Available online at www.sciencedirect.com

ScienceDirect

Procedia CIRP 36 (2015) 106 – 110

www.elsevier.com/locate/procedia

CIRP 25th Design Conference Innovative Product Creation

Simulation Based Planning of the Fuzzy Front End Stage of a Project

Michal Iluz[a*] and Avraham Shtub[b]

[a] *Rafael Advanced Defense Systems Ltd., Haifa 61532, Israel*
[b] *Technion – Israel Institute of Technology, Technion City, Haifa 32000, Israel*

* Corresponding author: Michal Iluz. Tel.: +972-52-4291-334; fax: +972-4-879-4291. *E-mail address:* michali@rafael.co.il

Abstract

Modern design processes present numerous challenges for organizations that deal with system development. The pace of system growth is high and is expressed in the complexity of the systems and products involved, and integration of new advanced technologies that influence system evolution. Traditionally, the decision early on in the project life cycle is based on documents and not on model-based analysis. The initial stages of New Product Development (NPD) projects are known as the "fuzzy front end"; this is the messy "getting started" period of the new product development process. It is in the front end where the organization formulates a concept of the product to be developed and decides whether or not to invest resources in further development of an idea. The Fuzzy Front End begins with the initial search for new opportunities, through the formation of a germ of an idea to the development of a precise concept. The Fuzzy Front End ends when an organization approves and begins formal development of the concept. The early but critical design decisions that need to be made are part of the funneling process performed during the Fuzzy Front End of the life cycle.

The funneling process is aimed at selecting the suitable design concept for a new product out of the many alternatives that exist. Modern systems exhibit a high degree of interdependency and thus the change of a single design parameter may affect the whole system, due to the interdependency trade off studies that are an increasingly difficult task.

trade off studies are an increasingly difficult task. Neither the contemporary document-centric design process nor the human mind can handle such an information explosion and thus new methodologies are required.

In this paper, we present a new approach for the Fuzzy Front End of the funneling process that includes a methodology and tools that provide an enhancement of the decision making process when the design of a new product is considered. We describe two specific technologies: one deals with the project management aspects while the second deals with the system architecture aspects; we show how the integration between these tools improves the effectiveness and efficiency of the funneling process. The highlight of the methodology is a workshop, based on an innovative decision support system, used to obtain immediate feedback regarding the effectiveness of various tradespace alternatives.

Peer-review under responsibility of the scientific committee of the CIRP 25th Design Conference Innovative Product Creation

Keywords: Fuzzy Front-End; NPD; Project Management; Simulation; Tradespace;

1. New Product Development (NPD)

New Product Development (NPD) is the process of bringing a new product to market. This is a process that encompasses the course of events from the early stages of the product inception – with a lot of fuzzy ideas and fuzzy thinking – to the final launching stage of the new product. The process should assure the appropriate translation of the stakeholders' requirements into the product design and development.

2. Do the Right Project - The Funneling Process

The funneling process is a process that is an essential part of the NPD process. One of the challenges in NPD processes is to manage the Fuzzy Front End at the beginning of the funneling process [Katz G, 2011]. The Fuzzy Front End (see Figure 1) occurs while:

a) Defining the project scope based on stakeholders' needs and expectations;

b) Defining the specifications to be designed so as to satisfy the requirements.

Peer-review under responsibility of the scientific committee of the CIRP 25th Design Conference Innovative Product Creation
doi:10.1016/j.procir.2015.08.038

The funnel model was suggested to emphasize the selection among different alternatives during the NPD process reaching one coherent product at the end of the funnel [Steven C. and Kim B. Clark, 1992]. The challenge is to improve the way alternatives are discussed and selected. In this paper, we focus on this gap.

The NPD process has been described in the literature in a multitude of ways, one of which is depicted in Fig. 1 below [5]. The process is described as a five-step funnel, portraying the narrowing down of the initial myriad of ideas into the final delivered product.

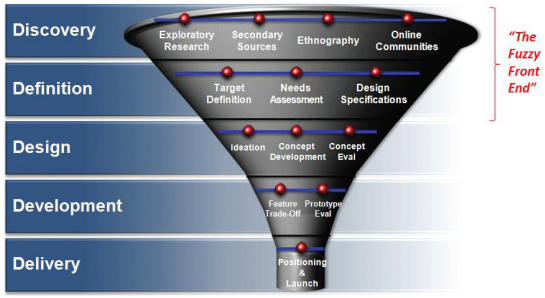

Fig. 1. The funneling process

3. The Fuzzy Front End (FEE) Process

The initial stages of the NPD process are termed the "fuzzy front end", as they are the messy "getting started" period of the new product development process. It is in the front end where the organization formulates a concept of the product to be developed and decides whether or not to invest resources in the further development of an idea. The Fuzzy Front End begins with the initial search for new opportunities, through the formation of an idea to the development of a precise concept. The Fuzzy Front End ends when an organization approves and begins the project.

The Fuzzy Front End presents many challenges. Stakeholders' requirements need to be understood and formulated. In large systems it may often be impractical to model entire systems due to sheer size and complexity. The alternatives' creation process is often manual, resulting in missed alternatives that may have been the best choice. Our challenge is to improve the way alternatives are discussed and selected.

A well-planned and organized commencement of the project is known to dramatically improve the probability of the success of the entire project. This paper presents a methodology using a Simulation Based Planning (SBP) workshop during the early stages of a program. The results of the workshop are: the selection of the preferred design alternative based on cost/benefit/risk analysis, a baseline work plan that coherently reflects this design alternative, the allocation of resources, and a risk mitigation and abatement plan.

The particular process proposed in this paper uses a **simulator** as a tool to support planning and testing the robustness of the project work plan.

4. The Decision Support System- The Project Team Builder (PTB)

The Project Team Builder (PTB) is a Decision Support System designed to support New Product Development teams in the Fuzzy Front End of the NPD process [8-12]. It is based on the following principles:

- A simulation approach—the Project Team Builder simulates new product development projects. The simulation is controlled by a simple user interface and no knowledge of simulation or simulation languages is required.
- A case study approach—the Project Team Builder is based on a simulation of case studies. Each case study is a new product development project performed under schedule, budget and resource constraints, in a dynamic stochastic environment. The details of these case studies are built into the simulation and all the data required for analysis and decision-making is easily accessed by the user interface. A user-friendly case study generator facilitates the development of new case studies as required.
- An integrated approach—several NPD projects can be managed simultaneously on the PTB. These projects share the same resources and a common cash flow.
- User friendliness and GUI—the Project Team Builder is designed as a Decision Support System. As such, its Graphic User Interface (GUI) is friendly and easy to learn. Although quite complicated scenarios are simulated, and the decision support tools are sophisticated, a typical user can learn how to use the Project Team Builder within an hour.
- A Pareto efficient frontier analyzer - the Project Team Builder is modelling alternative designs of the new product. For each alternative a model of the system is created that takes into account the value created, the cost and resources associated with that alternative, its duration and the risk associated with it. The Pareto efficient designs are identified and presented in the form of an efficient frontier.
- Efficient designs are fine-tuned by a simulator engine that simulates the risk associated with each alternative, its cost, schedule and the value it generates for the stakeholders.
- The Project Team Builder provides Decision Support in New product development for today's competitive environment. The PTB approach to guide decision making is shown in Fig. 2.