Managing Automotive Product Development

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Abstract

The new product development (NPD) is the process by which a new product idea is conceived, investigated, taken through the design process, manufactured, marketed and serviced. In Automotive Engineering these related to the product realization process (PRP) which consists of five phases: "Plan and Define Program", "Product Design and Development", "Process Design and Development", "Product and Process Validation", and "Production Launch, Feedback Assessment and Corrective Action". This paper proposes a process-based management concept focusing on controlling and measuring for their effective management including literature review of NPD performance measurement. Integrating the process-based management concept with the proper performance measure can initiate new knowledge which will contribute to the improvement of the automotive industry.

Keywords: *new product development (NPD); management; product realization process (PRP)*

1. Introduction

The product quality planning, which is sometimes used interchangeably with new product development (NPD), however, the second one seemed to represent the broader term, is the process by which a new product idea is conceived, investigated, taken through the design process, manufactured, marketed and serviced through obsolescence. [15]

noted that, the competitive advantage of a company can be linked to two key factors:

(i) the ability to generate new intellectual property that offers superior value to customers And

(ii) the ability to capitalize on it quickly. Superior quality and project management optimize the performance excellence of organizations, unfortunately, the combined leverage of quality and project management is often underutilized due to inadequate related knowledge and experience, time pressures or budgetary cutbacks [17]. For automotive production and relevant service part organizations, defined "Product Realization Process (PRP)" as one of major parts of the standard, a useful framework for understanding the product quality planning/NPD in general. defined the methodology for managing new product development, Advance Product Quality Planning (APQP), in the automotive supply chains. The APQP embodies the concepts of error prevention and continual improvement in contrasted to error detection, and is based on a multidisciplinary approach. The APQP consists of five phases as follows: Phase 1 - Plan & Define Program. Phase 2 - Product Design and Development. Phase 3 - Process Design and Development. Phase 4 - Product and Process Validation. Phase 5 - Production Launch, Feedback Assessment and Corrective Action. In real practice, these phases may overlap and many tasks are done in parallel (concurrent engineering) to streamline and maximize resource utilization. This paper proposes a process-based management concept focusing on controlling and measuring for their effective management including literature review of NPD performance measurement.

It also sought to determine the need for performance measurement, which measures are currently used, which further measures are needed and where can be improved.

2. MANAGING THE PROCESS-BASED NPD

One of the most important keys of success of NPD is interest, commitment and support of management. Reference [7] defined the NPD significant characteristics which are repeatable to effectively communicate to team with consistent use of the defined process and flexible to tailor to the different needs. Reference [1] stated that NPD are based on information content and their accompanying information dominated methods, therefore, an efficient methodology for reducing NPD time initially requires developing an understanding of information flow among different project processes. The trend in organizational structures for high performance product development organizations has moved toward

integrated models [19]. In addition this is supported by cross functional teams that know how to manage their knowledge and communication boundaries effectively [2].

Reference [16] described the meaning of concurrent engineering that is the process of designing a product using all inputs and evaluations simultaneously and early during design to ensure that internal and external customers' needs are met. This takes a major role in the NPD. Real change cannot be accomplished in a large organization without the impetus of a facilitator. Enterprise wide training programs, supported by top management, were necessary including effective tools used by the facilitator. The study conducted on 67 industrial organizations in Singapore shown that brainstorming is the most commonly used tool, however, benchmarking, DOE, and FMEA are also applied by more than half of the respondents [5]. Competence in the resource based perspective represents a combination of knowledge, skills and technologies which provide opportunities for the NPD and are difficult for competitors to duplicate. To pursue growth opportunities, the organization must now focus on the management of their abilities in product and technology development and the production expertise, while directing complementary human and physical investment [18].

According to a knowledge-based view of organizations, the principle function of a firm is the creation, integration, and application of knowledge [24]. A successful NPD strategy involves the identification, development and exploitation of key resources. Such exploitation of a firm's unique knowledge base ultimately leads to successful new products and, in turn, sustainable competitive advantage [10], [21].

Information technology is also a catalyst of fundamental changes in the strategic structure, operations, and management of organizations (including the NPD), due to their highly capabilities [26]. The NPD is a dynamic process driven by continual improvements. The NPD should be adapted constantly to changing environment, its own organization, and customer needs for sustainable success. In a product development chain, cost control through a proper or optimal plan and a selection of various NPD or suppliers are very critical to the success of customization [25]. Customer capability enhancement and contributor assessment, appreciation and renewal after project termination at the closure stage promote customer delight and referrals, organizational accountability and proud, grateful, reenergized contributors to future projects [17].

3. Controlling

"The management shall review the product realization process and the support processes to assure their effectiveness and efficiency [13]" The NPD is subjected to be controlled Fig. 1 QMS model (modified from model of process-based quality management system, ISO9001:2000) to help assure the desired results in terms of both effectiveness and efficiency. These controls are in the form of design reviews including verifications and validations as part of the review. The requirements of design and development review, verification and validations are identified in the ISO/TS16949:2002 standard under the PRP (NPD) part. In order to control the NPD through its review, verification and validation, it is necessary to understand the process-based QMS. The ISO/TS16949:2002 standard applied the concept of "process approach" to enhance customer satisfaction by meeting customer requirements. An activity using resources, and managed in order to enable the transformation of inputs into outputs, can be considered as a process [12]. Often the output from one process directly forms the input to the next.

The application of a system of processes within an organization, together with the identification and interactions of these processes, and their management, can be referred to as the "process approach" [12]. An advantage of the process approach is the ongoing control that provides over the linkage between the individual processes within the system of processes, as well as over their combination and interaction. In the automotive industry, organizations may classify the processes exists into three categories;

• Customer Oriented Process (COP), the processes whose output influence directly to the customer satisfaction.

• Support Process, the processes whose output support the COPs and other support processes to function properly.

• Management Process, the process of review and monitoring to all COPs and support process to assure their efficiency and effectiveness.

Fig. 1 describes how PRP (NPD) interacts with customer and other processes in the QMS including management process. It also shows that PRP (NPD) comprises of COPs and support processes as describe above. Fig. 2 simply focusing on management monitoring over COP and support process in the organization. The monitoring may include design

review, verification and validation. Design reviews including verifications and validations are formal reviews conducted during the development program to assure that the metrics, requirements of that stage of development, the issues are understood, the risks are being managed, and there is a good business case for development. Typical design reviews include: requirements review, concept/preliminary design review, final design review, and a production readiness/launch review including program's progress according to customer timing requirement. Reference [15] described that, under the design review concept, those who will be impacted by the design are given the opportunity to review the design during various formative stages. Design and development verification as part of the review should be performed in accordance with planned arrangements to ensure that the design and development outputs have met the design and development input requirements. Design verification is testing to assure that the design outputs meet design input requirements. Design verification may include activities such as: design reviews, performing alternate calculations, understanding and performing tests and demonstrations, and review of design documents before releasing. The verification for the NPD should focus on the inputs and outputs of each phase of the NPD including applicable customer requirements according to the customer timing program. Design and development validation as part of the review, is performed in accordance with planned arrangements to ensure that the resulting product and manufacturing process is capable of meeting the requirements for the specified application or intended use.

Product design validation is performed on the final product design with parts that meet design intent produced from manufacturing processes from PRP (NPD) intended for normal production. The success of the NPD is depending on how the NPD is controlled and how the control results is led to the improvements. One of the key of success for managing the NPD is determining the proper metrics together with effective control to assure the desired result. In doing so, the process analysis is necessary. While monitoring the process under the process approach, the management is supposed to review the process metrics in order to control the whole process to deliver the desired output. Depending on the resulting achievement of the metrics, the corrective action and/or improvement action then can be properly initiated. The route causes of problems encountered usually come from one or more of the process components, sometimes even the metrics itself are the cause of problem. This insists the significant role of the measuring dimension in managing the process-based NPD.

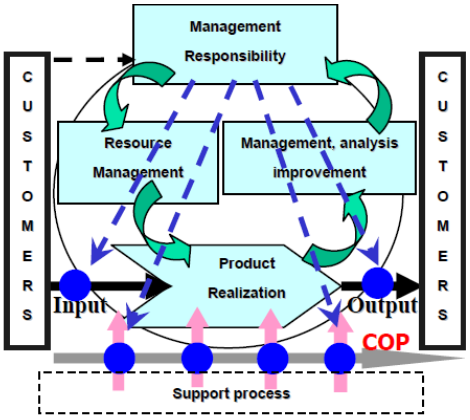

Fig 1. QMS model

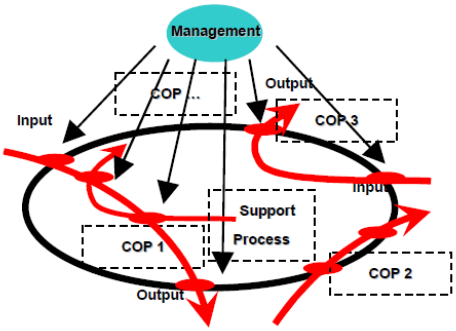

Fig 2. Management monitoring

4. Measuring

The NPD process performance is measured to assure an adequate level of performance through establishment of metrics. Criteria for effective metric typically include: simple, understandable, logical and repeatable. Some simple

target areas of successful product development efforts [27] included product cost, product quality, development capability, development cost, and development time.

Traditionally NPD competitive capabilities have been measured on the basis of lead times, productivity, and conformance quality [16]. Reference [22] further note that in an uncertain product development, cross-functional integration can have a positive impact on the financial performance of new products. Most of development programs failed because they are not focused on business issues and do not have metrics that drive improvements [4]. Reference [6] proposed four basic types of metrics for NPD as follows; Process metrics, Product metrics, Program metrics, and Business metrics etc. Reference [9] stated that, measures often based on outdated cost management systems with "lagging" metrics, not related to corporate strategy and contradictory to continuous improvement. Both academics and practitioners agree that reliance on international financial measure of NPD performance is inadequate for today's operating environment [11]. Reference [8] stated that measures used to evaluate an organization's performance, including NPD, have traditionally been largely financial, based on management accounting systems. These measures have last for long time because they are easily understood, familiar to senior management and can be easily obtained. Financial measures also have the advantage of being "precise and objective" [20]. NPD process measures used in many organizations currently are often lagging indicators, only concerned with revising the outcome of the individual project and integrated NPD effort, rather than providing guidance on what needs to be consistently measured to ensure they are successful [27]. Success in NPD is usually evaluated along multiple metrics. Apart from evaluating the success of the

NPD (measured by the attainment of NPD competitive capabilities), management are also interested in the overall impact of NPD on the business as measured by profitability, break event point, and initial market penetration [16]. Reference [11] concluded that, the best measures of NPD success are some combination of market share, profitability and customer satisfaction. Reference [27] provided understanding of how performance measurement has developed in the intervening period (from 1996 to 2001). The study stated that the lack of measures that assist with NPD is still adversely affecting company performance and hence future success. A more rounded evaluation of NPD projects requires operational measures that dynamically track progress and performance (leading metrics), preferably on a real-time basis, indicating an appropriate course of action to ensure that the outcome of the process is successful [27]. Based on the literature reviews, the NPD performance measurement has been changing from lagging indicators to organization integrated indicator. Increasingly, it is also tend to move from accounting based to customer oriented such as customer need and customer satisfaction. In order to achieve the desired output, the NPD must be process-based managed as all processes/phases are linked together. Improvement concept such as Plan-Do-Check-Action (PDCA) cycle can be applied to foster managing the process based NPD. Plan: establish the objectives and processes necessary to deliver results in accordance with

customer requirements and the organization's policies. Do: implement the processes. Check: monitor and measure processes and product against policies, objectives and requirements for the product and report the results. And Act: take actions to continually improve process performance.

III. CONCLUSION

Based on the literature reviews, the NPD performance measurement is increasingly focused on the customer need and customer satisfaction, rather than the accounting-based system. The author also proposes the process-based PRP (NPD) management concept within the context of the automotive quality management system standard, ISO/TS16949:2002. Integrating the process-based management concept with the proper performance measure can initiate new knowledge which will contribute to the improvement of the automotive industry. The further study of

NPD performance measurement in conjunction with the automotive process-based management is recommended.

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