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Risk Mitigation in New Product Development – A Concurrent Engineering Perspective

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Abstract- This research article deals with the analysis of available literature related to risk involved in NPD in a concurrent engineering environment. This will be helpful in design and development of products free from risk.

Keywords: Risk Mitigation; Product; Design; Manufacturing.

INTRODUCTION

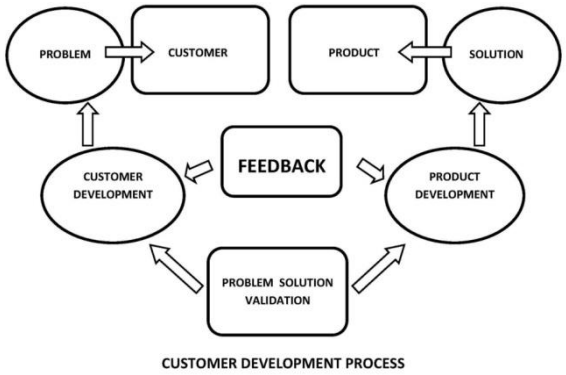
In **a** new product Development process, the term risk has a strong influence in terms of its success throughout its use**.** The industries throughout the globe have initiated several measures to exercise control over their processes/policies, thus improving the quality of products, right from marketing through manufacturing. Concepts like total quality management (TQM), six sigma, just in time (JIT), Kaizen, Design-for-X (DFX), quality function deployment (QFD), etc. have to some extent been instrumental in mitigating risk in a product/system. The Concurrent engineering (CE) approach involves integration of various essential parameters, which are used in a new product development. This involves a team work of design, manufacturing, marketing, maintenance/service, etc. as the characteristics in a NPD.

Concurrent Engineering Approach and Traditional Design Approach

It has been observed that a majority of risk factors that evolved during the traditional manufacturing, led to a shift from traditional manufacturing paradigm to concurrent engineering (CE). From risk perspective, a systematic integration of various critical factors is to be performed and thus incorporating the same in early design process in a new product development.

Forgionne (1999) developed an expert system called Concurrent Engineering Decision Technology System (CEDTS). The CEDTS system provides sharing of information related to design and manufacturing during the process of product development.

Thurston (2013) proposed multi attribute utility analysis integrated with an expert system under concurrent engineering (CE) for new product development.



CUSTOMER DEVELOPMENT PROCESS

Risk in New Product Development

The probability of undesirable outcomes is referred as Risk. Any occurrence which could adversely affect the attainment of project objectives **(Hall 2002, Space et al. 2002).**

Fertis (2012) carried out a research study on robust risk where risk is measured as the worst possible when occurrence of a possible events is expected. The author used convex duality methods to calculate and optimized the Robust CVaR and examined its performance using data from the New York Stock Exchange and the NASDAQ. After solving the theorems, the author concluded that after exactly knowing the probability distribution, then only the robust optimization principles can be implemented to measure the risk. In addition, same mathematical techniques can be used for financial decision optimization.

Fahimnia et al. (2015) presented a review article on quantitative models for supply chain risk management. In his study, the author found that supply chains are getting complex day by day and at the same time, research in this particular area has greatly increased since year 2000.

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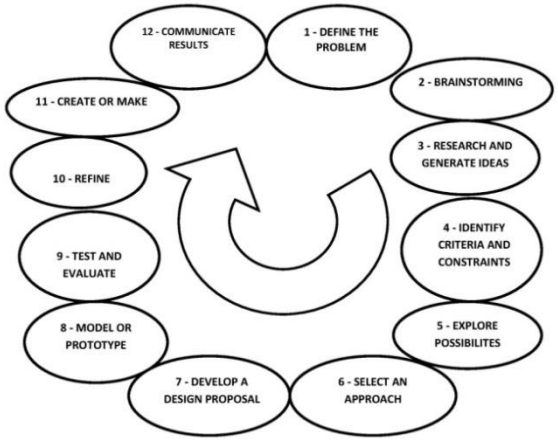
Ouedraogo et al. (2013) carried out a research study on how to learn from the resilience of Human–Machine Systems under unexpected disturbance. The author presented behavioral model in response to unexpected events and various resilience indicators are discussed to learn from resilience. The author validated the proposed architecture with to a defense air transportation system under defined criteria that related to system safety, human work- load, and the team mission.

Delgoshaei et al. (2016) presented a multi-disciplinary scheduling of dynamic cellular manufacturing systems in the existence of cost uncertainty using a new method in presence of bottleneck and parallel machines. The author developed hybrid genetic and simulated annealing algorithms to solve the model.

Chakraborty (2011) presented a research article on various applications of the MOORA technique, which aid multi-objective optimization on the basis of ratio analysis for decision making, in manufacturing environment.



DESIGN PROCESS

Yusuf Tansel IC (2016) carried out a research study on developing a multiple criteria optimization method to overcome the problems in engineering design. The author integrated regression function into a mathematical model with the criteria constraints along with DoE and TOPSIS techniques. The findings showed that the proposed new technique can be used as a tool to analyze the building design optimization problem in conceptual design phase.

Ahmed et al (2017) presented a research article on environmental life cycle assessment and techno-economic analysis of triboelectric nano-generator (TENG). In this paper, the author assessed potential techno-economic impacts life cycle assessment of two representative examples of TENG modules, one with a higher performance efficiency (Module A) than other (Module B).

The findings showed that TENG modules have the shortest EPBT among other existing PV technologies. In addition to this, the environmental hotspots come from the use of acrylic (both Modules A and B), PTFE (Module A) and FEP (Module B). So, advanced material optimization should be done for future development of this technology.

Angelo (2016) performed a research study on life cycle assessment and multi-criteria decision analysis (MCDA) approach on strategy selection for domestic food waste management in the city of Rio de Janeiro in Brazil. The author concluded that use of an appropriate MCDA approach not only provides clarity to the interpretation of LCA results, but also helps elucidating the acceptability of alternatives.

Arena et al (2016) proposed that recycling process of post-consumer absorbent hygiene products is able to provide reliable industrial operations, without external support of fossil energy sources after performing series of tests on a demonstrative scale. This suggests that the proposed recycling scheme, involving the utilization of energy content of the cellulosic fraction of the waste to produce the steam for the sterilization stage, permits closing the loop of the process, improving its overall environmental sustainability.

Vinodh et al (2015) presented a case study on LCA integrated value stream mapping framework to ensure sustainable manufacturing. The author consider the proposed structure capable of assessing the manufacturing process performance from sustainability view point. The study helped in enhancing the firm's sustainable performance and reducing its environmental impacts.

In another case study (**Peng et al (2016),** the author assessed system capability on the basis of six environmental indicators, namely, primary energy demand (PED), global warming potential (GWP), acidification potential (AP), eutrophication potential (EP), ozone layer depletion potential (ODP), and photochemical ozone creation potential (POCP). The author concluded that the statistics advocate the welded impeller has more environmental advantages over the overall milled impeller, majorly in terms of material utilization rate, electricity utilized, and service time; where raw materials production, manufacturing and usage were particularly the top three emission contributors.

Helmers et al (2015) investigated the consequences of a second life of a vehicle glider's impact on the environment. The author concluded that impact reduction by the longer lifetime of the glider (additional 100,000 km) due to electric conversion, saved 16 % (CO_2-eq) and 19 % (single score endpoint), respectively. The smart model showed the suitability for a quick and easy conversion.

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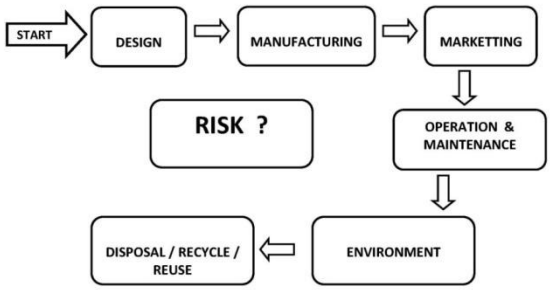
Subramanian and Yung (2016) presented a holistic review of LCA developments on Consumer Electronic Products special focus on environmental impact which clearly evident that ICT products have received more scholarly attention compared to other electronic products.

Fang et al (2016) presented a research study on sustainable design and analysis of CNC machine; from its application perspectives. The proposed sustainable design index (SDI) oriented approach for the machine design contains energy consumption, CO_2 emissions, costs, modularity design and analysis, light-weight design, security, working environment, accuracy and processing capability; and provide both the theoretical and practical tool for the machine tools designers.

Thus, based on the literature review above, it can be established that risk mitigation is an important aspect in a new product development. This research paper focuses on establishing some factors which may form the basis of research in the area of risk mitigation in new product development. Based on the research studies carried out during the past few years and our understanding, the risk in NPD may be in the following areas:

- Concept Hunt
- Material Selection
- Process Selection
- Tool and Equipment Selection
- Transportation and Packaging
- Production Planning
- Cost
- Environment
- Etc.



Concurrent Engineering and Risk

CONCLUSION

Thus, in a concurrent engineering environment, identification of risk in the following areas has to be looked into. This will result in design and development of products free from risk. We will work on some of the critical aspects of risk which will pave way to develop a product development model which effectively considers the role of risk during various stages of product design during the new product development. Some modeling approach will also be used such that a quantitative evaluation of product risk in a NPD can be done.

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