participation and pledge to keep data confidential.



- 2) Provide options for different language if necessary and list out definition of company categories to reduce ambiguity

The screenshot shows a survey form with the following elements:

- Language Selection:** A dropdown menu labeled "English" with a downward arrow. A red arrow points to it from a blue box labeled "E) Tri/Bilingual".
- Name of respondent:** A text input field.
- Job title:** A text input field.
- Company name:** A text input field.
- Based on the description above, what is the appropriate size designation of your company?** A section with three radio button options: "Large Company", "SME", and "Start-up".
- Definition of company size:** A section with a red arrow pointing to it from a blue box labeled "F) Clarify Definitions". The text below reads: "Large companies are companies with over 50 to 100 employees (over 100 employees for manufacturing enterprises). SMEs are companies with fewer than 50 employees and at least 3 years of establishment. Start-ups are SMEs with under 3 years of establishment."
- Navigation:** A blue button with a right arrow at the bottom right.

- 3) Ensure format of questionnaires answers are as consistent as possible through multiple choice instead of words

The screenshot shows a survey form with the following elements:

- Language Selection:** A dropdown menu labeled "English" with a downward arrow.
- Question:** "Do you currently have any intention to expand your business to/in Hong Kong?"
- Answers:** Two radio button options: "Yes" and "No". A red arrow points to the "No" option from a blue box labeled "G) Simple Click to Register Response".
- Navigation:** Two blue buttons with left and right arrows. A red arrow points from a blue box labeled "H) Clear Indication of Page Strolling" to both navigation buttons.

- 4) Ensure there is a clear indication that the end of the survey is reached

The screenshot shows a survey form with the following elements:

- Question:** "What initiatives / facilities / equipment are essential for your business to thrive this year? (Please select all that apply)"
- Options:** A list of checkboxes with labels: "Cash subsidy per annum", "Co-working space support", "Rent subsidy for office", "Wet-lab facilities support", "Engineering-lab facilities support", "Office facilities support", "Accommodation support", "Incubation/ Investment Fund program", "Other business and technical support", and "Others (please specify):".
- Annotation:** A blue box labeled "I) Multiple Choice Layout" with a red arrow pointing to the list of options.
- Input Field:** A text input field at the bottom for "Others (please specify):".

You have reached the end of the survey! Thank you very much once again for your time and your responses.

Sampling Size Determination

According to Hong Kong Government statistics, there are more than 1.38million local companies registered in Hong Kong since 2014. (HK Government July 2020)^[32] On the other hand, there are 13117 non Hong Kong companies registered locally. (HK Government July 2020)^[33] In order to cater for classification errors, a more conservative approach is taken and we assume all locally registered companies could be of High Technology nature. To achieve a target confidence level of 95% based on Slovin's formula, (Guilford, J.P. and Frucher. B; 1973), 400 companies ranging from Startups, Small and Medium Enterprise and Local Conglomerate or MNC Hong Kong branches will be required and contacted in our survey.

Data Definition

As we are trying to correlate the relationship between R&D investments and what type of output a company can achieve, R&D related data will be the basis of independent variables while company performance metrics will form the network of dependent variables. Due to the standard product cycle of 2 to 3 years in high tech industries, there is a time lagging effect between R&D investment and company financial figures achieved. Hence, our standard data will have a periodic separation of a three year interval which will be complemented by additional data points on a yearly basis. The majority of the independent and dependent variables will be numerical based so there is no need for further scaling.

Data Analysis Strategy

As most of the collected data will be numerical based, the research will use an empirical approach where the majority of data analysis will be done by Statistical Product and Service Solutions (SPSS) from IBM to identify potential correlation and allow prediction of data pattern through regressions. Detailed results can also be tabulated to highlight potential trends.

Subsequent conduction of ANOVA (analysis of variance) will also help to identify area worth further analysis due to their large or small variance from expected results. As previous studies already support the positive correlations between R&D spending and company financial results, the conduction of fixed-effects model should confirm similar observations for Hong Kong High Tech companies. On the other hand, mixed-effects model may be required to analyze scenarios where moderating factors are involved as they may be more random in nature.

The models derived by ANOVA will then undergo Post Hoc analyses to test against null hypothesis

Time Span of Research Duration

As common high tech product cycle is 2 to 3 years, this will also be the span of our research period so the actual R&D investment results can be reflected by the company performance data. To enhance the quality of the data, annual addition of incremental data will also be sourced and included into the research analysis if it is determined to be useful

Result Analysis and Expected Findings

Hypotheses Validation

As part of the hypothesis validation process, a pilot research, which includes a small number of interview with CEOs, Country Managers and Division Heads will be carried out after data is collected from a smaller group of companies. Reviewing of this dataset will help to check if the proposed hypotheses are reflective of the company growth data and strategies both in past, current or future. Hypotheses modification and retesting will be done if results from pilot data analysis indicates there is significant deviation from original hypotheses.

Although initial hypotheses may not include all the data collected such as Non R&D headcount and spending (X7, X8) initially, their inclusion is to ensure they could be used if there is adjustment and need for further considerations. For instance, instead of comparing a simple number of more academically qualified staff, the use of ratio may be more relevant.

Data Validation

For each of the hypotheses, Hausman test will be used to choose the more suitable model between fixed effects vs. random effects. This test will also help to determine if null hypothesis is valid for any particular case, or not, by checking if the probability is lower than 5%. In case probability is less than 5%, the null hypothesis will be rejected.

Expected Findings

Findings from this study will serve as a starting point for constructing successful R&D investment model which will hopefully enhance the success rate of High Tech companies in Hong Kong especially those with limited R&D resources.

Previous study by Jaruzelski B; Robert Chwalik R; and Goehle B (October 2018)^[7] from PwC used data from 1000 public companies and found “There is no long-term correlation between the amount of money a company spends on its innovation efforts and its overall financial performance. Instead, what matters is how companies use that money and other resources to create products and services that connect with their customers”. Hence, we expects the finding for Hong Kong Tech companies will exhibit similar characteristics where moderating factors, which were not included in any previous Hong Kong based studies, will play an important role in shaping the company performance

Nevertheless, our study will hopefully identify some level of relationships that exist in HK High Tech Industries R&D investment factors such as personnel qualifications and the likelihood of success and sustainability.

Limitations

As many companies involved in this research are not public companies, the integrity of data provided is based purely on the individual honesty and judgment of different companies. As respondents varying from Startups or SME CEOs to Country Manager of MNCs, personal attachment to the companies will also play an important role in the accuracy of data, especially for the more qualitative ones. “We tend to be prejudiced by our loyalties to family, friends, and country. We accord such loyalties disproportionate moral weight, he argues, out of mere habit and custom. If we were to reason properly, we would recognize the contingent character of our loyalties; but habit and custom blinds us.” (Sandel, A.A; 2014)^[31] Hence, the collected data will be subjected to a certain level of bias, especially qualitative data from the SME and startups management which is influenced by various level of confirmation, reporting and judgmental biases.

Discussion and Conclusion

As our research will try to adopt and modify a number of approaches used by previous studies for Taiwan, Korea and Chinese High Tech companies,^{[4][5]} output from this research should be an enhancement of their findings. Moreover, by using the data from local Hong Kong companies, findings from this study will be more relevant to Hong Kong High Tech business arena than simply referring to overseas models based on overseas data.

Since our data will undergo both qualitative and quantitative analyses and get tested against moderators, the final data models/relationships derived by this research report will hopefully enhance the success rate of classifying different types of High Tech companies in Hong Kong, especially those with limited R&D resources.

Management, Board of Directors, Investment firms as well as Government Chief for Technology can use the research findings to identify and refine Hong Kong technology companies by enhancing their ability to sustain and succeed. By appropriately categorizing different types of High Tech companies, they can be positioned and fostered differently to increase the overall competitiveness of Hong Kong High Tech industries. For instance, High Tech companies with star rating can be fast tracked to success with better government support or venture capitalist funding. On the other hand, companies with follower or “also run” characteristics can be incentivized to create internal changes or bring in external talent. For companies in the struggling or “dog” category, they can be encouraged to perform major restructuring or even changes of top management to increase the chance of survival.

Lessons learn from this research could provide a platform for carrying out similar studies in other type of businesses such as e-finance and logistics as part of the future research topics.

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