

# Design capabilities development in a Malaysian automotive vendor company

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**Abstract—** Global competition has made manufacturing enhancement saturated. Manufacturers have to find new ways of increasing their competitiveness. A company's capability to conduct design determines the success of innovative products as a main determinant of profit attainment, especially in the technological industry. Design capability (DC) is defined as the availability of technical manpower skills and facilities to conduct design, namely, R&D, testing equipment and prototyping facilities, and the presence of technology to support current and future manufacturing innovations. DC is a company unique resource and can be deployed as a strategy to response in any circumstances and enable a company to anticipate future market demands and to manage global challenges. However, not many Malaysian automotive vendors have full in-house DC. Prior studies also found that Malaysian vendors have limited capabilities in finance, technology and facilities which have impeded the DC development. There is a number of critical success factors (CSFs) involved in developing successful DC. Currently, studies on vendors DC, particularly in Malaysia are very limited, making the development process more complicated. A study was conducted in an automotive vendor company that has successfully developed an in-house DC and was able to improve its business performance. Productivity, reputation and the company's competitive advantage were increased. Thus, the DC development of the company was studied and a framework was proposed. This study is to enable other vendor companies to emulate and understand the DC requirements and serve as a guide for other companies intending to develop their DC.

**Keywords—** Design Capability (DC), Malaysia, automotive vendor, CSFs

## I. INTRODUCTION

Global competition has made manufacturing enhancement saturated. Manufacturers have to find new ways of increasing their competitiveness. Nowadays, excellence in manufacturing alone is inadequate for a company to lead in the consumer-driven market. Intense competition from the global market, demanding customers, critical resources, and environmental

issues have put manufacturers in a tough situation. The situation has pushed manufacturers to improve productivity beyond the typical practice. Enhancing company's design capability (DC) can be the smartest solution as it offers a very wide potential for products improvement and can be strategic differentiator because it has greater influence on customer-defined value as well as investment and cost compared with manufacturing ability, which is limited to quality and productivity [1], [2], [3], [4], [5], [6]. The Toyota Production System (TPS), through its basic philosophy of eliminating waste, has successfully sparked revolution in the automotive industry. At present, the idea is expanding beyond the manufacturing line, moving upstream toward efficient PD. Efficient PD considers the total value stream of the process thoroughly. Most of the important decisions regarding products are decided in advance during the PD process to improve both design and manufacturing stages. Greater flexibility in PD enables design changes with minimum impact because failures or defects can be removed earlier before reaching the production line [5].

Company's capability to conduct design determines the success of product development (PD), which is very important as a main determinant of profit attainment, especially in high technology industry [7]. In the automotive industry, the process of innovation and PD are very important and at the forefront as compared to other manufacturing industries [8]. Building a car is more complicated than building other consumer products because of more than 20 000 parts involved [4]. Automakers cannot develop products on their own. As based on conservative PD practice, the process took 24 to 30 months to complete one new car model. Indeed, Toyota manages to bring a new model to start of production in just 15 months [1]. As compared to conservative PD, the design responsibility was solely put on automaker. As of now, concurrent engineering enables automakers to conduct new PD activities with the assistance of hundreds of vendors at once. For example, Toyota works with 150 to 300 vendors [9] and Proton works with 265 vendors (as of February, 2010). In order to support the strategy, the vendors' roles becoming more severe and also need to be equipped with sufficient level of DC to ensure the success of the strategy.

This paper presented the outcomes of a study on DC development in Malaysian automotive vendor specifically

Proton. Even though Proton has introduced Early Vendors Involvement programme (EVI) that involved vendors in new PD since 1993 but not many Malaysian automotive vendors have full in-house DC. Prior studies also found that Malaysian vendors have limited capabilities in financial, technology and facilities which have impeded the DC development. There is a number of enabler factors involved in developing successful DC. Currently, studies on vendors DC, particularly in Malaysia are very limited, making the development process more complicated. The idea of SIPD may not success without sufficient vendors' technological capability [10].

This research is based on a case study of an AXX's (this is not a real company name) experience that has successfully developed an in-house DC. The interviews were conducted using a framework developed by [6] that includes four important steps: pre-fieldwork preparation, conduct of interview, clarification and verification, and data analysis. The company was represented by Deputy General Manager of **Engineering & Research Sdn. Bhd. (Subsidiary of AXX)** who is actively involved in PD projects as an expert sampling. [11] define PD experts as executives from the managerial level of design, procurement, engineering, or R&D units of companies, and who are directly involved in design activities. Expert sampling among the non-probability sampling methods is used to ensure reliable and informative input regarding the subject matter. Numerous previous studies, such as [12], [13], [14], [15] also selected managerial-level respondents for the same reasons.

## II. COMPANY BACKGROUND

AXX is a Malaysian company established since 1978. AXX is the largest manufacturer of auto parts in Malaysia with a group of seven companies operating in Malaysia and in regional countries (Vietnam, Indonesia, and Australia). AXX has various products classified into three divisions, as shown in TABLE I. AXX has a long list of customers for different products supplied to the local and overseas markets, namely, Audi, BMW, Citroen, Daihatsu, Ford, Hino, Honda, Hyundai, Inokom, Isuzu, Jeep, KIA, Landrover, Lion (Dong Feng), Mazda, Mercedes, Mitsubishi, Modenas, MTB, NAZA, Nissan, Perodua, Peugeot, Proton, Renault, Scania, Subaru, SsangYong, Suzuki, TATA, Toyota, and Volvo.

TABLE I. LIST OF AXX PRODUCTS

Division	Products
Suspension	Commercial vehicle: Leaf spring, parabolic leaf spring and U-bolt Passenger vehicle: Shock absorber and coil spring
Electrical & Heat Exchange	Compressor and cooling coil, radiator, auto-electrical components
Interior and Plastics	Mold door panel and side moldings Seats: sport seats, VIP coach seat, metro seats, city bus, forklift seats

## III. DC DEVELOPMENT EXPERIENCE

DC in AXX was developed over 20 years ago. DC development in AXX was initiated by the top management as a strategy to lead the industry via offering a complete line of business. The company realized that DC offers more advantages and strengthens the company's ability to win over competition by offering competitive and innovative products.

During this period, the company established manufacturing capabilities to contribute sufficient financial support for DC development. Top management has planned DC development to be gradually based on needs. The company began DC development with the recruitment of new staff in charge of design activities, and hired an entire team of local engineers. The staff was sent to Japan for training with appointed technical assistance (TA) companies, where they received fundamental knowledge about the products. Every year, the top management allocates a certain amount of money for development, influenced by the market and justification of technological needs. In 2010, the company successfully developed a full engineering and research center (ER) where research activities of the entire group of companies are centralized under one office located in Shah Alam. The company also has collaborations with a local university (Universiti Kebangsaan Malaysia (UKM)) to utilize the latter's expertise and facilities in research and development, especially on new materials. The collaboration has accelerated the development process and minimized cost.

Initially, all drawings of jobs were done manually. As AXX began expanding its businesses, the company realized the importance of having a data management system for establishing design activities. Therefore, the company started developing a database system for drawing and a standard of designs for future reference. In the company's early involvement in PD, the most crucial challenge was gaining customers' trust. The company needed to collaborate with foreign TA, from the initial stages of the design process until completion. At present, although the company has established the DC, some customers still request for a TA to approve the design. Most AXX products were specialized and no testing facilities were available in Malaysia at the time. Consequently, the company needed to send products to Japan for testing.

The company has achieved full capabilities to conduct in-house design. Currently, the engineering and research activities of the entire group of companies are centralized, thus creating larger resources and facilities. There are identified enabler factors that support the AXX DCs success are listed below:

- a) Top management commitment
- b) Sufficient financial allocation
- c) Experience in establishing PD processes
- d) An efficient organizational structure to run PD activities
- e) Strong human resource team to handle PD activities
- f) Complete facilities and technology for conducting PD activities in house
- g) Strong external support from TA, customers, and the government

#### h) Reliable market size

Summary of AXX experience in developing DC is shown in Appendix 1. All important critical success factors (CSFs) towards success of the company DC development are summarized in the framework. The arrows represent priority of sequence of the process as guidelines for others company who intend to set up the DC in their company.

#### IV. RESULTS OF DC DEVELOPMENT

Over 20 years of involvement in design activities allowed the company to receive significant benefits that made AXX as the largest auto parts manufacturer in Malaysia. Proton as the biggest automaker in Malaysia has recognized the company as a *black box* vendor. AXX becoming technological mastery and expertise is recognized by Proton. Proton always refers to AXX for specific requests or necessary changes in the new product development.

Specialization in the products produced allows them to improve quality and reputation. DC allows the company to design specifically to meet customer needs, given its long list of customers as listed in Section II. Improved products especially for the replacement market (RM), enables them to improve the overseas market. As the products' qualities improved and complied with European legislation and environmental restrictions, the products can easily enter any of overseas market. Thus, enables AXX to penetrate bigger market.

DCs allow AXX to improve product quality, cost, and delivery, resulting in fewer complaints from customers. Over the past few years, AXX has achieved zero defects and received zero complaints from customers. In other words, the company manage to have good relationship and gain customers trust. Instead of improving products quality, AXX admits that DC is able to improve the overall efficiency of process and products manufacturability. In-house DC allows the design team to consider manufacturing capabilities concurrently during the PD stage. The company can predict and avoid problems before these reach the manufacturing plant and become more costly. Overall reduction of up to 30% of development time through in-house DC and advanced CAE software allows cost savings of 30% to 40% compared with the previous practice of trial and error. Through DC, the company also can diversify its business by producing more complex parts, like seats as shown in TABLE I.

Basically AXX realizes that by having DC, they are not only able to please customers but also able to improve product quality by improving products manufacturability and save quite huge amount of money in term of processes, resources use and cost of redemption. As a result, the company is able to increase profit year after year as shown in FIGURE 1. AXX profit margin has rocketed about 200% in 2010 as compared to the previous years. Regardless of automotive economic crisis in 2008-2010, AXX managed to make profit with slight fall in 2008. This is partly due to the management strategy to reduce

operation cost through centralising the R&D facilities. Likely, the strategy has contributes significant impact towards effective and efficient resources usage and also improved product quality. All the R&D teams and facilities are placed under one roof that enhance the team working and immediate decision making. AXX enjoyed surplus cost saving as a result of facilities utilization, eliminate overlapping tasks and minimize tendency of errors.

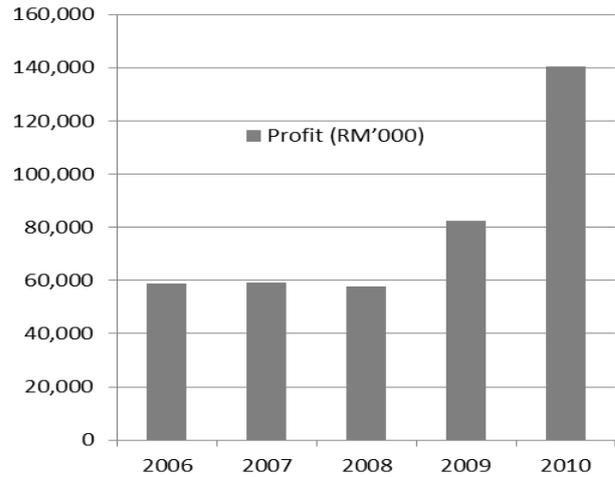


FIGURE I. AXX ANNUAL PROFIT (2006-2010)

#### V. DISCUSSION

According to [11], DC is defined as the availability of technical manpower skills and facilities to conduct design, namely, R&D, testing equipment and prototyping facilities, and the presence of technology to support current and future manufacturing innovations. AXX DC has fulfilled all the basic definition and yet there are many additional CSFs added namely top management involvement and commitment, financial capability, external supports, organizational structure, efficient process and business performance results (BPR).

Basically, AXX DC development has consider wider CSFs since the company was established older than the first Malaysian automaker, Proton. As what being practiced in Japan, automakers like Toyota play very important roles in developing their vendors. In this case, Proton learns a lot from AXX's experience. As pioneer in this industry, the challenge was greater and AXX has to set up by its own. Thus, reasons why the company has to appoint TA and send local engineers to overseas. AXX also highlighted the significance of strong BPR as critical enabler factor to gain customers' trust and also to convince government for loan to support further expansion. In addition, the organizational structure that has centralized research and development activities for the whole AXX companies seem very appropriate for effective facilities usage, resources expenditure as well as able to enhance productivity of the design team. Details discussion of the CSFs is as followed:

##### i. BPR

The AXX DC development framework visually shows the BPR as a dominant CSF with major influence on every criterion, as shown by the direct interdependencies. Instead of being the results of the development, BPR also has significant influence towards market expansion. More connected arrows in and out make BPR the core of the framework. It was admitted that the benefits of the DC have brought significant influence to the BPR and are used to facilitate further expansion planning in companies. These findings are aligned with those in prior studies. For instance, the ERIA [16] report identified well-developed firms as organizations with strong BPR, owning strong internal and external capabilities that make them highly capable of implementing new technological changes.

### ***ii. Technology and tools***

Financial capability as well as technology and tools are strongly associated. Both were identified as highly important enabler factors in achieving an adequate level of development in design components. Most Malaysian vendors have limited financial capabilities. Fortunately, AXX has established since 1970s and the company managed to strengthen their manufacturing development before developing the DC that consequently enable them to have sufficient level of financial capability. Thus enable them to acquire complete, and the latest, technology to conduct PD. A number of important technologies were identified those used by the company in conducting design processes, such as Computer Aided Design (CAD), Computer Aided Engineering (CAE), and Computer Aided Manufacturing (CAM) computer software, database systems, facilities for R&D and testing, and also supported by some design tools to facilitate decision-making, such as Quality Function Deployment (QFD) and Value Engineering (VE). Regarding on Concurrent Engineering (CE) practice, current telecommunication technologies are important for effective communication and information exchange.

### ***iii. Financial***

Limited financial capability was identified as the main barrier in developing DC among Malaysian vendors including AXX. This is due to high technological facilities need for huge investment but very difficult to get loan approval. This issue sounds rare because many leading automotive companies that started a long time ago have grown into well-established organizations, and financial capability is no longer a critical issue for them. As described by Binder et al. (2008), the European automotive industry has specifically developed capabilities that provide them an advantage in adopting changes, compared with the Malaysian automotive industry. Annually AXX has self-discipline to allocate some portion of the company profit for R&D development to ensure up to date facilities used.

Furthermore, centralizing the R&D facilities is a smart strategy which is good for cost reduction and also optimizes the facilities usage.

### ***iv. Human Resource***

Human resource pertains to specific manpower requirements to form a successful PD team, which include knowledge background, experience, skills, specialization, and a cross-functional integrated team. Justifying and organizing the roles of a multi-functional team is quite complex; thus, a specific organizational structure that facilitates the coordination and management of the design team is needed.

Based on the experiences of AXX, critical positions in the design team, such as engineers, were sent overseas, for training. This company has made specific investments on manpower to ensure that they meet the required levels of competency in conducting design. Such strategy is aligned with the competency theory, which emphasizes the internal features in improving company competitiveness [17, 18]. However, the high technology automotive industry has made the knowledge transfer process more critical. According to Dyer and Singh [19], the success of knowledge transfer depends on the absorptive capacity of the recipient. By putting all the R&D teams (consist of different education background, different level of experience and multi-skills) in one premise enhances the manpower skills and knowledge through application and sharing between staffs.

### ***v. Organization Structure***

The success of SIPD highly depends on an established and systematic process. As the PD process involves sharing of much critical information, collaboration with a number of suppliers makes the process more complex, and creates a need for specific processes for the successful management of SIPD. Meanwhile, complexity of managing the SIPD process can be delayed without right organizational structure. Centralizing R&D facilities enable the company to improve the PD process through fully utilize available resources, eliminate overlap functions and minimize duplication of responsibilities, encourage mutual support among team members and allow for immediate decision making. As a result, AXX manages to minimize mistake, shorten the PD development time and reduce development cost.

### ***vi. External support***

This study found that the most significant source of external support is TA, and not buyer firm/automaker or government. TA contributes significant benefits to advanced technology and knowledge transfer in the Malaysian automotive industry. Automakers, with their technological propriety, have the capability to lead the PD, including the vendors. However, in Malaysia, the vendors cannot rely on Proton as the latter is also dependent on technical partners for technology

enhancement [20]. Therefore, the vendors have to depend on external TA to minimize risks of failure and to gain customer confidence and trust. The case study is among the successful Malaysian vendors has revealed the importance of foreign TA to their success. Likewise, Wad and Govindaraju [21] encouraged local companies to form JV with foreign companies as a strategy for improving technological capabilities. Such strategy promotes the development of DC.

However, the benefits gained in technology and knowledge compared with the costs spent in hiring TA remains an issue. Mohamad (2008) provided an in-depth discussion of the technology transfer situation in Malaysia. TA is considered an expensive investment, and returns are subject to the agreement set by the provider and the receiver. At the same time, the willingness and commitment of both affect the success of the collaboration.

Proton also encouraged Malaysian vendors were to partner with foreign companies to gain technology and knowledge transfer that would support DC development. AXX admitted that early vendor participation in PD has indirectly enhanced the vendors' knowledge and skills in design. However, AXX did not receive any physical assistance from Proton. This finding is similar to that of Lettice et al. [22] and Reed and Walsh [23] whereby the existing supplier development program identified in the buyer firm was limited to certain activities and process improvement, and contributed very little to developing the technological capabilities of suppliers. Meanwhile, close collaboration between industries and the academia may benefit both parties. As practiced by AXX, collaborating with a non-profit organization such as a university can successfully optimize R&D resources. The company provides an actual scenario in seeking assistance from a university that owns full facilities and expertise.

#### **vii. Market**

Bigger market is essential in guaranteeing a sufficient return on the investment made in DC. Proton operates under capacity. Vendors that depend solely on the small domestic market face difficulties in investing on expensive design components. Other established automotive players always target exports to gain deeper market penetration. For instance, the UK auto industry has exported 60% of the vehicles produced in the UK to the European market [24]; similarly, Thailand production in 2005 exceeded 1 million and about one-third of the production caters to the export market [25]. Proton has recently announced that it is gradually moving toward internationalization, starting with its neighbouring countries and the Islamic countries. AXX has established a mixed customer base (domestic and overseas market) aside from Proton demonstrate a secure and bigger market as results of having DC.

#### **viii. Top Management**

Top management plays a highly important role in development planning. The experiences of the studied company has confirm that top management strategy significantly contributes to the success of the companies. It was top management initiative to set up DC in AXX in order to have complete business cycle. Vision of the top management has brought the company to lead the Malaysian automotive industry.

In general, the DC development takes ages to get established because the development requires huge investment. As what is being practiced by the company, the technology was set up gradually and profit gained was reimbursed on the development planning. Definitely, the AXX DC development planning was impossible without the top management commitment. Strategic planning that came from internal initiative has considered its own capacity, weakness, threats and strength of the company. Smart partnership with non-profit agencies and reputable TA contribute to fruitful success of the company's DC development.

Once the DC is in place, the benefits received by the suppliers are greater than the buyer [26]. Potential of DC that offers more advantages are able to strengthen the company's ability to win over competition by offering competitive and innovative products. Consequently, synergizing the existing core company resources with the design potential is able to produce total effect that is greater than manufacturing-focused alone. This is aligned with findings from other researchers that used to identify DC as a company unique resources and can be deployed as a strategy to response in any circumstances [27] and enable a company to anticipate future market demands and to manage global challenges [2, 28]. Definitely, the chosen case study company has proven it.

The DC development in AXX has similarities with the model of innovation process in developing countries. Such model has three stages, namely, (i) acquisition of foreign technology, (ii) process development and acquisition of product design technologies, and (iii) application of R&D to produce a new product line (Hobday et al., 2004). AXX currently in stage (ii) but is moving toward (iii). Likely, by having DC AXX is able to improve products and undergo evolution that enables them to achieve dynamic capability and become more responsive towards global competitive market [28, 29].

#### **VI. CONCLUSION AND RECOMMENDATION**

Enhancing PD enables efficiency and effectiveness of the whole operations that govern the upstream supply chain as well as the downstream of production and sales chain. Vendors' involvement in PD has opened great opportunity for vendors to be competitive and independent. Therefore, all vendors should strengthen the company's DC as it appears to be the dominant core competency of companies [1], [2]. As a conclusion, design has a greater potential and is not exclusively only for high technological automotive industry.

In Malaysia, design activities that related to innovation have just started to emerge. SIPD has just been introduced by

Proton and it involves only a selected number of vendors. Since not many companies in Malaysia have the DC it is hoped that DC development framework of AXX can be applied to other manufacturing companies which intend to sustain in business. It is hoped, this article is able to contribute to the knowledge of design activity in the Malaysian automotive industry and also vendors from other developed countries with similar conditions. For future work, the model has to be tested and verified with the automotive vendors. Its application and suitability in other industries also have to be tested.

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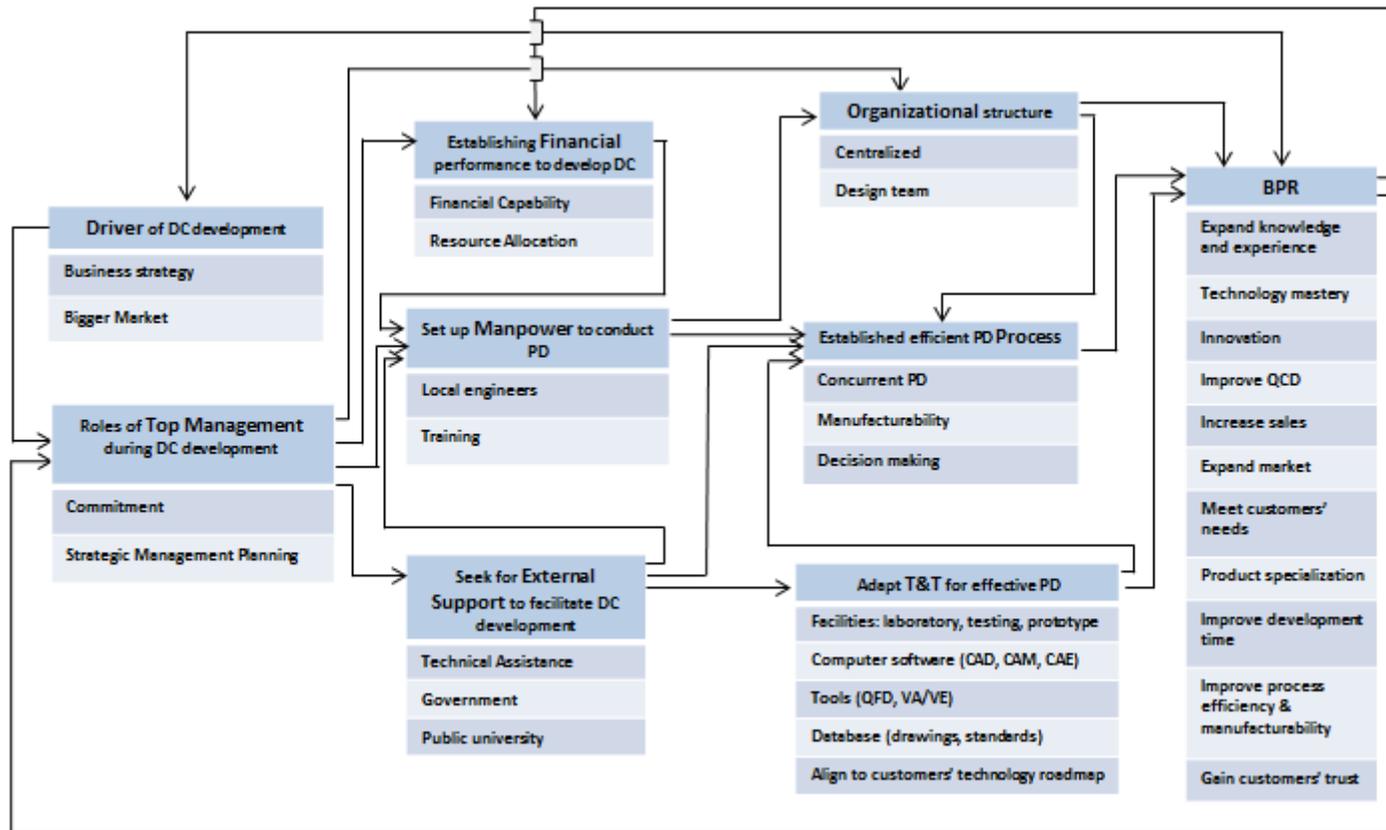
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Appendix 1. Framework of DC development of AXX company