New Product Development By Applying SIT Tools To Existing Products ENOVIA V5 and ENOVIA V6 And Its Application to Passenger Cars. (May 2016)

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***Abstract*— This literature studies various issues faced by organizations during migration projects such as loss of data, data corruption, data security, data integrity after migration. Due to these issues organizations are reluctant to migration projects. In this literature I discuss about a customer Toyota Motor Corporation (TMC) reluctance to migrate to ENOVIA V6 from ENOVIA V5 due to migration issues and propose a new product V6-5 as an alternative to migration process. This new product is developed by applying Systematic Inventive Thinking (SIT) tools to existing products ENOVIA V5 and ENOVIA V6.**

Key Words: SIT (Systematic Inventive Thinking), ENOVIA (Enterprise Innovation Interactive Application)

I. INTRODUCTION

The New Product Development process consists of the activities carried out by firms when developing and launching new products. A new product that is introduced in the market evolves over a sequence of stages, beginning with an initial product concept and idea that is evaluated, developed, tested and launched on the market. This sequence of activities can be viewed as a series of information gathering and evaluation stages. In effect, as the new product evolves, management becomes more knowledgeable (or less uncertain) about the product and can assess and reassess its first decision to do new development. Following this process of information gathering and evaluation leads to improved new product decisions by firms by limiting the level of risk and minimizing the resources finalized for products that eventually fail. The NPD process differs from industry to industry and from firm to firm. This process should be adapted by each firm in order to meet specific company resources and needs.

Most companies rely on 3 sources for new product development ideas: 1) surveying competitors, 2) market knowledge and research, 3) and new technologies. The 1st one cannot result in a different product on its own. While being an important component in a company's portfolio, the second source market research has been proven to not be conducive to product offerings that distinguish one company from the competition. Technology can be a source of differentiation, but only provided that your company should have access to technologies that are not available to others.

In this literature I propose Systematic Inventive Thinking (SIT), a fourth source for developing new product using existing products as a basis. As per experts, it can serve as a strong differentiating factor between companies that know how to utilize it and those who do not. The method has been used by hundreds of companies in more than forty countries, including several in chemical industry, for example Univation Technologies and Bayer Environmental Science to help them "listen to voice of their products." SIT provides a structured process to arrive at innovative ideas for new products and technologies.

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II. PROBLEM DEFINITION

In Product Life Cycle Management industry scenario, firms are never readily willing to migrate from exiting version of ENOVIA product they use to newer versions that are available in market as migration is a complex process and carries a risk of data loss, data corruption and is a time consuming process. Due to these issues firms prefer to stay on legacy (old) version and request for support on existing version of ENOVIA. But there is always a risk with legacy systems (old versions) that vendors may withdraw its support and make the system obsolete. To make use of the advanced features and functionalities that new systems offer it is fruitful for organizations to move the huge amounts of data stored in legacy systems to newer and more reliable current systems. But as customers are not willing to migrate vendors may lose their loyal existing customers. Hence, to retain existing customers and prevent them to move to competitor's PLM products there is a requirement to come up with an altogether new product which provides all capabilities of new version of ENOVIA V6 with legacy version ENOVIA V5. This need creates the problem statement. In this literature I propose ENOVIA V6-5 as a new product using existing products ENOVIA V5 and ENOVIA V6 by applying SIT tools to satisfy the requirement.

III. LITERATURE REVIEW

Mohan.G and Madhu.M highlighted three primary

problems in data migration as Lack of Data knowledge, Data Quality Problems and Lack of Flexibility for Specification Changes. Without the ability to solve these "Three Primary Problems", data migration projects will continue to experience the syndrome of Code, Load & Explode

Priyanka Paygude and P. R. Devale proposed an automated testing tool in migration projects in order to reduce risk and guarantee that the data has been migrated and transformed successfully.

Arun Swaminathan presented the tasks and issues of executing a database migration project and has proposed a 10 step procedure for a successful database migration.

Rashmi Rao and Pawan Prakash have highlighted security concerns for data migration in cloud computing and proposed an encryption technique in cloud computing environment using randomization method to increase security and optimize the encrypted data in migration process.

Baljinder Singh, Jason Matthews, Glen Mullineux and Tony Medland have identified and evaluated various different approaches that have been proposed for supporting various product development activities within manufacturing SMES. Specific challenges in applying these approaches to address different needs of SMES have also been studied.

Nadia Bhuiyan proposes a framework of critical success factors, metrics, and tools and techniques for implementing metrics for each stage of the new product development (NPD) process.

Moshe Barak has reviewed systematic inventive thinking and discussed examples on developing systematic methods for problem-solving and new product development.

R.Horowitz has proposed five tools of SIT Subtraction, Unification, Multiplication, Division and Attribute Dependency for new product development.

M. Barak and N. Goffer have discussed about how SIT tools helps in new product development by using existing products as compared to traditional process followed by organisation.

R.Horowitz and O.Maimon have compared traditional design approach followed for new product development with SIT and concluded that SIT is fast and involves much lower cost as compared to traditional new product development process.

Steve Turner has proposed SIT sets is built on the thesis that certain patterns are identifiable, objectively verifiable, widely applied, and learnable, and that these patterns, termed templates, can serve as a facilitative tool that channels the ideation process, enabling the individual to be more productive and focused.

Yoni Stern, Idit Biton and Ze'ev Ma'or have reviewed application of SIT process in chemical industry and also proposed SIT as a fourth source for new product development.

IV. METHODOLOGY

From study of above literatures it has been observed that data migration is a critical process and involves huge challenges for organisations like data loss, data corruption, data security and quality of data after migration. Due to these issues organisations are reluctant to undertake migration projects. To address these issue vendors need to develop a new product which eliminates the need for migration. Researchers in various fields have proposed Systematic Inventive Thinking (SIT) as process for new product development using existing products.

A. Selection of existing two products ENOVIA V5 and ENOVIA V6
B. Identify capabilities and limitations of ENOVIA V5 and ENOVIA V6
C. Selection of SIT as source for new product development
D. Apply SIT tools like Task Unification, Attribute dependency, Division, Subtraction, multiplication to ENOVIA V5 and ENOVIA V6 to develop a new product.
E. Connect V5 client to V6 server using Integration Exchange Framework (IEF)
F. Save V5 data in V6 server.
G. Search V5 data on V6 server

V. SYSTEMATIC INVENTIVE THINKING (SIT)

At the heart of SIT is a crucial idea: inventive solutions share common patterns. It is evident that inventors unknowingly follow patterns when coming up with new product ideas - patterns that can be identified by observing thousands of products and their evolution. Surprisingly, a majority of new and inventive products can be categorized according to only five patterns. One of these patterns is called, in SIT parlance, Subtraction. In opposition to the conventional approach to new product development whereby components, attributes or features are added in line with the perceived wants of consumers, with Subtraction, instead of adding components, you remove them particularly those that seem most essential and indispensable.

A. From Patterns to Tools

Subtraction is only one of the five patterns that form the core of the SIT method for product innovation. But in order to be able to proactively use the patterns to create future innovations rather than to simply categorize historical ones, a systematic process has been developed to apply them. Thus, the patterns become "thinking tools" which can be used to come up with new ideas. This process is called Function Follows Form (FFF), a term coined by cognitive psychologist Ronald Finke. Instead of innovating by identifying a "function" or need and then creating a product accordingly, one first manipulates the existing product and then considers how the new form could be of benefit. Using Function Follows Form, then, one develops products in the reverse order to the market research process. Applying FFF, one begins with an existing concept or product. A list of the product's physical components and its environment is constructed. Then one of the five thinking tools is used to manipulate the product. These new forms, or virtual products are immediately assessed as to their business value and feasibility. If the virtual product has both market potential and falls within existing company and technological constraints, it undergoes whatever minor adaptations are needed and is considered worthy of following up. As market knowledge is used here as a filter rather than as the starting

point, the ideas generated are likely to be different from those that competitors arrive at by searching the market for ideas.

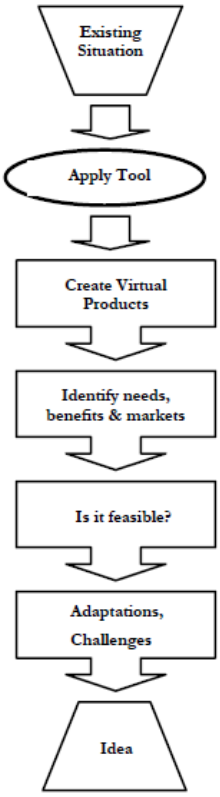

Fig 1: Function Flow Form [12]

B. Why SIT:

Many researchers have tried to develop a model that captures the relevant stages of the New Product Developmet (NPD) process (Ulrich & Eppinger, 2011; Wind, 2001; Cooper, 2001; Crawford, 1987; Scheuing, 1974). A number of detailed NPD models have been developed over the years, the best known of which is the Booz, Allen and Hamilton (1982) model, shown if figure below, also known as the BAH model, which underlies most other NPD systems that have been put forward. This widely recognized model appears to encompass all of the basic stages of models found in the literature. It is based on extensive surveys, in depth interviews, and case studies and, as such, appears to be a fairly good representation of prevailing practices in industry.

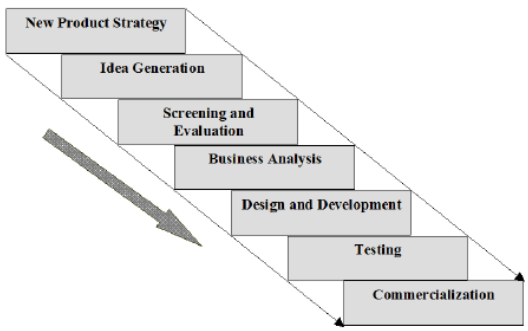

Fig 2 Stages of New Product Development ((Booz, Allen & Hamilton) [7]

The stages of the model are as follows:

New Product Strategy: Links the NPD process to company objectives and provides focus for idea/concept generation and guidelines for establishing screening criteria.
Idea generation: Searches for product ideas that meet company objectives.
Screening: Comprises of an initial analysis to determine which ideas are pertinent and merit more detailed study.
Business Analysis: Further evaluates the ideas on the basis of quantitative factors, such as profits, Return-on-investment (ROI), and sales volume.
Development: Turns an idea on paper into a product that is demonstrable and producible.
Testing: Conducts commercial experiments necessary to verify earlier business judgments.

C. This process has a few disadvantages:

a. Most customers have difficulties in thinking about needs or products, which do not exist. This is particularly true for needs which are not vital. For example: how many customers thought of the need for a compact, transportable cassette player as addressed by Walkman? How many customers thought about the possibility to use the Internet communication as a means to conduct telephone calls?
b. To find those customers which do think of new needs\products, huge and very expensive surveys are needed. But even if you succeed in finding those people, chances are they will not be keen to share their good ideas for free.
c. If the need is clear or easy to define, it is most likely that, at least a few of your competitors have already defined it and are in the process of addressing the need.

In order to overcome these problems, the SIT method suggests starting the process of product development from the product itself. Applying systematic thinking tools in analyzing the product can lead to potential new products or to a definition of new needs.

D. The advantages of this method are as follows:

a. The process requires only a limited amount of hours and is conducted in-house;
b. Applying the method yields many new ideas and a definition of many potential new needs
c. As the new products are based on the old one, no major changes are usually required in production.

One of the important elements of SIT is to characterize the system and environmental variables. After having defined these variables, the participants are asked to examine the correlation between them, and to examine the impact of manipulating one or more of the product variables on the potential use of the "new" product; how such a change affects the correlation between the product and the environment and who may want to use such a product.

E. SIT Tools:

Table 1: SIT Tools [12

The Tool	Definition	The Concept	Example	Especially useful
Task Unification	Assigning a new and additional task to an existing resource	To view everything as a potential resource that has multiple uses.	One piece defroster + antenna in cars.	Cost reduction
Attribute Dependency	Creating a new relationship or eliminating an existing relationship between two variables of a product.	To create, change or eliminate dependencies between variables of a product and its environment.	Toothbrush that changes color once the child has brushed long enough	To segment in a saturated industry
Division	Dividing the product and/or one of its components and rearranging them in time or space.	To increase the degrees of freedom within a product so that it can be rearranged to create a new product or new uses for the existing product.	Detachable panel in car radio	For product packaging
Subtraction	Removing an essential component from a product.	To remove from the product a component thought to be so essential that it seems impossible for the product to exist without it.	Placebo	Highly complex systems
Multiplication	Adding to a product a component of the same type as an existing component in the product, but changing the copy in some way.	To transcend a mere change in quantity in order to achieve a qualitative change.	Gillette razors in which the 2 blades are angled differently to provide a new advantage.	When there are few components in the starting product

F. Case studies of application of the SIT method:

The following sections describe case studies of the application of the SIT method, through the Function Follows Form work process, for the purpose of arriving at innovative product and technological solutions in the chemical industry. In each case, the benefit for the innovation was identified as a secondary step rather than as the starting point of the process, contrary to the conventional approach of first identifying a need and subsequently searching for solutions.

a. Case Study: Ahava Dead Sea Laboratories [12]

Ahava Dead Sea Laboratories is a world leader in the mineral based cosmetics industry, functionalizing the effects of the unique natural elements found in the Dead Sea. Ahava has been working with the SIT method for two years and the tools can be identified in many of the company's recent patent registrations.

The Multiplication tool presents a very different, even opposite, approach to the Subtraction tool discussed above. Instead of removing components, as in Subtraction, you replicate or multiply existing components, but alter the copies according to some parameter. It is critical to not simply add more copies, but to change the copies in some way. For example, there are several magnetic minerals in Dead Sea salts and they have been utilized previously in many Dead Sea cosmetic products. In order to launch a new line of cosmetics, Ahava did not simply increase the amount of the existing metallic minerals in its products. Rather, they added other types of metals, to increase the total percentage [US patent application No. 10/519, 38]. This, they realized, would amplify the positive effects of increased blood flow to the areas to which the cosmetic is applied, and thereby give the user an added benefit.

Task Unification, a third SIT tool, is defined as “assigning a new and additional task to an existing resource”. It manifests itself when one of a product's components – or some other object in the product’s immediate vicinity – is given an additional task without losing its original one. Ahava's innovative new Gentle Body Exfoliator uses the body's own moisture to melt the active ingredients through a process of emulsification.

Since the body's moisture is utilized for the task of activating the cosmetic's ingredients, Ahava was able to produce the product without adding water. Therefore, when applied, the product is of a rough texture, removing dead skin cells from the surface. However, the cosmetic, with the help of the body's moisture, shortly dissolves into the skin, to nourish it with the Dead Sea minerals [while not patent ending, this product is based on unique know how of the company].

A second Ahava patent, a Purifying Mud Mask, demonstrates SIT's Attribute Dependency tool. Attribute Dependency involves the creation of new relationships between the different variables of a product or its immediate environment. Innovative ideas are often generated by creating new dependencies where they may not currently exist or by modifying or dissolving dependencies where they do. The Attribute Dependency pattern helps accelerate the discovery of products that seem in hindsight to be inevitable. The Purifying Mud Mask product is applied as a typical mud mask, but does not retain that function over time. In fact, the mask undergoes a chemical process that changes it into a "peeling" to remove dead skin. Unlike most 2-in-1 products that have multiple functions at the same time, this product provides both functions but at different times. The ability to imagine the same product changing its properties over time allowed for this breakthrough, as the functions of a Mud Mask and a Peeling would be physically impossible to occur simultaneously.

b. Case Study: Vitco / Unilever [8]

Now that we are familiar with some of the SIT thinking tools and the theory of the process used to apply them, we can review a step-by-step case study of such a process conducted with Vitco Detergents in 1996. That same year, Unilever acquired 60% of the shares of Vitco Israel at a consideration of $13 million, and changed the name to Lever. However, at the time, Vitco sold various products, among them a laundry detergent, and was looking to expand their offering.

Step 1: Define the existing situation by listing the product’s physical components and its immediate environment.

Table 2: Product’s Physical Components and its immediate environment [8]

Components	Environment
Active Ingredients (detergents)	Washing machine
Perfumes	Water
Binders	Clothes

Step 2: Apply one of the five SIT thinking tools:
In this case, we applied the Subtraction tool. Identifying the most essential component, we subtracted the Active Ingredients.

Step 3: Define and visualize the virtual product:
What we had now was a "detergent" that contained perfumes and binders, but could not clean clothing, as this function was removed along with component that performed it (the Active Ingredients).

Step 4: Identify needs, benefits, and markets:
The Virtual Product obviously sounds ridiculous – what is the use of a detergent that doesn't have an active ingredient? But, as one of the workshop participants noted, the Active Ingredients are very hard on the material of the clothes and actually wear them down. Removing them, would allow the clothes to wear less and last longer. Therefore, a potential market could be those individuals who launder their clothes frequently, not because the clothes are soiled, but because they were worn since their previous laundry cycle and are no longer "fresh".

Step 5: Identify feasibility:
The technical experts believed that they could create a stable product that would contain very little Active Ingredient. It would also need to contain less of the binders that had been used to bind the Active Ingredients to the perfumes.

Step 6: Identify challenges and make adaptations:
The main challenge that was raised was that legally, due to industry regulations, this product would not be allowed to be marketed as a "detergent" since it had no cleansing properties. The CEO, who was in the room, immediately gave an answer to the challenge – why not launch a new product that will define a new category- "Clothes Fresheners".

Vitco never introduced the product described above. Nevertheless, 4 years later (in 2000) Procter & Gamble launched a new category under their Febreze® brand, which they termed "Clothing Refreshers".[15] Several other companies sell similar products which they call "Laundry Fresheners" or "Laundry Refreshers". The concept is the same – detergents with substantially less cleaning elements. It is interesting to note that P&G market the category citing an additional benefit not raised in the Vitco process. Namely, clothing refreshers can be utilized in combination with detergents in a wash cycle to add a fresh scent to the clothing.

G. Comparison of the Two Case Studies

Table 3: Comparison of two case studies

Company	Vitco/Unilever	Ahava
Main Innovations and the SIT tool applied	**Subtraction** Clothes refreshener – a detergent with very little active ingredient used for "refreshing" non-soiled clothes.	**Multiplication** Cosmetics enriched with metals to increase the bloodflow **Task Unification** Gentle Body Exfoliator Using the body's own moisture to melt the active ingredients through emulsification **Attribute Dependency** Purifying Mud Mask A mask that undergoes a chemical process that changes it into a "peeling" to remove dead skin
Success in the market	The product was never introduced to the market by Vitco. However, a similar product created a completely new category, but needed to wait 4 years until it was launched by Procter & Gamble.	Three innovative patented or patent pending products. Considered to be a success based on the innovation criterion of surviving for at least 12 months on the shelf.
Main learnings from the case study	1. The process forces people to think counter-intuitively. It is easy to understand why no one had ever thought of creating a new detergent by removing the active ingredients (cleaning agents). 2. Oftentimes innovative ideas exist within companies, but are never launched to the public. Of the most important determining factors is the organizational situation. Perhaps the main reason that this product was never launched by Vitco was a Unilever acquisition which had created opportunities in the same region as the new product.	1. Applying different thinking tools to the same starting point yields completely different concepts. Thus applying 3 tools to the Ahava product led to 3 new product technologies that have widespread application and are very different one from another. 2. As can be seen with the metal-enriched cosmetics, sometimes there is no need for a completely new product. It can be just as powerful to make a small adaptation to an existing product to emphasize a market benefit and create a line of products around it (New Promise Development as opposed to New Product Development)

VI. Applying SIT tools to ENOVIA V5 and V6

A. Capabilities of ENOVIA V5 and V6

ENOVIA V5 VPM offers a comprehensive, streamlined approach to managing the creation and maturation of the virtual product definition. With ENOVIA V5 VPM, engineers are able to extend the power of CATIA V5 knowledge ware and Relational Design to quickly optimize designs within the context of an assembly or an entire portfolio - improving performance and increasing reuse across product lines and variants. Built to incorporate industry-leading practices, globally dispersed design teams rely on ENOVIA V5 VPM to manage intense multi-discipline collaboration and decision making, producing more innovative products in less time that are optimized for both manufacturability and market acceptance.
ENOVIA V5 VPM captures and manages engineering design intent by exposing specifications, rules, operational parameters, simulation results, and manufacturing processes accelerating the understanding of how change affects associated product components and processes. This unique capability allows engineers to analyze and propagate change quickly, accurately, and completely until product performance and costs are optimized. To increase the likelihood of market

success, ENOVIA V5 VPM effectively allows development organizations to front load the design and validation of all possible product configurations to deliver precisely the product the market expects - and the profit margins the company requires.

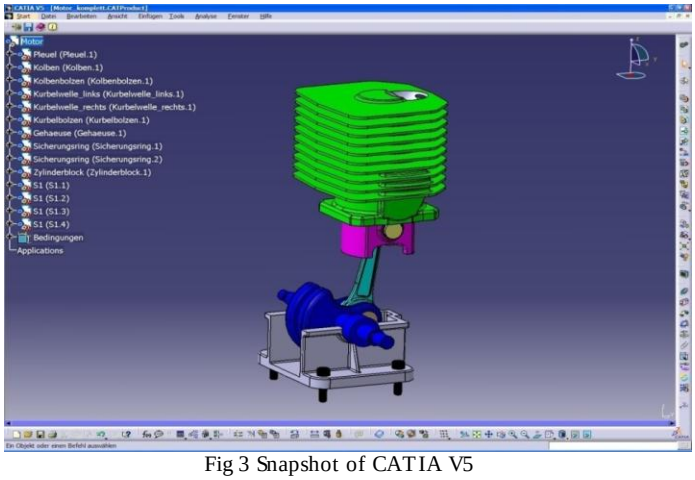

Fig 3 Snapshot of CATIA V5

ENOVIA V6 is Dassault Systèmes (DS) next generation platform for enabling PLM 2.0 and harnessing the collective intelligence among online communities. PLM 2.0 brings life to knowledge from idea to product experience merging the real and virtual in an immersive lifelike experience. Through V6, the ENOVIA Live Collaboration platform delivers the flexibility, open standards, scalability, and industry-specific functionality today's global companies need to tie together multi-discipline engineering groups and other key contributors. V6 represents the next step in the PLM evolution, extending the breadth, depth, and reach of enterprise-wide collaboration in the new product development process. Combined with reduced total cost of ownership (TCO) and improved return on investment.

Fig 4 Snapshot ENOVIA V6

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Table 4: Applying SIT tools to ENOVIA V5 and V6

The Tool	Definition	ENOVIA V5 / ENOVIA V6
Task Unification	Assigning a new and additional task to an existing resource	Modify V5 data in V6 and vice versa.
Attribute Dependency	Creating a new relationship or eliminating an existing relationship between two variables of a product.	Introduction of IEF to facilitate connection between ENOVIA V5 and V6
Division	Dividing the product and/or one of its components and rearranging them in time or space.	Division of ENOVIA V5 as a whole system into ENOVIA V5 client, IEF and ENOVIA V6 server
Subtraction	Removing an essential component from a product.	Removed ENOVIA V5 server
Multiplication	Adding to a product a component of the same type as an existing component in the product, but changing the copy in some way.	Adding IEF to connect with ENOVIA V6 server

VII. Conclusion

From above literature we summarize that applying systematic thinking tools in analyzing the product can lead to potential new products or to a definition of new needs. SIT approaches New Product Development by identifying and applying certain well-defined tools derived from an historical analysis of product-based trends, termed patterns or templates. SIT tools can be applied successfully to existing products ENOVIA V6 and V5 and develop an altogether new product V6-5. This new product satisfies customer needs and also eliminates the critical process of migration.

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