MASTER'S THESIS

New Product Development (NPD) based on Customer Knowledge Management (CKM)

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Abstract

Human beings have always been tried to make new, innovative things to benefit from. The new things have been improved from a wheel to a smart car and the benefits have been improved from survival to survival plus fitness, happiness, sense of belonging, security and etc. Companies which have been following the human nature, and thinking of new, innovative products and consumers' benefits cohesively, could gain competitive advantages. But the process of new product development has always been costly and due to the high failure rate it is risky. Academics and practitioners alike agree that one of the new product development failure reasons is consumers' nonacceptance. So they try to enhance the new product development (NPD) process to reduce the consumers' nonacceptance. One of the most famous tools used is Knowledge Management (KM). KM focuses on employees' knowledge but has little systematic attention to the customers. In order to overcome the KM limitation, the concept of Customer Knowledge Management (CKM) introduced. CKM by combining KM and customer relationship management (CRM), more clearly extract knowledge 'for' customers, knowledge 'about' customers, and knowledge 'from' customers, so that a more beneficial product can be delivered to the right group of customers, to prevent product failure and to ensure commercial success.

In this research, review on NPD, KM and CKM are provided and new product development based on customer knowledge management has been implemented. To develop new products based on customer knowledge management framework, the customers' knowledge should be elicited and converted to a pattern of consumers' need towards the products attributes. The need patterns and consumers' characteristics have to be segmented to be more meaningful for marketers to target and communicate. This reduces the customer fuzziness dimension in the NPD process and elevates the likelihood of success.

For eliciting customer knowledge, Means-end chain theory has been adapted, and with data mining clustering algorithms, the consumers' segments has been derived based on their means-end chains toward the product (Malt Beverage or None Alcoholic Beer - N.A.B).

Data collection is done with a survey of 660 university people. The questionnaire consists of two sections: 1-measuring means-end chains with Association Pattern Technique (APT), 2-questions about buying behavior and demographic characteristics to better profile the segments. Data analysis of means-end chains with clustering algorithms, results in three segments of consumers, three groups of preferred product attributes and

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the proper communication message for each segment. Data analysis of second part of the questionnaire, help to profile and describe the segments found.

The main objectives of this research include finding and implementing systematic approaches to extract customer knowledge, and finding frameworks for more involvement of customer and using customer knowledge in the idea generation phase of NPD process.

The outcome of this research is a practical framework for "idea generation phase of new product development process based on customer knowledge". In continue, the mentioned framework implemented in a part of Iran N.A.B market and result in segmenting and profiling this market. Also, the critical new product attributes and bases of communication message and promotion campaigns extracted. We have also contribution, in implementing text mining techniques for clustering algorithms.

The framework proposed in this dissertation, can be used in any consumer industry in Iran. Having a framework for precisely delineating the process of customer knowledge management for new product development can lead Iranian companies and consumers to more satisfaction.

A

Table of Content

B

List of Tables

B

List of Figures

C

C

C

Chapter 1:
Introduction

1-1. Background
1-2. Problem Description
1-3. Importance of Topic
1-4. Research purpose and question identification
1-5. Delimitation
1-6. Terms & Phrases
1-7. Abbreviations
1-8. Overview of the entire thesis

1-1. Background

New product development process allows firms to deal with progressively intensive competition when facing challenges from a rapidly changing market condition. Companies try to gain sustainable competitive advantages with continues innovation. These efforts are critical for the companies because introducing a new product to the market is expensive and challenging due to acquiring new knowledge and technologies and implementing new processes.

At the other side, many firms have tried hard to enhance their customer-relating capability with knowledge management tools. But successful implementations of such initiatives are still exceptional.

Knowledge Management has long been known to managers and researchers and its importance in the innovation has been properly recognized (Grover and Davenport, 2001). Many works shows the effectiveness of KM concepts and result of its application in firm functional areas including NPD.

According to the new insights of KM, a creative knowledge worker can contribute to face the problems that need new kinds of decision, the situations that require innovative approaches, and the relationships that can be discovered in the more complex markets where firms are operating (Carneiro, 2000).

Cooper (2003) declared flourishing new product development requires effective strategies for reducing risk. Knowledge management could be beneficial in risk reduction, e.g. by gathering and processing significant information and summarize knowledge from a variety of internal and external sources.

Knowledge management works as a coordinating mechanism. Empirical evidence supports that a firm with a knowledge management capability will use resources more efficiently and so will be more innovative and efficient. Knowledge management components including -knowledge acquisition, knowledge dissemination and responsiveness to knowledge- were found to have a straight effect on innovation (Darroch, 2005).

The value of knowledge management in the innovation of product technology has been identified; yet, the potential for customer knowledge management has not been studied deeply (Soo et al., 2002).

Meanwhile, Customer relationship management (CRM) is a modern management tool. CRM manages the relationship with customers by employing up-to-date information technology (IT) such as on-line data analysis, data-mining and database management in order to know, communicate with, and to catch the attention of customers. Its goal is to please and retain customers (Dyche, 2002). Growing the productivity of knowledge work and managing customers' knowledge in order to understand their needs, enables a firm to gain a competitive advantage in the market.

Lately, the 'customer knowledge management (CKM)' model has attracted much attention by the combining of both the technology-driven and data-oriented approaches in CRM and the people-oriented approach in KM, with a view to utilize their synergy potential (Garcia-Murillo and Annabi, 2002). The prospect result from this effort is to more eloquently describe knowledge 'for' customers, knowledge 'about' customers, and knowledge 'from' customers, so that a more beneficial product can be delivered to the right group of customers, therefore new product failure risk would be reduced.

1-2. Problem Description

Even though vast investments of firms on new product development, many of them face with weak market acceptance and fail (Su et al, 2006).

New product development is a costly and risky process. And in today's competitive business environment, firms have to introduce new products which could survive and make profit.

Research on NPD has recognized a number of factors that influence NPD process: technology, product characteristics, project structure, team member characteristics and patterns, team processes, organizational context, and external environment, and internal resources needed like budget, knowledge and skills (Cooper, 2003). We can conclude that the more difficult the project in terms of scale, new technology, and complexity, the more risky it is mismatches in the team, organization, and external environment, and the greater the need for knowledge acquisition and development for the project to thrive.

A significant challenge in new product development projects is how to acquire knowledge and manage sources of ambiguity in order to reduce the risk of failure of either the process or the resulting product. To clarify it see table 1-1. As shown in the table, the new product can fail due to process fail or products fail and also due to its intrinsic variable or extrinsic variables

Table 1-1: NPD Problems

Problems	Product failure	Process failure
Intrinsic variables	A: Does not meet performance, reliability, safety, or other requirements for the proposed environment	B: Violating resource constraints (e.g. cost, schedule)
Extrinsic variables	C: Unfavorable reception in market; regulatory change	D: Competition develops product first

Adopted from: (Cooper, 2003)

Each of these problems needs considerable efforts in terms of time and profession. According to the time allocated to master thesis and the major in marketing, the problem of NPD projects in the case of market/ customer acceptance that locates in cell C, conjunction of product and extrinsic variables, have been chosen. Customers are outside the firm and they should accept the product features but how could we know their acceptance before introducing a new product to them? How can we know what they want from our products? What Is the systematic solution?

Consider this problem from another point of view: Most projects do not fail at the end; they fail at the beginning (Zhang & Doll, 2001). The product development success depends on the performance of the front-end activities. See figure 1-1. Because these front-end activities are the final gate before the team decides to invest in designing and producing the products, they need to be well managed. Otherwise, both time and money may be wasted in producing the wrong Products. The front-end activities include idea generation, assessment of market, technology and competition and product definition, project justification and action plan (Zhang & Doll, 2001). At these stages, project team may not be sure what

customers they really want, what competitors are producing, and what product and process technologies should be utilize. Environmental ambiguity related to market changes, emerging technological developments, and the evolving competitive situation is defined as "front-end fuzziness".

Product development managers perceive at least three sources of uncertainties in front end activities:

(1) The customer's requirements;

(2) The nature of competition; and

(3) The changing technology.
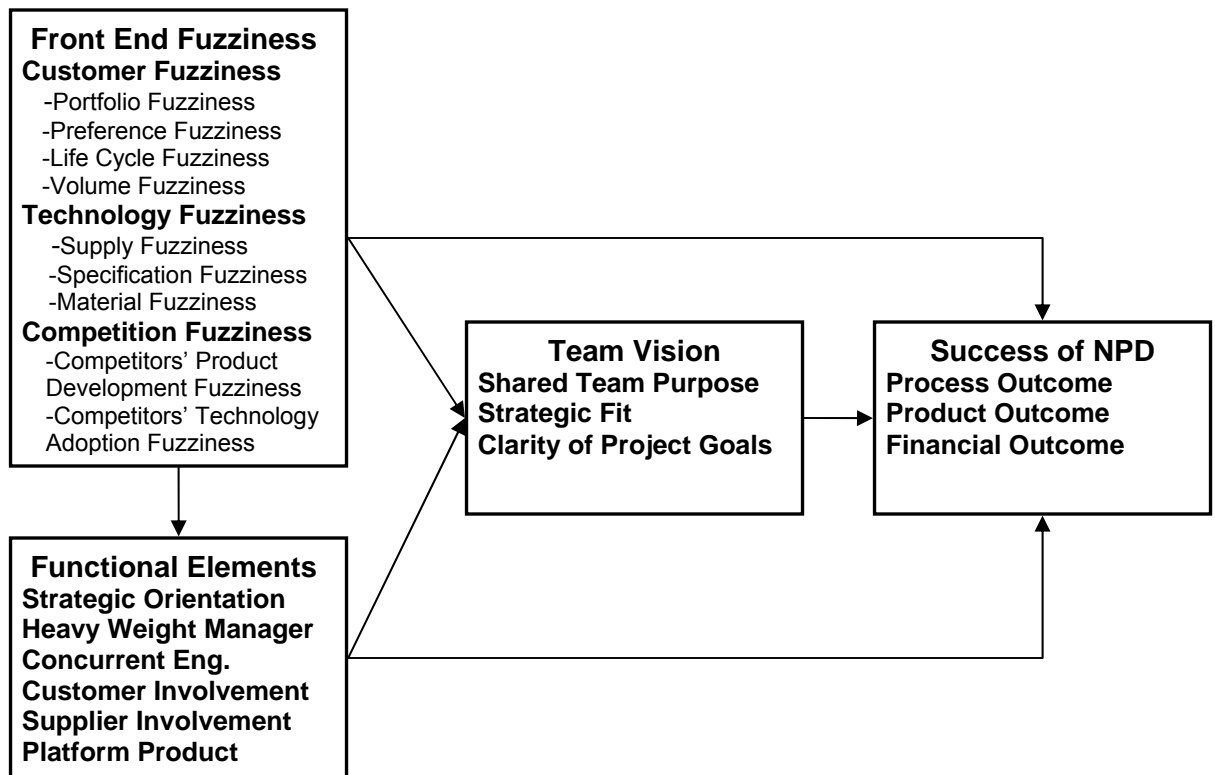
Source: (Zhang and Doll, 2001)

Figure 1-1: The fuzzy front end and success of new product development: a causal model

In this research, the focus is on one specific source of uncertainty: customers. The debate is that modern tools, CRM and KM techniques and processes, have some constraints. In brief, CRM acquire customer knowledge but it doesn't propose how to apply it and KM is about sharing knowledge but its focus is on intrinsic variables. CKM with combining these two, demonstrates how and what elicit from outside the firm, specifically customers, and how to apply it as an input to the new product development process.

1-3. Importance of Topic

By developing a framework to involve customers in the new product development process to assure that customers will accept the new product, the following advantages will be gained:
- The risk that inherently exists in NPD will be reduced.
- Introducing new successful products to market will improve firms ROI, one of the most important performance indicators.
- The process of NPD will be more structured.
- The consumers will be more satisfied with the new introduced product.
From the manager's viewpoint each of these advantages are valuable.

1-4. Research purpose and question identification

The main purposes of this research include:
-   Introducing new models of NPD process
- Finding and implementing systematic approaches to extract customer knowledge
- Finding a framework for more involvement of customer and using customer knowledge in NPD process.
- Implementing the proposed framework to verify its applicability
- Promoting usage of mixed quantitative and qualitative marketing methods

To reach these purposes, a framework should be developed to provide an answer to our main question:

> *RQ- How firms can understand preferences and requirements*
> *of customers in order to have more successful new product*
> *development?*

In detail, what are the motives behind consumer's preferences? Why they accept some products and why they do not accept some other products? How can we identify customers' requirements to be considered in NPD process? How customers can participate in NPD Process?
Here we try to introduce and improvise a recently developed concept: Customer Knowledge Management (CKM), and to provide a framework based on CKM concepts showing the method for acquiring customer knowledge, so that the product will meet the customers' needs, in order to secure market acceptance.

1-5. Delimitation

New product development process has many dimensions and involves almost all parts of the firm. In this study, the focus is on:
-   Customer fuzziness of NPD fuzzy front end, not technology fuzziness or competition fuzziness (based on fuzzy front end model of Zhang and Doll, 2001)
-   Opportunity identification stage of NPD process not development or optimization (product testing) stages (based on stages of new product development of Van Kleef, 2006)

- NPD failures originated from extrinsic and product related variable in NPD not Intrinsic or process related variable (based on NPD problems model of Cooper, 2003)

The conceptual framework can be conducted in many different industries. Due to intensive competition, low variety of products, access to resource for data collection from consumers, food industry was selected which is naturally a B2C industry. **The product in this research is Non Alcoholic Beer, N.A.B or Malt Beverage.**

1-6. Terms & Phrases
New Product Development: process of transforming customer needs to product characteristics and production of the product based on those characteristics.
Customer Knowledge Management: a new developed concept combining KM and CRM, specially developed to elicit and manage knowledge for customers, about customers and from customers.
Data Mining: The sum of methods for extraction of hidden predictive information from large databases.
Means-end Chain Theory: The sequence of attributes–consequences–values is called a *means–end* chain. Means–end chains are a way to describe how consumers perceive products. Attributes are the tangible aspect of products. Benefits are the positive functional consequences and values are the ends that a person wants to achieve in his/her life.

1-7. Abbreviations
NPD: New Product Development
KM: Knowledge Management
CKM: Customer Knowledge Management
DM: Data Mining
N.A.B: None Alcoholic Beverage/Beer
APT: Association Pattern Technique
LSI: Latent Semantic Indexing

1-8. Overview of the entire thesis
CKM is a combining concept that relates concepts including Segmentation, KM, CRM and NPD. Regarding our pre-mentioned problem, at first we review the literature of NPD, KM, CKM, and segmentation with clustering in chapter two. In the third chapter, the methodology of research is provided which include stages of data collection and data analysis and description of selected quantitative and qualitative methods. In chapter four, empirical data which used in analysis and the questionnaire used to collect data is presented. In chapter five, results are shown in graphical diagrams and three identified clusters will be described in detail. The last chapter, chapter six, is the conclusion of research including our proposed framework, limitations of the research, implications and future research areas.

Chapter 2:

Literature Review

2-1.   Introduction to New Product Development
2-2.   Concurrent New Product Development (CNPD)
2-3.   Integrated PVQ and NPD Model
2-4.   Model of Innovation-Driven Learning in New Product Development
2-5.   New Product Development Dynamic Model (NPDDM)
2-6.   Generic model of NPD
2-7.   Introduction to Knowledge Management
2-8.   What Is Knowledge?
2-9.   What is Knowledge Management?
2-10. KM in NPD
2-11. Introduction to Customer knowledge Management
2-12. A Model for Customer Knowledge Management
2-13. E-CKM Model, a model for NPD based on CKM
2-14. Market Segmentation, A Core Component of E-CKM
2-15. Process of Market Segmentation
2-16. Major Segmentation Variables for Consumer Markets
2-17. Segmentation by Data Mining

2-1. Introduction to New Product Development

New product development is an ordered and determined set of tasks and steps that describe the method by which a company repeatedly converts undeveloped ideas into commercial products or services.

There are distinct categories of new products (PDMA Handbook). Some products are new to the market, some are new to the company, and some are totally new and make totally new markets. From another point of view, some new product concepts are minor modifications of existing products while some are completely innovative to the company. These differences are displayed in the following figure.
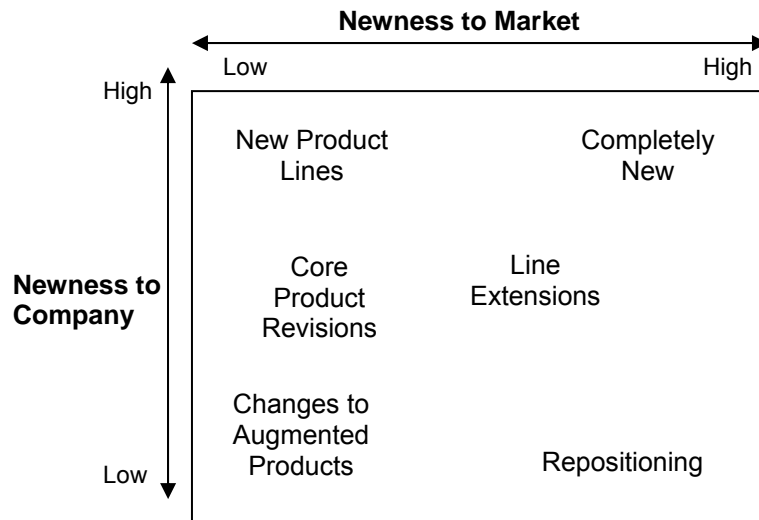
Source: (PDMA Handbook)

Figure 2-1: New Product characterizations

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New product development is one of the most influential but complex activities in business (Clark and Wheelwright, 1995). Business managers and marketing academics alike agree that a fundamental factor of an organization's long-term survival is success in new product development. The developments of excellent products not only opens new markets and attracts new customers, but also influence existing assets and expand an organization's capabilities (Zhan, 1998)

The vast literature on new product success and failure reveal some factors that are critical to be a winner at this game (Snelson and Hart, 1991):

(1) *The need for interdisciplinary input:* usually the tasks involved fall within the field of different functions, based on professional education, training and certification. To be successful these various professions should actively and effectively collaborate through the NPD process.

(2) *The need for quality inputs to the process*: it means both technical and marketing information, two building blocks of NPD, have to be accurate and timely, and must be constantly revised during the development.

(3) *The need for speed in the process*: The NPD process has to be managed in such a way as to be quick enough to capitalize on the new product opportunity before competitors do so.

A formal, but conventional new product screening model was created, with its ratings, checkpoints, etc. The following seven points summarize the model:
(1) Strategy;
(2) Idea generation;
(3) Assessment;
(4) Business plans;
(5) Development;
(6) Testing;
(7) Commercialization.

Figure 2-2 shows a traditional NPD process. In this model new product development is disconnect from product validation and qualification.
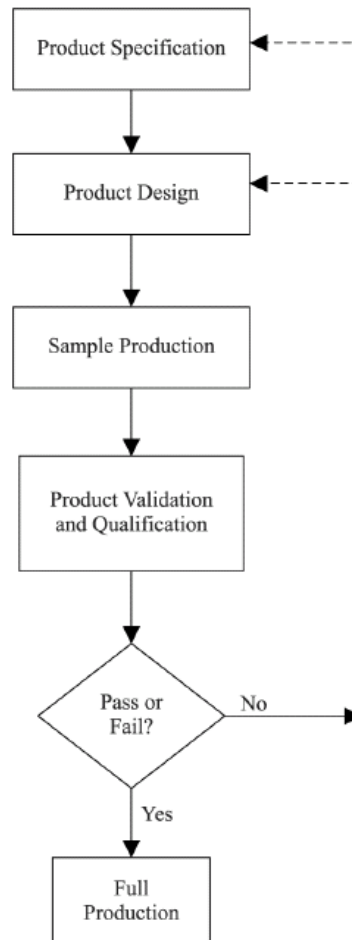
Source: (Aw, 2005)

Figure 2-2: Traditional NPD Process

These traditional models are valid where uses are known, and there are standard homogenous market segments. Traditional models are unable to provide

multidisciplinary, high quality, and quick inputs for NPD process (Coates and Harry Robinson, 1995).

For today situation with modern products and for diverse dynamic markets, traditional NPD process is not enough, it is impossible to reach the development target without using new framework and method. Next sections propose some of new frameworks and methods reviewed in the literature.

## 2-2. Concurrent New Product Development (CNPD)

One way to change an organization is to control the scheduling of activities in the NPD process so that:

> (1) activities that were once carried out in series are now carried out in parallel – e.g. product engineering and production engineering phases;
>
> (2) People are involved throughout the life of the development project working in cross-functional teams.

The above way of working is "concurrent new product development" (CNPD) (Maylor and Gosling, 1998).

Some tools have been developed to apply the concept of CNPD.

Figure 2-3 shows the top eight techniques and their level of usage in firms. Responds are base on a scale of 0 (no usage) to 10 (extensive usage) for each technique.
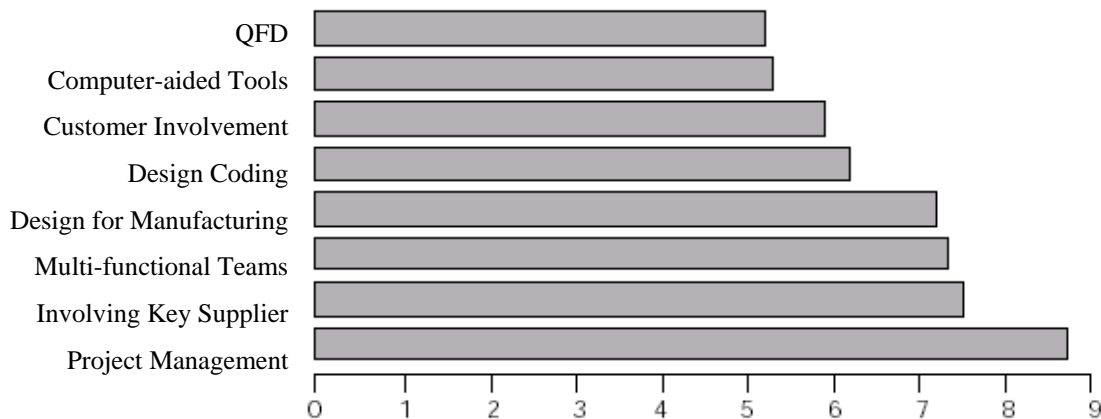
Source: (Maylor and Gosling, 1998)

Figure 2-3: Use of tools and techniques for CNPD

As can be seen, project management is the most used technique. Involvement of key suppliers ranks second. Use of multi-functional teams was highly rated – as was employing design for manufacture and assembly. Customer involvement (the active participation of customers in the design process) was still in the top group of tools and techniques, though not as highly rated as one might think from the literature on quality management. Similarly, regardless of much exposure, the use of quality function deployment (QFD) scores relatively low.

Since people are taken out of their functional duties to work in multi-disciplinary teams, the most difficulty in CNPD implementation is resistance to functional change (Maylor and Gosling, 1998).

2-3. Integrated PVQ and NPD Model

PVQ stands for product validation and qualification which means making sure that product has a particular level of quality and reliability.

In this integrated NPD model shown in Figure 2-4, there are "Gates" between stages 1, 2, 3 and 4. Each "Gate" allows the NPD team to meet each other and review each stage. A checklist will be used to review if all tasks or activities were done before taking the next stage actions. (Aw, 2005)
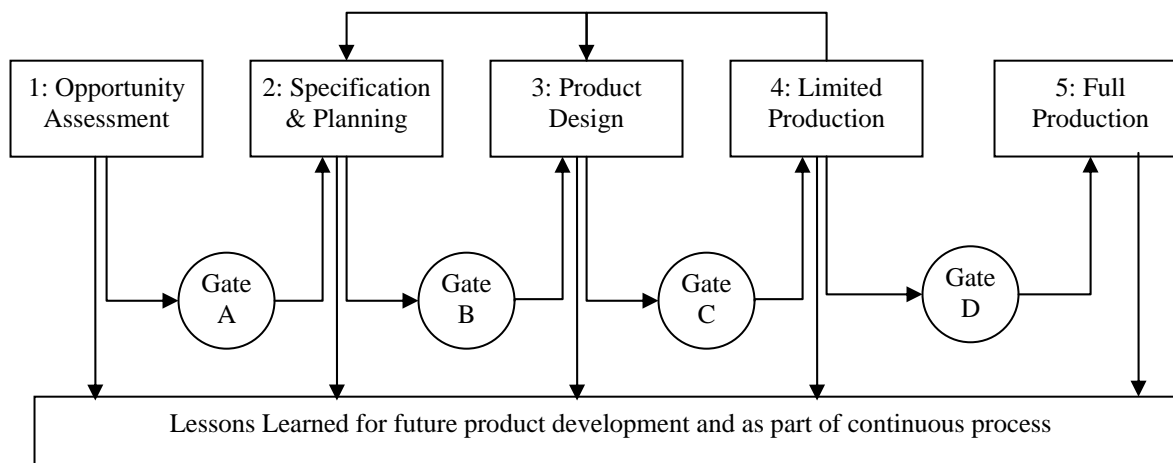
Source: (Aw, 2005)

Figure 2-4: Integrated NPD and PVQ process

Stage 1: Opportunity assessment stage is where new product or concept will be initiated which is named as project initialization. At this stage a draft business case will be written and then technical assessment will be carried out. This stage usually involves the marketing and business development people.

Stage 2: Upon completion of stage 1, a product development team from various departments will be arranged and stage 2 begins. The product development team usually comprises of members from design, quality and reliability, product engineering, test engineering, manufacturing, planning, marketing, and after sale service departments. A project plan and budget will then be drafted after the completion of the product's specification. Finally, a project budget will be presented to the management team to get their approval.

Stage 3: At this stage, the actual product design activities will begin to produce a few working prototypes by the pilot production line. At this stage the various activities are as mechanical design, electronic design, software design, manufacturing review, and material review.

Stage 4: At this stage, samples and also as PVQ's test samples will be produced. At this stage, several evaluations and reviews will be carried out.

Stage 5: This stage will permit the product to be mass-produced. Therefore, it is essential that the product has all the necessary customers' requirements.

11