

The Impact of R&D Resources and Capability on Company Performance

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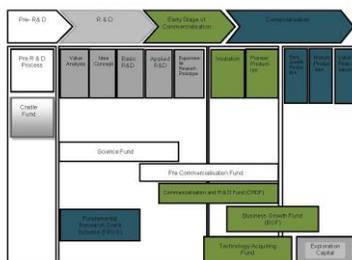
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Graphical abstract



Abstract

R&D resources and capability is expected to affect company performance, especially those of high technology. Highlights of the work shows companies with high R&D expenditure and manpower resources typically influence company performance. Therefore, in order to improve the company's performance it is important to take into account the elements of R&D resources and capability. Given the fact that these elements are important to the technology-based companies, this study was conducted to examine whether R&D resources and capability influence business performance. A set of questionnaire was distributed among 138 technology-based companies and statistical analyses were employed to analyze gathered data from the survey. Findings indicate that the elements do influence the business performance of the companies.

Keywords: R&D resources and capability; technology-based companies; company performance

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1.0 INTRODUCTION

A transformation from a low income country to a medium income country requires a model that stresses a need for a high income economic superstructure which is based on high value added activities. The transformation towards high valued added activities demands for continuous productivity growth. Productivity enabler is driven by innovation enablers such as research and development (R&D) [1] while productivity may become a catalyst to make the economic growth of Malaysia a reality. Hence, on 25 October 2010, the Malaysian government introduced the economic transformation programme (ETP) which aims to achieve a high income country by the year 2020 [2].

Advanced technology developed is the result of innovation, covering the process of invention of new products, improvement of existing products, as well as the reduction of the cost of existing products and services. Establishment of R&D department or unit enables the company to do the transformation ranging from product imitation to product innovation [3] and thereby encouraging scientists, engineers, entrepreneurs, and inventors to develop product innovations that can be commercialised. Thus, this indicates that there is a relationship between innovation, R&D and commercialization in a technology-based company.

To ensure the success of economic growth through productivity and innovation, the Malaysian government has set

up various funds, incentives and mechanisms to encourage the private sector (technology-based companies) to carry out R&D activities successfully (see Figure 1). Emphasis on R&D is due to research and development being the enabler of innovation.

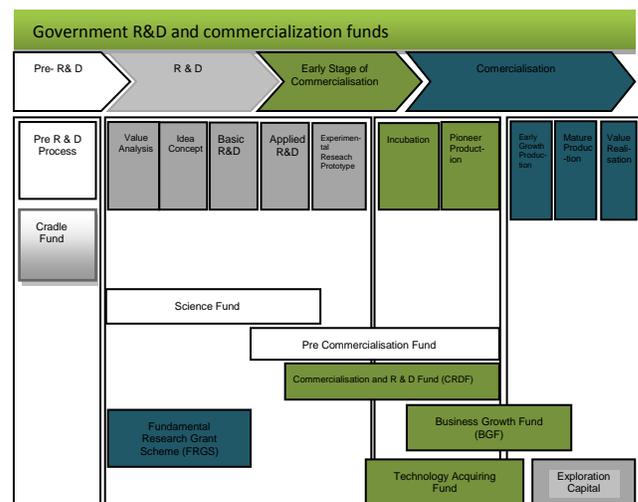


Figure 1 R&D and commercialization funds under RMK-10. *Source:* [1]

In addition, Table 1 shows the amount allocated to R&D activities in Malaysia from the fifth Malaysia Plan to the Ninth Malaysia Plan increased from RM414 million to RM3.6 billion. This trend in increase clearly gives the impression that Malaysia has made the effort to enhance innovation for national development.

Table 1 R&D budget increase

The 10th Malaysia Plan	Years	The Provisions Of (RM)
RMK-5	1986-1990	414 million
RMK-6	1991-1995	629 million
RMK-7	1996-2000	935 million
RMK-8	2001-2005	1.4 billion
RMK-9	2006-2010	3.6 billion

Source: [4] [5] [6] [7] [8]

Although the government provides various facilities and services to support the private sector in R&D activities, the performance of R&D in the private sector is still unsatisfactory and is far back [9]. Besides limited financial resources, lack of participation and a lack of skilled and qualified manpower are the factors contributing to the low R&D in Malaysia [10]; [11]; [12]; [13]. However, according to the [10], the role and involvement of the private sector in R&D has been growing since 1998. This shows there is increased involvement of the private sector in R&D activities in line with the government's objectives to develop the field of R&D in Malaysia.

Today, the Malaysian government is providing a number of agencies that support the private and government sectors in enhancing the ability of R&D activities so that the R&D are successfully commercialised. Among them is the Malaysian Technology Development Corporation (MTDC). MTDC is a government-backed venture capital company that plays a major role in the commercialization and management of government funds since the 7th Malaysia Plan and it also has a strong reputation as a major player in promoting technology-based companies in Malaysia. Under the 10th Malaysia Plan, the role of MTDC has been expanded in creating an effective ecosystem for local technology commercialization. MTDC trains new generations to become Technopreneurs through comprehensive nurturing service; from the development of ideas to commercialization of the product. Various incentives are also provided to encourage the private and government sectors to increase R&D capability and successful commercialisation of their R&D. However, there are some problems facing the companies when applying for a R&D grants. Among them are the unclear definition of R&D, unawareness of the availability of R&D grants, unclear application procedures and strict requirement scope [14].

Increase in company performance depends on the resources and capacity of the company [15] Literature on resource-based view of the firm (RBV) points out that the company needs resources and specific capability to gain competitive advantage [16]; [17]. Therefore, in this complex industry environment, the companies should have the right resources and capacity as the basis for competitive advantage [18]. Hence, the technology-based companies have to also compete based on the ability of the R&D resources and capability in order to respond to the dynamic environment and to develop innovative new products at a speedy pace [15]. [19]; [20]; [21]; Past researches suggest that company performance can be explained by physical resources, technology, knowledge resources, resource organization and management efficiency [19]; [20]; [21]; [15]. Therefore, in this study we applied this

idea of R&D resources and capability as the technology-based companies' ability to obtain the following resources: (1) Financial resources including investment funds that are generated internally or externally (loans), (2) Facility resources including basic infrastructure and IT equipment, laboratory facilities, technology, etc. provided by the companies or collaboration with external parties, (3) human resources are defined as the recruitment and development of skilled workers (scientists or engineers) and integrated with R&D team with technical capabilities, knowledge and experience from different disciplines and departments, while support, involvement and competence management in supporting R&D activities, and (4) collaborative resources is defined as "having a good relationship with customers, suppliers, and collaboration partners that is characterized by trust and relationships, which allow companies to develop a network and share information, respond and communicate more effectively with customers, suppliers and collaboration partners in R&D activities".

From the resource-based view of the firm (RBV) theory, R&D capability, among other capabilities, is seen as a critical element to a company to achieve its strategic [22]. In particular, the R&D activities enable technology-based companies to offer high-value products, rare, difficult to copy and different from the products that are available in the market. Thus, R&D will lead the company towards achieving high financial performance [17]; [23]; [24].

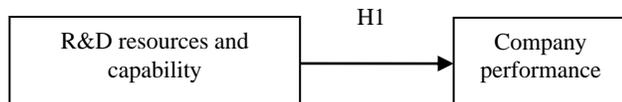
[25] found that R&D has positive and significant effects on company but negatively impact company profits. This finding is not supported by [26] which states that product innovation can attract new consumers and maintain market share and thus improve company profitability. Increased investment in R&D activities by technology-based companies showed an increase of R&D interest in product innovation as the basis of the continuity of the company. Technology-based companies conduct R&D in order to transform their resources into product innovation and this is not easy. However, if the product is successfully commercialised it can bring in profits and the company remains competitive [26].

Accordingly, efforts in R&D can speed up information gathering, provide strength in technology and determine company performance. The literature indicates there are various methods to establish and define the relationship between R&D and company performance. An empirical study by [27] there is a strong relationship between R&D expenditure with increased sales. Further, [28] argued that R&D investment has a positive relationship with company long term performance. In addition, a study by [29] found that R&D intensity has a significant contribution to the increase in market share.

Based on the literature review, it was found that research related to the elements of R&D resources and capability affecting efforts to increase organizational performance in Malaysia only concentrated in the public sector [9]; [11]; [30]. Some elements of R&D resources and capability that affect organizational performance have been identified in the research such as the financial mechanism, commercial awareness, management of research, workforce, research focus, rewards and incentives, industrial relations, infrastructure innovation, the dissemination of science and technology and research possibilities.

However, the elements are not empirically confirmed. In addition, there may be other elements in R&D resources and capability that can influence the performance improvements of technology-based companies and they need to be tested in order to get empirical evidence. Through studies conducted by

[31] on telecommunications service companies in Indonesia, the findings indicated that resources and capability can increase profitability for small and medium companies as denoted by the impact on the increase in return on sales, return on equity, and return on assets. In this regard, a more comprehensive research needs to be conducted to identify and confirm R&D resources and capability that can contribute to the effort to improve the performance of technology-based companies. Table 2 is a summary of some of the researches that have been carried out in this field. Based on the literature review, the following is the proposed model for the relationship between R&D resources and capability and company performance as well as the hypothesis that was developed to investigate this relationship.



H1: R&D resources and capability positively and significantly influences company performance.

Table 2 Some significant researches on R&D resources and capability and company performance

Author	Short Description of Research
[10]	This research has outlined several factors limiting R&D in the private sector in 2000 and 2002, among the main issues arising for internal factors are associated with the resources. Among them, financial resources are limited, lack of skilled R&D staff, inadequate market research, lack of facilities and equipment and the lack of proof analysis techniques. While external factors ranging from the lack of specialist researchers, increased capital costs, incentives provided insufficient government, increased labor costs and issues related to intellectual property rights.
[30]	This paper presents the development of a model to analyze and improve the performance of R&D at the university level in Malaysia. This research employed deductive approach to identify factors that progressively determine R&D performance.
[32]	This study investigates the effects innovation ability on company performance in the <i>integrated circuit</i> (IC) industry in Taiwan. The findings showed that innovation ability has a positive relationship with performance (ROA). Meanwhile, R&D intensity and R&D workforce are predictors of company performance.
[11]	This research presents 10 factors that theoretically influence the low rate of commercialization of R&D in Malaysia. Descriptive analysis results showed that of the 10 factors listed, four factors have strong proof i.e. weak innovation infrastructure, constraints in the dissemination of new knowledge in science and technology, labor issues and the lack of a strong relationship between academicians, research institutions, industry and government agencies.
[33]	A review of 74 Canadian biotechnology companies was carried out to examine the relationship between R&D intensity, a measure of innovation, and company performance using survey method. The study found that critical market demand plays a critical role in company performance. Meanwhile, the introduction of new products (a measure of innovation) is related to with the company performance. Internal factors have higher influence on the performance of the Canadian companies than external factors.

2.0 METHODS

The main objective of the study was to answer the research questions on technology-based companies in Malaysia is i.e. Do R&D resources and capability influence business performance? The target population of the study was 130 technology-based companies in Malaysia. Technology-based companies were selected by choosing the companies which undertake innovation in their business strategy [34] and employ scientists and engineers in their workforce [35]. The sampling frame gathered from the government agency directory was the listing of the companies that are involved in Science and Technology activities in Malaysia. The unit of analysis in this study was technology-based companies in Malaysia, while operations director or operations executive or R&D personnel were the respondents of the study. A questionnaire was designed based on the literature review. Four dimensions were linked to measure the R&D resources and capability i.e. the financial, facilities, manpower and collaboration sources. The questionnaire comprised 20 items and was employed as the instrument to collect data via online survey. The items were adopted and modified from studies by [11], [36], [37], [38], [39] [40], [41], [42], [43], [44], [45], [46], [47], and [48]. Each of the items in the questionnaire was fixed on a five-point scale to measure the respondent's agreement.

The company performance construct was measured using financial performance indicators. A five-point scale of (1) substantial decrease, (2) slight decrease, (3) no significant changes, (4) slight increase, and (5) substantial increase was utilised. A total of eight items (such as percentage of sales growth, ROI, ROA, and profitability) were developed to measure company performance. The items were adopted and modified from [43], [44], [47], [50], [51], [52], [53], [54], [55], [56], [57], and [58]. Only 53 out of 138 companies (38.4%) answered the questionnaires completely. Therefore, the data analysis was based on 53 companies.

Linear regression analysis with the aid of Statistical Package for Social Science (SPSS) was employed to test the relationship that exists between the independent variable (R&D resources and capability) with the independent variable (company performance) [59]. This analysis highlights the influence of the independent variable on the dependent variable.

3.0 RESULTS AND DISCUSSION

The information on the demographic characteristics of the respective companies include the sectors, sizes of company, clusters, business locality, types of funds, years of establishment and the market orientation. The demographic characteristics are presented in terms of frequency as shown in Table 3.

Based on the size of the companies, 34 are categorized as small businesses. Geographically, 25 of the companies are located in the central region of the peninsular Malaysia. Majority of the companies were established between 4 to 8 years back.

Table 3 Demographic characteristics

NO.	CHARACTERISTICS	FREQUENCY (No. of companies)
1	SECTORS	
	Services, Primary Agriculture & Information & Communication Technology	10
	Manufacturing, Manufacturing-Related Services and Agro-based industries	35
2	SIZE OF COMPANY	
	Small (less than 50 employees)	34
	Medium (51-150 employees)	10
	Large (151 employees and above)	1
3	CLUSTERS (multiple responses)	
	Bio Technology	16
	Industrial Product	10
	Electronics & Electrical	8
	Advanced Materials	2
	Others	19
4	BUSINESS REGION	
	Eastern	5
	Central	25
	Northern	7
	Southern	8
5	TYPES OF FUNDS	
	CRDF	39
	TAF	6
6	YEARS OF ESTABLISHMENTS	
	More than 9 years	17
	4 to 8 years	24
	Less than 3 years	4
7	MARKET ORIENTATION	
	Local and international	31
	Local	12

3.1 Fit between R&D Resources and Capability and Business Performance

We examined the fit between R&D resources and capability and business performance. The mean of 20 R&D resources and capability variables and eight business performance variables were calculated for the dependent and independent constructs respectively.

The hypothesis tested was as follows:

R&D resources and capability positively and significantly influences company performance.

The regression model is as follows:

$$\text{Company performance} = B_0 + R\&D \text{ resources and capability} + \text{Error}$$

Results presented in Table 4 shows that the F Statistic is highly significant ($F = 90.733$, $p < 0.000$). R&D resources and capability is significantly related to Company performance ($p < 0.000$). This provides support for the hypothesis that R&D resources and capability positively and significantly influences company performance. The adjusted R^2 of 0.624; indicates that the variables in the model explain only 62.40% of the variation in company performance. The adjusted R^2 is significant and indicates that company performance is affected by R&D resources and capability.

Table 4 Regression analysis results

Model	Unstandardize d Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 (Constant)	.477	.300		1.589	.188
R&D resources and capability	.836	.088	.795	.925	.000

*DV=Company performance; Adjusted $R^2=0.624$; ($F = 90.733$, $p < 0.000$).

It has been shown that R&D resources and capability does influence company performance, this particularly tends to involve the use of financial, facilities, manpower and collaboration resources. Our study established that resources include physical resources, technology, knowledge resources, organizational resource and management efficiency. Given that physical resources are tangible assets (such as laboratories, equipment, machines, and materials required for R&D activities, technology is the relevant and latest knowledge on the R&D methods applied in the R&D, knowledge resources are intangible resources i.e. qualified human capital that have the right know-how, innovative and creative, organisation resources are the proper processes and procedures of the companies, management efficiency is ability to manage not only effectively but also competently), while capability is the ability to carry out R&D, it is no surprise that the result of our study is such. It is obvious that the resources and capability determine the R&D quality that results in innovation. The innovation when commercialised will bring profits to the company and it signifies financial performance. This result is considered interesting because it supports the finding of past research (e.g. [19]; [20]; [21]; and [15]). However, the finding does not support the study by [25] who found that R&D negatively impacts company profits. Further, the finding is consistent with RBV theory which suggests that R&D resources and capability are highly related to financial performance [17]; [23]; [24].

The finding implies that technology-based companies require high investment in resources and capability. The resources are both tangible (such as physical resources and technology) and intangible (such as human resources and efficient management) and they are expensive. The companies need to identify the right technology to be employed and need a lot of funds for acquiring not only physical resources but also recruiting qualified human capital. Employees also may need to be sent for special trainings. This is where the role of MTDC comes into play to provide funds for the technology-based companies. The R&D consequently has to be commercialized and this also requires further funding.

4.0 CONCLUSION

This paper deals with research in R&D and company performance. In this paper, we have examined the question whether the level of R&D resources and capability within technology-based companies such as physical resources, technology, knowledge resources, resource organization and management efficiency influence company performance. We have offered the findings based on a survey of technology-

based Malaysian companies which shows that some respondents have high levels of R&D (appropriately analysed into resources (physical resources, technology, knowledge resources, organisation resource and management efficiency) and capability but with some variation amongst the respondents. Our finding suggests that the level of investment in R&D resources and capability is highly associated with company performance. As R&D creates innovations and innovation is necessary to become high income country, it is imperative and pertinent that R&D resources and capability be regarded as utmost priority in the Malaysian government agenda.

Further research may examine companies which are not technology based to find out the difference or look at commercialisation of R&D of technology-based companies, employ interviews to get richer information such as on how or why the relationship is between R&D resources and capability is high.

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