The NPD Process Design Canvas: Tool for NPD Process Creation

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Abstract. New Product Development (NPD) is important for the growth and sustainability of companies. One of the most important factors in NPD is the management of the NPD process. NPD process is believed to be a crucial factor in NPD success. NPD process may vary between organizations. Companies must be able to implement the most suitable NPD process. Therefore, the design of NPD process is crucial. This article proposes a tool that can support organizations to design their NPD process. The tool is conceptualized based on the sequence of NPD design method. The tool is based on the form of ‘space of elements’ and called the NPD Process Design Canvas. The concept has been tested and several feedbacks identified. Some of the pros are its ability to capture the risks and elements of process design. Some of the cons are the variation of detail and inability to describe the existing process. Based on the feedbacks, improvements proposed are the addition of specific ‘iterations’ and ‘reviews’ analysis in the canvas, and the paradigm of the canvas as the integrator of several analyses carried out based on the sequence of NPD design method. Further research may focus on the testing of a more sophisticated canvas implementation and how the tool considers the position of companies’ existing NPD process.

Keywords: New Product Development, Process, Design, Tools

1. Introduction

In a competitive business environment, company’s ability to consistently deliver successful products is important. New product development (NPD) play important role in sustainability and growth of companies [1]. It is essential for a firm’s business continuity, in almost all industries [2]. Considering its importance, NPD is expected to succeed. Prior studies related to the success factors of NPD show that NPD process is a crucial factor [3-6]. Therefore, it is beneficial for a company to have a well-designed, well-managed NPD process.

The product development process can be defined as a set of activities that enable the transformation of ideas into marketable products [7]. Focusing on the NPD process design and improvement is believed to have an important contribution to the success of NPD [3, 5, 8-10].

NPD process may differ from one organization to another, and deciding which NPD approach to be implemented is principal [11]. Unfortunately, not all organizations have a clear NPD process. It is found that in large organizations, the process tends to have a long decision-making stage, and in medium-small sized organizations, the process is lacking formal evaluation and monitoring [12]. Based on this, it is important for a company to be able to design their NPD process.
Designing the NPD process should consider several things, such as the risks in NPD [13] and the analysis of existing process implementation [11]. Unger and Eppinger [13] suggested a method that consists of identifying risks and assigning risks to a process that consists of stages, iterations, and reviews. It needs to take into consideration the specific NPD situation. This method is able to support organizations designing their NPD process [11], but an analytical tool to comprehensively analysed the whole NPD process design steps is needed. The focus of this article is to conceptualize the analytical tool that can be used to help organizations design their NPD process.

2. Methods
Based on the purpose, the method to design an analytical tool for the NPD process is divided into two main steps i.e. **Ideation** and **Concept Testing**, as shown in Figure 1.

![Design steps](image)

**Figure 1. Design steps**

To conceptualize the NPD process design tool, Ideation and Concept Testing will be carried out.

- **Ideation**. This is the phase where the tool concepts are generated. The result of the phase is the tool concept. Ideation is done using Functional and Morphological analysis. Functional decomposition can be beneficial for technical or non-technical design, and it can be done based on the sequence of user actions [14]. Morphological analysis can help to comprehensively manage ideas and integrate them into a solution [15]. Both techniques are used to help in capturing and managing design ideas.

- **Concept Testing**. This is the phase in which the concept is tested. Testing is done by applying the proposed concept. The respondents of the testing phase come from product development and innovation department from pharmaceutical, transportation & logistics, and building material companies. The prototype is given to respondents, and feedbacks are recorded. Based on the feedback, the early concept then improved.

| Steps     | Data Collection and Analysis Techniques       | Output                                      |
|-----------|-----------------------------------------------|---------------------------------------------|
| 1 Ideation| Functional diagram, Morphological chart       | Overall function and Subfunctions           |
|           |                                               | Concept of the Analytical tool              |
| 2 Concept Testing | Physical model, Questionnaire | User feedback                              |
Functional Diagram is used to identify the function, Morphological Chart is used to generate concept, Physical Model is built and given to respondents, and Questionnaire is used to collect respondent’s feedback, as shown in Table 1.

3. Results and Discussions

3.1. Ideation
The analytical tool is based on the NPD process design with the sequence of [13]:
- Identifying the scope of NPD
- Risk documentation and prioritization
- Identification of loops, evaluation, or NPD phases
- Identification of planned iteration and process consolidation
- Identification of primary evaluation
While each of the steps may have specific methods, the NPD process design tool is conceptualized to support the observation of the whole process.

3.1.1. Functional Decomposition. “The first step to in decomposing the problem functionally is to represent it as a single black box operating on material, energy, and signal flows” [14]. While material and energy are relevant to physical technical products, ‘signal flow’, in this case ‘information flow’ seems to be the most appropriate approach to be used in the context of the NPD process design tool. The next step is to identify the subfunctions that will explain the overall function of the product. The decomposition is based on the researchers’ understanding about the problem. The result of the functional decomposition is shown in Figure 2.

![Functional Decomposition Diagram](image)

**Figure 2.** Functional decomposition: (a) The overall function (b) Subfunctions.

The primary function of the NPD process design is to get a specific NPD process relevant to the situations faced by the company. This specific condition is described in the Product Innovation Charter. The NPD process design sequence is based on the analysis risks, so it seems logical that the Product Innovation Charter and Risks are the inputs of the design. The subfunctions of the tool are referred to the sequence of the NPD process design. The subfunctions are stated as Categorize and Prioritize Risks, Identify Activities, and Identify Iterations, Stages, and Reviews as described in figure 2 (b).
3.1.2. Morphological Analysis. The next step is to find solutions based on the functional decomposition. For this purpose, a morphological chart is utilized. For relevant functions, solutions alternatives will be generated. These 'sub solutions' then analysed to get an intact design. The morphological chart is described in Table 2.

| Table 2. Morphological Chart |
|------------------------------|
| Functions | Options |
| Tool form | ![Sequence of Matrices](image1) ![List of Description](image2) ![Space of Elements](image3) |
| Categorize and Prioritize Risks | ![Arranged](image4) ![Not Arranged](image5) |
| Identify Activities | ![Arranged](image6) ![Not Arranged](image7) |
| Identify Iterations, Stages, and Reviews | ![Arranged](image8) ![Not Arranged](image9) |
| Process Finalization | ![List of Description](image10) ![Sketches](image11) ![Tables](image12) |

The 'tool form' explores the possibility of the tool main form will be in the sequence of matrices represent the PDP process design sequence, in the list describing the sequence, or in the space with elements related to PDP process design. The risks, activities, iterations, stages, and reviews may be arranged or not arranged into defined categories. The process finalization describes on how to finalize the process.
design. Based on the combination of solution options, several tool concepts are generated. The concepts are represented in table 3.

| Concept | Tool Form                | Combination | Concept Description                                           |
|---------|--------------------------|-------------|--------------------------------------------------------------|
| Concept 01: The NPD Process Design Matrices | Sequence of Matrices | Not arranged | Not arranged | Not arranged | Tables |
|         |                          |             | The sequence will be identified using matrices, and connections between matrices is important as it showed the sequence progress. The specific arrangement is not needed as it can be identified on the matrices. The process is described in tables, as it is easier to 'translated' from matrices |
| Concept 02: The NPD Process Design Canvas | Space of Elements | Arranged | Arranged | Arranged | Sketches |
|         |                          |             | As elements need to be elaborated and relations between elements need to be identified, it is beneficial to put all the elements in one space. Risks, activities, iterations, stages, and reviews need to be arranged since the 'empty space' does not beneficial to illustrate the connections between them. The process is finalized using sketches. |
| Concept 03: The NPD Process Design Manual | List of Description | Arranged | Arranged | Arranged | List of Description |
|         |                          |             | A strict descriptive tool that describes the NPD process design sequence. Beneficial for inclusion of all-important information. Have risks of being too packed with textual descriptions. |

The ‘best’ concept then selected. The concept is chosen using the ‘pros and cons’, one of the concept selection approach based on the strengths and weaknesses of each concepts [14]. The concept with the design canvas approach (Concept 02) considered to be the best concept since it can elaborate on the connections between elements and can make the analysis performed not in a strictly linear approach. As example, risk can be re-identified as activities are listed. The ‘space of elements approach’ can support this process better compared to rigid matrices or textual description.
The sketches approach also could balance between the graphical and textual forms to describe a process. This concept is illustrated in Figure 3.

![Figure 3. The NPD Process Design Canvas](image)

The canvas is consisting of five main parts: The Product Innovation Charter List, the Risks List, the Activities List, the Process Sketch Area, and the Additional Information Area. The working sequence is started with the identification of project scope stated in the Product Innovation List. The next step is the identification of uncertainty and risks, and the identification of necessary activities to address those risks. The activities then arranged into a complete process and describe in graphical form (sketch). The process should describe the iterations, reviews, and stages. Additional information that cannot be explained from the process illustration then added into the Additional Information Area. The canvas may function as ‘integrator’ that captured information from analysis for each part.

### 3.2. Concept Testing

The purpose of the concept testing is to collect the customer feedback for the NPD Process Design Canvas. The testing session is done using the physical canvas (using printed paper) that is given to respondents who directly using the canvas to perform the sequences. The respondents are from pharmaceutical manufacturers, transportation & logistics provider, and building material manufacturer. Respondents are representative of the innovation and product development functions at the companies. During the testing session, feedback is collected as respondents asking questions and give comments. At the end of the session, respondents are asked to fill the questionnaire about the proposed concept.

The result shows that risks are successfully identified. Risks of overdesign, trends, product similarity with the competitor, unmanaged design changes are several risks that must be faced by pharmaceutical companies. Limited market, different preferences in product design, and delayed product trial are main risks that must be solved by building material manufacturer. Maintenance, shifting customer behaviour, rapid technology changing, long approval stages are some risks that the transportation & logistic company must deal with.

NPD process also successfully designed. Although more detail must be completed for all the designed process, the process that is built based on the risk analysis has been done. Most of the processes are described in the gating system, explaining gates such as Idea Generation, Feasibility Study, Development, Testing, and Launching Preparation. It is interesting that almost all process is described as a linear multi-stages sequence and no clear iterations and reviews that are stated. It might be an indication that the canvas is not able to assist the conversion of activities into iterations, reviews, and gates.
The pros and cons of the concept also identified. The result is described in Table 4.

**Table 4. Advantages and Disadvantages of The NPD Process Design Canvas**

| Advantages | Disadvantages |
|------------|---------------|
| Serve the needs of mapping the process comprehensively | Lack of product description |
| Risks can be studied in detail, enable risks anticipation | Elements have various detail; it is not easy to wrap it to a complete process |
| Elements in the canvas is adequate to design the NPD process | Unable to capture the information of existing NPD process |

Based on the result, several improvements for the canvas need to be done. The proposed improvements are

- **The conversion of activities into process’ iterations, reviews, and stages.** In the Process Sketch Area, additional boxes to identified iterations and reviews could be added under the Macro Stages and Micro Stages box. The illustration is as described in Figure 4.

![Figure 4. Additional ‘iterations’ and ‘reviews’ boxes in the Process Sketch Area](image)

- **NPD Process Design Canvas can be positioned as an integrator of several analyses.** All the sequences of NPD design [13] may need specific analysis. As an example, the process of risk prioritization may need some sort of rating method. The existing NPD process may be valuable information, and it may need a specific illustration space that cannot be fulfilled in the NPD design canvas. The result then can be included in the canvas. In that way, other tools are needed to comprehensively enable the design of the NPD process. This paradigm is important once the canvas will be implemented physically (such as in the whiteboard) or conceptually (such as in worksheet software or mobile apps).

4. **Conclusion**

The analytical tool that can be used to help organizations design their NPD process is conceptualized as the NPD Process Design Canvas. The tool concept is based on the ‘space of elements’ tool form, using ‘sketches’ to finalize the NPD process and provide arrangements of risks, activities, iterations, reviews, and stages. The concept has been tested and some improvements based on the feedbacks are the additional boxes for iterations and review identifications, and the position of NPD Process Design Canvas as an integrator of several analyses.
While this article explains the concept of the NPD Process Design Canvas, further testing needs to be done involving a more detailed analysis of risks, using a more sophisticated physical or software media. Other research also needed to address the issue about the position of organization’s existing NPD process and how the NPD Process Design Canvas take it into consideration.

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