

## Augmenting Commercialization of New Technology Intensive Firms

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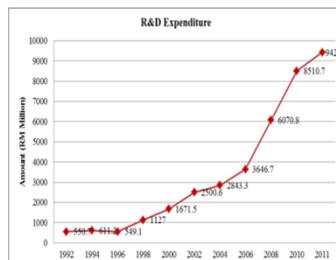
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### Graphical abstract



### Abstract

Technology licensing and commercialization has increasingly been looked at as a complementary and attractive solution to gain insights into new technology innovations and market products. Stories of successful research commercialization programs from Silicon Valley have become the catalyst that encourages states to provide incentives and established structural reform in the form of state controlled agencies to accelerate and assist the commercialization of potential R&D products. Considerable debate has arisen about the effectiveness of those agencies, but asides for a few lone voices, the scholarly literature has largely neglected the views of grant recipients in commercializing of scientific research. This study hopes to shed some understanding of the impediments that grant recipients face in their endeavor to commercialize scientific research. Qualitative data examination utilizing theme analysis was performed and three main determinants were identified: human resources, market penetration, and financial constraints. We believe these three determinants have wider implication to the modern regime of commercialized scientific research.

**Keywords:** Commercialization; start-up fundings; high-technology based companies

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### 1.0 INTRODUCTION

Commercialization and technology licensing have increasingly seen as potential sources of knowledge and the creation of knowledge workers that will be fueling the growth of corporations and governments for the coming millennium [1-5]. Successful migration of research programs from Route 128, Silicon Valley to the market has inspired states to play a greater role in encouraging commercialization venture by researchers [6]. Efforts such as the provision of proof-of-concept center; center of excellence; technology transfer office; university-affiliated enterprises; and funding are some of the endeavors taken by states to encourage commercialization [7-16].

While government could drive commercialization by providing signals and supports such as the creation of agencies responsible for commercialization; studies by various authors found inconclusive evidence about the effectiveness of those centers and/or agencies entrusted to steer commercialization. For example Martin (2007) found that outfits such innovation centers and scientific research agencies are critical for successful commercialization [2]. However, investigation in Chinese universities by Xue (2004) of the usefulness of these agencies found evidence of hindrance to commercialization [14]. This is largely due to the lack of theoretical guide [17]. Hence, efforts thus far, characterized by MacBryde (1997) as learning by doing, all too often did not lead to the desired outcomes; resulting in the

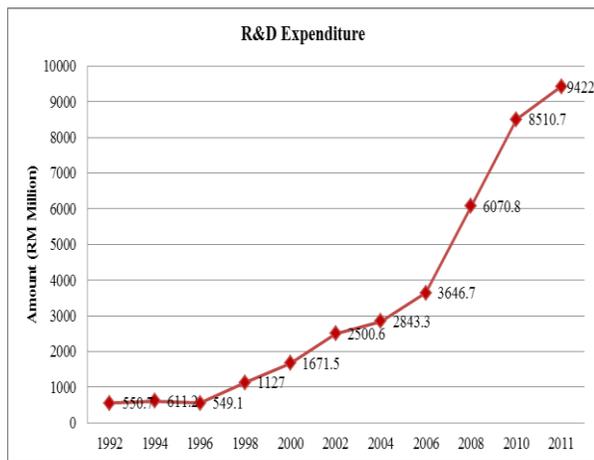
proponents of the economic benefits of R&D becoming more circumspect in their predictions [18, 19]. Various postulations have emerged to explain this observation. While there is no dearth of studies in the area of commercialization, academic literatures are rather fragmented [10, 17]. Moreover, most of these studies have mainly focus on academic researchers and/or managers. This resulted in little guidance for policy makers to effectively focus their attention and efforts to elevate entrepreneurial result. Though attempts have been made to explore the decision making process that leads to commercialization none has tried to investigate the impediments that grant recipients faced in commercializing R&D innovations [20, 21]. Indeed, one of the least studied has been the grant recipients [22]. Additionally, Booyen (2010) claim that future research must provide direction to enable the creation of public policies that promotes commercialization [23]. Hence, this study hopes to offer understanding of the obstacles that grant recipients encountered in their attempts to commercialized R&D products. Knowledge gained from this effort will enable the creation of a topology that provides guidance for policy makers to facilitate commercialization efforts; which currently is sorely needed.

## 2.0 LITERATURE REVIEW

### 2.1 Espousals for Commercialization in Malaysia

Malaysia has undergone tremendous transformation since independence in 1957, evolving from a poor agrarian society to an upper- middle income manufacturing concentrate society by the end of 20<sup>th</sup> century. However, over the last decade, the country's economy growth has slowed down considerably making the attainment of a high income nation by 2020 ineffective [22]. Realizing that the past economic model is no longer tenable; the country has embarked on transformational shift strategies to higher value-added and knowledge intensive activities. Chief amongst these strategies is the development of an innovative and creative entrepreneurship. In this regard, R&D activities were constantly being singled out as the engine for the country's future growth and competitiveness; and the government has been supportive of such ventures.

In Malaysia the total funding for R&D has shown mark increased. Figure 1 indicates the amount of R&D expenditures in Malaysia from 1992 to 2011.



**Figure 1** R&D Expenditure by Malaysia Government (*Source: National Survey of Research & Development, 2012, MASTIC*)

The augmented expenditure from 1996 onwards, stemmed from the realization that Malaysia must move up the value chain of economic transformation from a production-intensity economy to a knowledge-intensity economy. This fund in the form of grant was mainly distributed via the following mechanism: (a) Technology Acquisition Fund (TAF), (b) Commercialization of R&D Fund (CRDF), (c) Demonstrator Application Grant Scheme (DAGS), (d) MSC Malaysia R&D Grand Scheme (MGS), (e) Industrial Technical Assistance Fund (ITAF), (f) Biotechnology R&D Grand Scheme, (g) Support for R&D Institutions of Higher Learning – Sciencefund, Technofund and Spectrum Research Collaboration Program (SRCP), (h) R&D Investment Scheme, (i) Fundamental Research Grant Scheme (FRGS), (j) Construction Research Institute of Malaysia Grant Scheme (CREAM) and (k) University Cradle Investment Program (U-CIP).

### 2.2 Grants

According to the Business Dictionary (2014) grants are bounty, contribution, gift, or subsidy (in cash or kind) bestowed by a

government or other organization (called the grantor) for specified purposes to an eligible recipient (called the grantee). It is usually given conditional upon certain qualifications as to the use, maintenance of specified standards, or a proportional contribution by the grantee or other grantor(s) [24].

Investopedia defines grant as a financial award given by the federal, state or local government to an eligible grantee. Usually, government grants are not expected to be repaid by the recipient. However, grants do not include technical assistance or other forms of financial assistance such as a loan or loan guarantee, an interest rate subsidy, direct appropriation or revenue sharing. There is typically a lengthy application process to qualify and be approved for a government grant. Additionally, most recipients are required to provide periodic reports on their grant project's progress [25].

### 2.3 Obstacles to Commercialization

Institutional theory postulated that institutions are created as solutions to perceived social problems. In the case of commercializing R&D's produce, the problem was the failure of government-funded inventions to move from the laboratory to the marketplace [26]. Hence, institutions such as technology transfer offices and their derivatives were established to achieve the cognitive, organizational, and/or legal conditions necessary for overcoming the prior mentioned problem. Paradoxically, institution's ability to attract adequate people with collectively sufficient resources to overcome the current problems created a new set of problems. Chief amongst them is that the existing institutions' structures constrain individual and organizational behavior thereby limiting rational action [27]. The top-down approach inherited from institution's approach is the testimony of this phenomenon.

Funding of the venturesome effort was a particular focus of numerous authors. In the business environment, it was found that access to financial support was both difficult and sources lacking in understanding [28]. Martin (2007) suggested that the general condition of capital scarcity can impact the perceptions of potential entrepreneurs about the possibility of succeeding in the effort [2]. It was also discovered that angel or informal starts up funds are critical in the early stages of developing a commercially successful product from the result of academic research [15, 16]. Similarly, Martin (2007) observed that the availability of family finances can play a direct role in providing informal, friendly seed and start-up funding [2].

Successful commercialization requires the progression of both the technical and business competencies along the product life cycle. In other words, the resources provided must also expand in tandem with the commercialization process. Study by Nelson (2005) indicated that there are instances where funds to be used for business development and/or organizations are difficult to source from the grant providers [29]. Often such expenditures are seen as unnecessary evils that take money away from the "true" development effort i.e. technical development.

In discussing the issue of resources, it is also imperative to acknowledge the impact of strategic network [9, 30]. Networking improves transactional efficiency in that it allows effective utilization and exploitation of each player's area of specialization. Through networking, researchers gained access to develop new avenues of their research as well as to practically test their ideas and knowledge. Commercialization through collaborative effort, hence not only provides a mean for business opportunities but also to foster the efficiency on both sides and add value to the produced and transferred knowledge.

Seminal work in 2001 by Zucker and Darby, and later by Jain and colleagues (2009) on the emergence of the biotechnology

industry indicated that one of the impediments to successful commercialization is the lack of human resource to work on a particular project [31, 32]. Very often people with the necessary technology are being pinched by their better established competitors rendering startups failure.

Another impediment to successful commercialization of academic researcher has been the lack of understanding about the market trends and needs. According to Strickland (2003), someone must be willing and able to purchase the product for use at a price that includes profit [33]. Identifying the potential customers, their problems, or needs is the first step that occurs on the path to market, which unfortunately, some entrepreneurs do not have sufficient knowledge to successfully exploit it. This situation of “technology push” variety where the inventors look for a market as oppose to “market pull” variety where market is screaming for a new product has led to many failed commercialization effort [11].

### ■3.0 METHODOLOGY

This study employed the cross-case study methodology since it is one of the more established widely accepted methods in social study [34]. Though, case studies exhibit potential drawbacks in objective reporting, analysis of evidence and generally have weak it can explain the causal links in real-life situations where a single survey or experiment is unable to unearthed [35]. We utilized the theoretical propositions as basis to guide the collection of specific data type of cross-case study. Once the data are collected, themes and patterns matching to identify a certain outcome and explore the how and why of the outcome were utilized. The logic behind this approach is that respondents within each group tend to have the same characteristics and are therefore affected by the same external stimuli which resulted in the observable pattern. Moreover, researchers are prevented from reaching premature conclusions since this technique requires researchers to view the data from various angles. Only when a pattern from one data is corroborated by the evidence of another, are the patterns allowed to emerge; improving the likelihood of accurate and reliable findings. 14 companies were subjected to in-depth interview. This is deemed appropriate in line with Merriam and Simpson (1988) proposal that in qualitative case study the number of respondents is not the mitigating factor but rather the contribution that each respondent brings to improve the understanding of a particular phenomenon that is important [36]. To ensure consistency of response, a semi-structured interview pro-forma was constructed. The interviewees were identified through individuals provided by an investment holding company of the Government of Malaysia; one of the agencies task with the disbursement of commercializing fund. Transcriptions were carried out by the authors and were later coded following the guidelines suggested by Strauss and Corbin [14]. Word level analysis was not taken into consideration as one of the predominant assumptions during the interview has been the acceptance of answers.

### ■4.0 RESULTS AND DISCUSSION

Based on the analysis from in-depth interviews with 12 companies funded by an investment holding company of the Government of Malaysia, by utilizing themes and analysis approach, three general themes were identified from the transcribed data: market penetration; skilled human resource and; financial difficulties.

Under the market penetration theme, two major impediments were singled out by grants recipients i.e. capacity planning and

market endorsement. Capacity planning deals with the ability of grant recipients to accurately determine total demand and time of introducing their product into the market. Being small some grant recipient’s production capacities are not able to matched the demand for their products resulting in the loss of sale. Additionally, some of the grant recipients’ products are seasonal making the adjustment of machine capacity challenging. According to Zhang *et al.* (2012) ability to accurately forecast demand of one’s product requires in-depth knowledge of the environment that firms resides [38]. The impediments that grant recipients highlighted indicates that grant recipients either lack expert insight of their market or are unable to aggregate their production accordingly. This could be attributed possibility to the incomplete selection criteria of grant recipients. Very often, grant recipients are selected based on the strength of their business proposal. It is assume, perhaps erroneously that a strong business proposal indicate in-depth knowledge of the business. This perspective was highlighted by Meseri and Maital (2001) on how Israeli universities’ projects were being evaluated [39]. In their study, the most important determinant in the project’s evaluation was the business proposal; and it must include the market needs and size as well as the existence of a patent. However, it was later found that this criterion is inadequate for successful commercialization.

Most of the respondents also indicated that they face impediments in terms of getting endorsement of their products from the market and/or the related authorities. In the case of market endorsement, grant recipients indicate the difficulties of gaining a foothold in the local market. This is because their products are relatively unknown and/or their companies do not have the clout to engage the bigger player in the market. Herein the issue of gaining market acceptance and distributor’s trust developed. Some industry needs at least 3-4 years before market and distributor’s trust could be achieved. This situation is further exacerbated when the market is being controlled by oligopolies such as the medical industry in Malaysia. Studies by Udell (2002; 2007) found that there exist strong bias on the part of retail buyers who prefer to purchase product from establish firms, resulting in situation where many potential new products do not have the sufficient critical mass to sustain a solo launch [40].

There are also situations where grant recipients find difficulties in penetrating the local market due to the mind-set of the Malaysians. Generally, Malaysians tend to perceive imported goods as having better quality and credibility than the locally produced products [41]. Hence, it takes greater effort to create awareness and convince the public on the equal standing if not superior of local products as compared to the imported products.

Another thing that makes market penetration difficult is due to the newness of the products. Some grant recipients generally produced products that “disrupt” the existing technologies or the existing production. Hence, they will have to educate the market about their technology first before any marketing activities could be launched.

Skilled human resource theme points to the ability of grant recipients to attract and retain good and experienced personnel. This is partly due to their inability to pay competitive wages to their people since they have limited financial resources. Moreover, some of their more competent employees are also been pinched by their competitors. Losing competent employees not only affect their production and/or R&D capabilities; but also the risk of technology transfer to their competitors. This view was also echoed by researchers where it was found that competent personnel are important to ensure organizational sustainability [32, 42].

Although there could be various reasons for approaching government establishments for commercialization assistance,

funding issue was mentioned repeatedly by the grant recipients. In reflecting funding as the main concern, we noted the tendency of poor financial management and the over dependency on government grants. Reasons cited for such dependency are the difficulty in gaining funding for the existing financial institutions due to the prevalent factors such as high level of risk adversity of such institutions and the untested position of their organizations. This issue is not new. In fact, in the year of 2000, Shane (2000) proposed the theory of demand-side perspective where it was posited that the contextual conditions that prompt scientist to commercialize their findings includes the appropriate source of funding. In most cases, financial institutions are not much of help due to their low tolerance to risk [43, 44].

## 5.0 CONCLUSION

This study attempts to shade some insight into the impediments that grant recipients faced while trying to commercialize new innovations in Malaysia. It should be noted that this finding is peculiar to Malaysia experiences and should not be used as a one-size-fits-all solutions since each market is unique. Nevertheless, the three themes unearthed in this study provide an empirical framework for future research guide. Some of the obstacles mirrored that of the academic researcher's endeavor in commercialization especially in the marketing and financial prudence domain. Perhaps a more comprehensive evaluation of grant recipients' competencies and closer integration of government agencies are required to ensure higher probability of commercialization success. In this way, the ambition of Malaysia to move away from the middle income trap and remain competitive could be realized.

## References

- [1] Arntzen Bechina, A. 2007. Knowledge, Learning and Innovation: The Quest for a Competitive Edge. In Cader, Y. (Ed.). *Integrated Knowledge Management*. Heidelberg Press, Heidelberg.
- [2] Martin, M. J. 2007. University Perspective on Commercialization of IP. *Technology Management*. September–October 2007. 13–18.
- [3] Rasmussen, E. 2008. Government Instruments to Support the Commercialization of University Research: Lessons From Canada. *Technovation*. 28(2): 506–517.
- [4] Wonglimpiyarat, J. 2009. Commercialization Strategies Of Technology: Lessons from Silicon Valley. *Journal of Technology Transfer*. 1–12 at DOI 10.1007/s10961-009-9117-3.
- [5] Youtie, J., Iacopetta, M., and Graham. 2007. Assessing the Nature of Nanotechnology: Can We Uncover an Emerging General Purpose Technology? *Journal of Technology Transfer*. doi:10.1007/s10961-007-9030-6.
- [6] Miller, R. and Cote, M. 1985. Growing the Next Silicone Valley. *Harvard Business Review*. 63: 114–123.
- [7] Uraga, M. G., Kerexeta, G. E. and Campàs-Velasco, J. 2007. The Dynamics of Commercialization of Scientific Knowledge in Biotechnology and Nanotechnology. *European Planning Studies*. 15(9): 1199–11214 at <http://dx.doi.org/10.1080/09654310701529136> (access on 15 January, 2009).
- [8] Harman, G and Harman, K. 2004. Governments and Universities as the Main Drivers of Enhanced Australian University Research Commercialisation Capability. *Journal of Higher Education Policy and Management*. 26(2): 153–169.
- [9] Gulbranson, C. A and Audretsch, D. B. 2008. Proof of Concept Centers: Accelerating the Commercialization of University Innovation. *Journal of Technology Transfer*. 33: 249–258.
- [10] Rothaermel, F. T., Agung, S. D., and Jiang, L. 2007. University Entrepreneurship: A Taxonomy of the Literature. *Industrial and Corporate Change*. 16(4): 691–791.
- [11] Gehani, R. R. 2007. Technology roadmapping for Commercializing Strategic Innovations. *Journal of Technology Management and Innovation*. 2(2):31–45.
- [12] Chen, K., and Kenney, M. 2007. Universities/research Institutes and Regional Innovation Systems: *The Cases of Beijing and Shenzhen*. *World Development*. 35(6): 1056–1074.
- [13] Guan, J. C., Yam, R. C., and Mok, C. K. 2005. Collaboration between Industry and Research Institutes/Universities on Industrial Innovation in Beijing. *Technology Analysis & Strategic Management*. 17(3): 339–353.
- [14] Xue, L. 2004. University–market linkages in China: The Case of University-affiliated Enterprises. Paper Presented at the Symposium on University, September 7–8, Research Institute and Industry Relations in the U.S., Taiwan and Mainland China, Stanford Project on Regions of Innovation and Entrepreneurship, Palo Alto, CA.
- [15] Riding, A. L. 2008. Business Angels and Love Money Investors: Segments of the Informal Market for Risk Capital. *Venture Capital*. 10(4): 355–369.
- [16] Harrison, R. T. and Mason, C. M. 2008. Sampling and Data Collection in Business Angel Research. *Venture Capital*. 10(4): 305–308.
- [17] Philbin, S. 2008. Process Model for University–industry Research Collaboration. *European Journal of Innovation Management*. 11(4): 488–521.
- [18] Lehrer, M., Nell, P. and Gärber, L. 2009. A National Systems View of University Entrepreneurialism: Inferences from Comparison of the German and US Experience. *Research Policy*. doi:10.1016/j.respol.2008.11.007. 1–13.
- [19] MacBryde, J. 1997. Commercialization of University Technology: A Case in Robotics. *Technovation*. 17(1): 39–46.
- [20] Ahmad D. R. and Rabelo, L. C. 2006. Assessment Framework for the Evaluation and Prioritization of University Inventions for Licensing and Commercialization. *Engineering Management Journal*. 18(4): 28–36.
- [21] Gehani, R. R. 2007. Technology roadmapping for Commercializing Strategic Innovations. *Journal of Technology Management and Innovation*. 2(2): 31–45.
- [22] Malaysian Science and Technology Information Centre (MASTIC), *Malaysian Science & Technology Indicators 2008 Report*. 2008. Malaysia. 11–125.
- [23] Booyesen, K. 2010. An Analysis of the Process from Innovation to Commercialization-A South African perspective., 16–172.
- [24] Business Dictionary at <http://www.businessdictionary.com/definition/grant.html#ixzz2szZATRHF> (access on 28 Jan 2014).
- [25] Investopedia at <http://www.investopedia.com/terms/g/government-grant.asp> (access on 28 Jan 2014).
- [26] Berman, E. P. 2008. Why Did Universities Start Patenting?: Institution-Building and the Road to the Bayh-Dole Act. *Social Studies of Science*. 38(6): 835–871.
- [27] Meyer, G., Zacharakis, A., and de Castro, J. 1993. Postmortem of New Venture Failure: An Attribution Theory Perspective. Paper Presented to Babson Entrepreneurship Research Conference In Kruger, N. F., Riley, M. D. and Carsrud, A. L. 2000. Competing Models of Entrepreneurial Intentions. *Journal of Business Venturing*. 15: 411–432.
- [28] O'Grady. 2002. Influence of Personal and Environmental Factors on Academic Medical Researchers' Decisions to Commercialize the Results of Their Research, PhD, University of Calgary.
- [29] Nelson, J. 2005. Leveraging the Development Impact of Business in the Fight against Global Poverty. 1–14.
- [30] Muscio, A. 2009. What Drives The University Use of Technology Transfer Offices? Evidence From Italy. *Journal of Technology Transfer*. DOI 10.1007/s10961-009-9121-9127.
- [31] Zucker, L. G. and Darby, M. R. 2001. Capturing Technological Opportunity via Japan's Star Scientists: Evidence from Japanese Firms' Biotech Patents and Products. *Journal of Technology Transfer*. 26: 37–58.
- [32] Jain, S., George, G. and Maltarich, M. 2009. Academics or Entrepreneurs? Investigating Role Identity Modification of University Scientists Involved in Commercialization Activity. *Research Policy*. 38: 922–935.
- [33] Strickland, S. L. 2003. Copyright's Digital Dilemma Today: Fair Use or Unfair Constraints? Part 1: The Battle over File Sharing. 1–5.
- [34] Miles, M. B. and Huberman, A. M. 1994. *Qualitative Data Analysis: An Expanded Sourcebook*. Sage, London.
- [35] Yin, R. K. 1994. *Case Study Research, Design and Methods*. 2nd ed. Newbury Park, Sage Publications.
- [36] Merriam, S. B. and Simpson, E. L. 1998. *A Guide for Research for Educators and Trainers of Adults*. Malabar, Florida: Robert F. Krieger Publishing Co.
- [37] Strauss, A., and Corbin, J. 1990. *Basics of Qualitative Research: Ground Theory Procedures and Techniques*. Newbury Park: Sage Publications.
- [38] Zhang, Y., Puterman, M., Nelson, M. and Atkins, D. 2012. A Simulation Optimization Approach to Long-Term Care Capacity Planning. *Operations Research*. 60(2): 249–261.

- [39] Meseri, O. and Maital, S. 2001. A Survey Analysis of University-Technology Transfer in Israel: Evaluation of Projects and Determinants of Success. *The Journal of Technology Transfer*. 26(1–2): 115–125.
- [40] Udell, G. and Hignite, M. 2007. New Product Commercialization: Needs and Strategies. *Journal of Applied Management and Entrepreneurship*. 12(2): 75–92.
- [41] Maznah Ghazali, M. Said Othman, Ahmad Zahiruddin Yahya and M. Sarif Ibrahim. 2008. Products and Country of Origin Effects: The Malaysian Consumers' Perception, *International Review of Business Research Papers*. 4(2):91–102.
- [42] Tether, B. S. and Tajar, A. 2008. Beyond Industry–university Links: Sourcing Knowledge for Innovation from Consultants, Private Research Organisations And The Public Science-Base. *Research Policy*. 37: 1079–1095.
- [43] Calomiris, C.W. and Carlson, M. 2014. Corporate Governance And Risk Management At Unprotected Banks. NBER Working Paper Series, National Bureau Of Economic Research, Working Paper 19806. 1–62, at <http://www.nber.org/papers/w19806> (access on 31 January 2014).
- [44] Yu, Y., Liang, L., and Gao, Y. 2013. Empirical Study of Factors Affecting the Financing Ability of Small- and Medium-Sized Real Estate Enterprises. *ICCREM 2013*: 836–845. doi: 10.1061/9780784413135.078.