Measuring effectiveness and efficiency of a new product development project using performance matrix – The PROTON case

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Abstract. This paper presents a study on the development of a performance matrix to measure the new product development project performance for a small car producer in Malaysia. This study was carried out through open-ended interview sessions, involving a couple of project managers, a new product introduction manager and senior product planning manager and engineers. The questionnaires were developed based on the literatures and pre-tested prior the interview sessions. The feedbacks were used to identify the most important internal and external performance outcomes that crucial to the car producer. The development lead-time represents the efficiency, while the market share represents the effectiveness of the product development process. The performance matrix was successfully developed and the relation between the development lead time and market share is asymmetric. This performance matrix is best used for comparing NPD performances between plan and actual of a developed project, as well as between actual performances of a previous project and a new project that are having a similar project scopes and contents. The application of the performance matrix through a case study indicates that the success or failure status of the new product development project can be determined. The performance matrix is found to be viable and suitable for this indigenous car producer.

1. Introduction

This study focuses only on the completed development projects of Perusahaan Otomobil Nasional Sdn. Bhd. (PROTON) that were launched between the year of 2000 until the mid of 2017, before the acquisition of 49.9% stake in Proton by Zhejiang Geely Holding Group. During this time, PROTON managed to increase the frequency of the New Product Introduction (NPI) by more than 100% [1]. Prior 2000, most of the New Product Development (NPD) projects were only involved the lower degree of enhancement and facelift types of projects due to the constraints of limited resources i.e. product development experts and capability, monetary investment, and man powers. However, circa 2000 the establishment of a well-defined integrated product development practice and the continuous improvement of this formal practice enabled PROTON to introduce several models for the local
market either through own development or collaboration with other producers. Although, the challenges of limited pool of resources were not holistically overcome; with appropriate business strategies PROTON successfully achieved its performance targets i.e. shorter development time and lower development cost.

This study is carried out based on the request from the respondents of having a simple and straightforward decision-making tool for measuring NPD performance. Product development project performance has been studied by many scholars based on different theoretical perspectives together with different parameters or variables [2-4]. An NPD performance is a significant subject matter in engineering management field. The performance of an NPD project may be considered as a success at the project or program-level, but the product may ends up as failure right after it enters the market. In addition, a set of specific performance measures may not work well for other product development projects in different industries at various international locations. These two examples depict how an NPD performance must be managed astutely. The selection of appropriate performance measures is so crucial for product development practitioners in order to completely understand what the best parameters to be used to measure the NPD performance. As such, for this study the development of the performance matrix for measuring Proton’s NPD performance depends on the feedbacks obtained from the respondents during the interview sessions in which the efficiency and the effectiveness of the NPD are considered and become the main interest.

2. Literature review

The performance of an NPD is closely related to the project or program goals set by the product producers which could be classified as the internal or external outcomes. The NPD performance is influenced by many factors such as project content, product complexity, development team, and knowledge management for problem solving. Lee and Markham [5] emphasise the importance of having a flexible NPD that suits specific environments in order to increase new product success. Thus, as an established car producer Proton adopt its own formal product development practices known as new product introduction (NPI) that meets its own business conditions.

2.1 Internal and External Project Goals.

The success and failure of an NPD have been the interest of practitioners and researchers from different backgrounds and industries. The NPD performance measures consist of many determinants such as development speed, market share, profitability, and cost [6]. Griffin and Page [7] provide an interim report that represents the findings of a Product Development and Management Association (PDMA) workforce on dimensions used for measuring success and failure of an NPD. These dimensions, in general include customer acceptance measures, financial performance, product-level, and firm-level. Furthermore, they can be classified as the internal or external project goals i.e. unit cost, lead time, unit sale, breakeven, and profit.

2.1.1 Development lead time. The development lead time is considered as an internal project goal. Another examples of this types of goals are development cost, product performance, meeting quality goals, and launched on time [8-10]. Clark and Fujimoto [11] define the development lead time as the time in month between the initial stage of a development project and the introduction of a first model to the market. Many scholars have proved that building product quickly and on time is beneficial to the manufacturers [12-14]. In short, development lead time is a dimension that tells us how project execution adheres to the project schedule.

2.1.2 Unit sale and market share. The unit sale and market share are known to be the external project goal since it reflects the product performance in the market. Some of the external project goals are commonly known as customer acceptance and satisfaction, return on sales, breakeven and breakeven point [15]. According to Page [16] sales and profits are measures that quantify the impact of development program on the profit and loss statement of a firm and tell the effect of the NPD activities on financial performance. Therefore, an assumption was made that the higher the unit sale and market share, the higher the effectiveness of the NPD. In this case, unit sale refers to the amount of a newly
introduced product being sold within a specific period i.e. monthly or yearly basis. On the other hand, the market share refers to a portion of a market controlled by a product.

2.1.3 The efficiency and effectiveness of the NPD. The development lead time is considered as the efficiency, and the monthly or yearly unit sales as well as the market share are representing the effectiveness of the NPD. These three dimensions are considered based on the facts that shorter development cycle will not have any effect over product success, if the new product does not meet the requirements of the customers [17], and product success is best assessed by combining market share, profitability and customer satisfaction [13]. Therefore, this infers that the efficiency and effectiveness of an NPD are influenced by the development lead time, the unit sale and the market share of a product. With reference to Wheelwright and Clark [17], a conclusion is made: the effectiveness based on the market share is more significant than the unit sales. The market share tells the impact of the newly introduced product in terms of relative competitiveness i.e. a competitive product is expected to have a decent or positive sale volume even the economy situation is in down trend. Of course, both dimensions for measuring effectiveness are more important than the development lead time. Thus, it is believed that the efficiency and effectiveness of the NPD are asymmetric. Moreover, since PROTON is known to be as the ‘people car’ due to lower or affordable price offered to customers mainly at the bottom of the pyramid, an increase in sale must be one of its main concerns. Unlike the previous research works, the development of a decision-making tool to determine the NPD performance is the main concern of this study.

3. Research Approach

Figure 1 illustrates the process of the systematic research review in this study. It involves massive effort, pertaining to the new product development process and project performance from various perspectives. Information was gathered and reviewed across several databases i.e. SCOPUS, Google Scholar, Springer Link, ScienceDirect, and IEEE Explore through a systematic research review method. The documents were first extracted based on years of publication from the mid-80s’ to 2018. Second, they must be available in full-text in English. Third, the publications had to include all the peer-reviewed articles and relevant to new product development. Forth, the publication must consider reliable writers who have had more than five publications related to the topic and must have more than five citations after 2000. And finally, the publications were categorized into specific folders in Mendeley database, and duplicate publications were deleted.

Figure 1. The systematic literature reviews.

Initially, a draft version of the questionnaire was sent off via email to the contact person for pre-testing purpose. The questionnaire was cross-checked against the literature and with the respondents. Later, the questionnaire was fine-tuned; a face-to-face interview was planned and scheduled. The interview session was conducted at the project management office in the car producer’s assembly plant a few months later. The participations involved were a senior manager from the planning division and a senior executive from the NPI unit, along with two project managers from two different vehicle programs, and four development team members: two from each of the vehicle programs. Even though, the number of the participants is small, most of them have involved in many development projects. The interview was an open-ended semi-structured where the discussed topics cover without limitation the formal NPD process and project, the project characteristics, and finally the NPD performance. To
suit the requirements from the respondents, the unit sale, market share and the development lead time were used to measure the effectiveness and the efficiency of Proton’s NPD performance. Although, the development cost is another significant internal project goal for Proton, due to confidential issue it was ignored. This leads to a decision to exclude all financial performance measures as well. In fact, in Malaysia the car companies are not allowed to let the public know about the sales data by the Malaysian Competition Commissioner (MyCC). The development lead time reflects the efficiency of the NPD project while the annual sales volume and the market share reflect the effectiveness of the NPD project.

Finally, to compare those performance outcomes a simple yet straight forward performance matrix was developed in which both outcomes were measured and compared. The comparison of the performance measures can be made for a single project i.e. plan versus actual, and for similar types of development projects i.e. new platform versus new platform, full model change versus full model change that considerably involve design contents and project scopes of about the same weight. This performance matrix is known as Boejiang Performance Matrix (BPM). The outcomes from the evaluation determine the performance of a specific NPD project. Some specific levels of performance which reflect the efficiency and the effectiveness of the NPD i.e. lower than before, same as before, better than before were assigned to each of the boxes in the matrix. A case study was used to illustrate the application of the BPM.

4. Results and Discussion

Data from the literature and the interviews were used to establish the performance matrix. Since both performance goals are asymmetric, the following Table 1 were developed. An NPD effort is failed when the efficiency and the effectiveness met the following conditions:

i. Lower efficiency and lower effectiveness.
ii. Lower efficiency and same effectiveness.
iii. Same efficiency and same effectiveness
iv. Same efficiency, and lower effectiveness and higher efficiency and lower effectiveness.

Meanwhile, an NPD is considered to meet its performance success when these conditions are occurred:

i. Higher efficiency and same effectiveness (partially successful).
ii. Same efficiency and higher effectiveness (successful).
iii. Higher efficiency and higher effectiveness (very successful).

There is only one condition where the NPD performance is classified as “difficult to judge” when the efficiency is lower, and the effectiveness is higher. The levels: lower than before, same, and higher than before for the efficiency and effectiveness are based on comparison between actual against the planned development lead times (month) and unit sales (volume) for a single project. Furthermore, it also refers to the comparison in terms of efficiency and effectiveness of the previous and new development projects. The 3rd generation of PROTON Saga (New Saga) which was launched in September 2016 was used in this case study. It was developed to replace the 2nd model (Old Saga). Table 2 shows some data of the developed models. These data were obtained from a couple of websites especially from the Malaysia Automotive Association (MAA) and Astro AWANI online news as well as from the respondents. The total numbers of passenger vehicles sold in 2017 is 70,991 units, and 80% is contributed by the selling of the New Saga, Persona and Ertiga, and according to the Vice President, Sales and Marketing of Proton the total number of units sold for Persona is 19,510 units, and for Ertiga is 6,091 units [18, 19]. 80% out of 70,991 is equal to 56,793 units. By deducting the units sold of Persona and Ertiga, the total numbers of unit sold for the New Saga is 31,200 units or at an average of 2,600 units/month.
Table 1. Boejiang Performance Matrix

|                | Efficiency                  |
|----------------|-----------------------------|
|                | Lower than before           |
| EFFECTIVENESS  | New NPD failed              |
| Same           | No improvement (NPD failed) |
| Higher than    | Difficult to judge          |
| before         | Successful                  |
|                | Very successful             |

Table 2. Development time and unit sold of PROTON Saga Model.

| Model     | Year | Development lead time(month) | Average Unit sale/month |
|-----------|------|------------------------------|-------------------------|
|           |      | Plan | Actual | Plan | Actual |
| New Saga  | 2017 | 24   | 16     | 3,000 | 2,600   |
| Old Saga  | 2008 | 24   | 18     | 3,000 | 5,544   |

It is found that the development lead time for the New Saga is reduced by 33.3% from the planned development lead time. The eight months’ reduction in the development lead time shows that the NPD is efficient. On contrary, the actual unit sale of the model in 2017 is 13.3% lower than the planned volume. Meaning, the efficiency of the NPD is improved, but not the effectiveness of the NPD where the average of the actual unit sale of 2,600 units/month is lower than the target unit sale by 400 units. Therefore, the NPD is considered to be a failure as it has a higher efficiency, but lower effectiveness. The BPM can also be used to judge on the NPD performance between the Old Saga also known as Saga-BLM which was released in 2008 and its successor which is the new model after a year both products being released to the market. However, Table 2 only shows the average monthly sales unit, since the exact monthly sales data for both models are not available due to restriction imposed by the MyCC.

From the Table 2, the actual development lead time for the New Saga is two months lower than the Old Saga which represented by 11.1% reduction by comparison. Thus, its efficiency is higher than before. For the unit sale there is a decrease in effectiveness as the average monthly unit sale for the new model is 2,944 units less or 53.1% lower than the average monthly unit sale of the old one. As such, with reference to the BPM the NPD performance of the New Saga is a failure when compared with the old model.

Table 3. Development time and unit sold of Proton Saga.

| Project | Market Report (year) | TIV (units) | Total PV | Total Unit Sale | Total Market Share (%) | Market share (%) |
|---------|----------------------|-------------|----------|-----------------|------------------------|-----------------|
| New Saga| 2017                 | 514679      | 70991    | 31200           | 13.8                   | 43.9            |
| Old Saga| 2008                 | 525770      | 141958   | 66533           | 27.1                   | 46.9            |

Table 3 above shows some findings of both products for effectiveness test. The market report from MAA tells that the Total Industry Vehicle (TIV) in 2017 for passenger vehicle (PV) is equal to 514,679 units where 70,991 units are PROTON. Thus, PROTON controls 13.8% of the market share of the passenger car [18]. The New Saga total unit sales in 2017 is 31,200 units in which it represents 43.9% of the total PV of PROTON. Meanwhile, in 2008 the TIV of the PV is 525,770 units in which 141,958 units are PROTON. This is about 27.1% of the market share of the PV in that year. As the total unit sale of the Old Saga is 66,533, it represents 46.9% of total PV sold by PROTON in 2008.
From those figures it is very clear that the market share controlled by PROTON in 2008 is better than in 2017. The unit sale of the Old Saga is about doubled the unit sale of the New Saga. With reference to the BPM, it is found that the NPD performance of the New Saga is a failure as well, although the efficiency is higher, the effectiveness is lower than before. However, from the observation it is also found that both the New Saga and Old Saga have significant impacts on the market share as both contribute 43.9% and 46.9% of the total number of the PV of PROTON relatively. As such, it can be said that the low market shares of PROTON’s passenger vehicles in 2017 (13.8%) may be due to some other reasons i.e. promotion, macro-economic scenario, competitors’ strategies that are differed from the 2008. It also suggests that PROTON must address those possible external factors that affected the market share in order to have a better insight into its NPD performance. Moreover, for PROTON to have a better picture of its NPD project performance it is best to use the actual data of the monthly unit sale rather than the average monthly unit sale used in the case study since the outcomes would enable the practitioner to understand the actual comparative improvement between the NPD projects, and to have a better control in the product life cycle of the new and old models within certain periods of times.

5. Conclusions

Based on the findings and case study it is concluded that the BPM is reliable and suitable to be used as a decision-making tool that tells the status of an NPD performance. The BPM is applicable in determining the success and failure of an NPD by comparing the efficiency and effectiveness of the product development projects or programs. The measurement of the effectiveness of an NPD project in terms of market share gives better picture on the NPD performance rather than the unit sale. From the case study, the application of the BPM is found to be feasible on both cases. The adoption of a well-defined NPD is crucial, and the selection of types of project is very important for comparing the NPD performance when using the BPM. The efficiency of PROTON’s NPD has improved over time as the development lead time is getting better. Further investigation must be carried out in order to test the reliability of the BPM. The respondents are willing to use BPM as decision making tool for the future development projects.

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