Mapping the Innovation Space One: Novel Tools for Problem Definition in Product Innovation.

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Abstract
The following article introduces and describes two novel problem definition tools. The tools include the Concurrent Problem Definition Tool, and the Innovation Hurdle Filter System. The rationale behind the development of these tools is discussed.

Introduction

According to Romelaer (2000) the innovation process interacts with numerous contexts and must be framed within these contexts. The various actions of which the innovation process is composed must be co-ordinated with each other. The firm must have competence and resources for each of the actions of which the innovation process is composed.

To do this they need to have at their disposal innovative methodologies that enable them to interact and learn from both within the system in which they operate and also from external factors such as technological, organisational, social, environmental, and intellectual influences.. In effect organisations need to manage technical and economic environments. Padrao (2002) suggests that successful innovations are linked to commercial value. Consequently any innovation activity must ultimately lead to economic success.

The Move Towards Systemisation

One of the key tenets to an organisations success lies in the development of a total systematic approach. According to Elfving et al., (2003:1) 'success in manufacturing requires continuous development and improvement of how products are developed and produced. There is a need for new methods, tools and procedures to improve product development especially due to increased complexity and amount of relations between different actors.' One of the main drivers in this 'Innovation Age', is the identification of future consumer needs and demands supported by innovative tools. To maintain this 'innovation advantage' organisations implement a number of methods such as concurrent engineering, axiomatic design, value engineering, QFD, DFM and TRIZ.

The Importance of Problem Definition

Problems experienced at the micro level can be the result of improper problem definition at the macro level (Figure 1). Improper consumer product definition at the macro level can often lead to product failure, even though the product has met the technological criteria required. For example a product which is technologically sound can fail at the consumer (macro) level because it has been designed for minimum handling rather that frequent handling through the value chain. This highlights the overriding importance of 'rigorous' problem definition well in advance of product development and commercialisation. The meso level is the enabling link between the mciro and the macro levels to help sustain competitiveness.

In TRIZ a ‘problem’ can be technical or managerial, simple or complex, a need for innovation, an opportunity or a perceived need for something to happen. These are expressed in terms of a problem definition. For example, the need for a more comfortable chair is inherently a consumer need. Within the TRIZ approach, however, a more comfortable chair is both a technical problem and a market opportunity.

Essentially problem definition tools need to combine both the technical and consumer aspects of innovation. Consequently the innovation process can be enhanced by interfacing the existing innovation philosophies to create a more robust problem definition methodology.

Macro Level	The Market, Usage, Organisational Structure, Environment, Social, Political
Meso Level	Competitiveness, Education, Research, Technology Policy
Micro Level	Technology, Product Development, Process

Figure 1: Elements of Macro and Micro Levels

The problem definition phase is a central activity in the innovation process. In the context of problem definition information is analysed to define the most likely ‘cause of a problem’ or to ‘derive a solution’. Information needs to be gathered in a systematic manner prior to formulating a problem statement. The information gathered is critical and central to helping define the problem, diagnosing and providing an accurate and faster solution to the problem. Moreover, both the problem definition and information gathering should be used simultaneously in order to achieve an accurate resolution.

Once sufficient information is gathered, a problem statement can be created to define the problem in a specific, concise, and accurate manner. The development of a robust problem statement makes it easier to focus and give clarity to the problem and eliminates the risk of solving problems that do not fall within the scope of the problem definition phase.

Rationale for a Concurrent Problem Definition Tool

Generally the process for solving a problem will consist of a sequence or structure that fits together in order to ensure nothing is overlooked. Concurrent engineering philosophy is based on the integration of the engineering, marketing and the voice of the consumer. Proulx (1996) suggests that CE is a 'systematic and multidisciplinary approach that simultaneously integrates the different phases of product development and the management of its processes. These processes include the identification of customer needs, specification of product performance requirements, design of the product, manufacturing processes and fabrication of the product, while considering the entire product life cycle, including distribution, support, maintenance, recycling or disposal'. Fundamentally, the key philosophy behind concurrent engineering is the integration of both productionisation and commercialisation concerns in order to achieve a successful product innovation.

In CE projects the voices of both internal and external customers are captured and converted into specific predictable and measurable product characteristics (Hales,1993). Any successful problem definition tool needs to be capable of mapping both the technical and consumer innovation space (Figure 2).

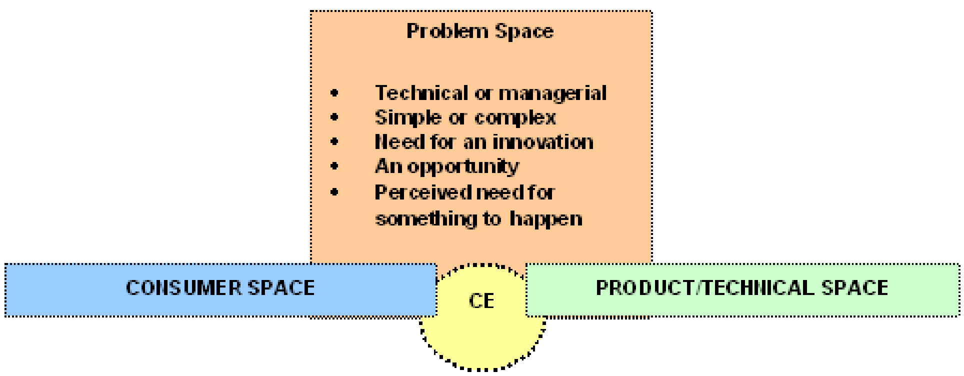

Figure 2: Concurrent Nature of the Consumer and Technical Problem Space.
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Description of the Concurrent Problem Definition Tool

The concurrent problem definition tool (CPDT) maps both the product and consumer space. It focuses on both the positive and negative aspects of the consumer and product. This process is carried out in order to ensure that the generic problem is mapped and defined in more specific terms.

The roadmap for utilising the CPDT is described below:

STEP 1

- State problem and enter into the CPDT problem space.

STEP 2

Map the Consumer Space

- Map from a consumer viewpoint. This should include needs and perceptions.
- Map from a generic to numerous more specific definitions.
- Use 'because' as a means to question consumer needs.

- Map both negative and positive aspects from the consumer view point.
- Phrase in 'wants' and 'doesn't want' terminologies.

STEP 3
Map Product Space

- Map from a product view-point. This should include such factors as materials, shape, colour, ergonomics system, sub-systems.
- Select a product benchmark. The product may 'be your own' or a competitors product. It could also represent 'best in class'.
- Map from one generic to numerous more specific definitions.
- Use 'because' as a means to question technical requirements.
- Map both positive and negative aspects from a technological perspective.
- Phrase in 'is' and 'isnt' terminologies.

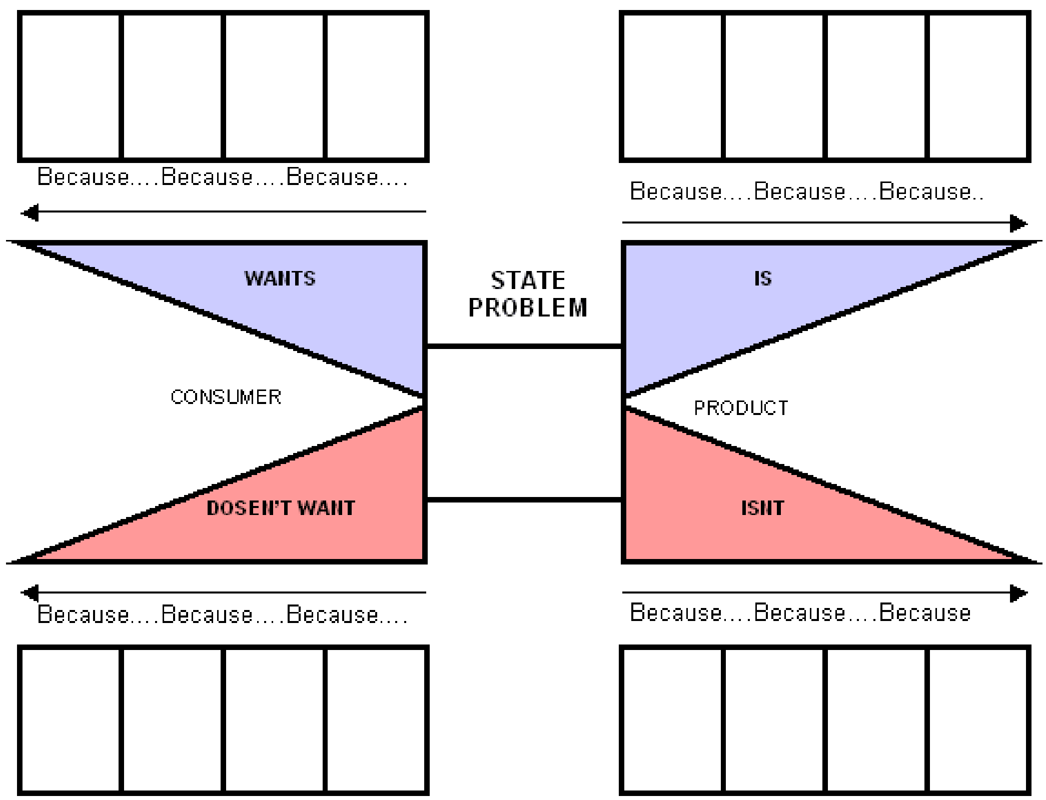

Figure 3: Concurrent Problem Definition Schema.
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Barriers and Obstacles to Innovation.

Braadland et al (2001) identify a number of innovation barriers for different industry groups. These include economic risk, high costs, finance, organisational rigidities, lack of qualified personnel, lack of IT, lack of market information, regulations, standards and customer responsiveness. It is essential whilst carrying out problem definition analysis that these type of generic obstacles or hurdles to innovation are properly identified and mapped in order to maintain a realistic perspective on what is achievable. Workshops carried out by the authors identified that people engaging in problem analysis have a tendency to under estimate the importance of identifying the innovation hurdles that need to be overcome in order to arrive at a solution for a specified problem. In this regard they tended to adopt the traditional unsystematic brainstorming approach, which is good for creative thought but not for focusing on innovation within constraints.

Description of the Innovation Hurdle Filter System

The Innovation Hurdle Filter System (Figure 4) is used to map identified barriers and hurdles within the system. Innovation hurdles can be technological: organisational; political; social (personal, consumer); environmental or informational. Furthermore, an organisation

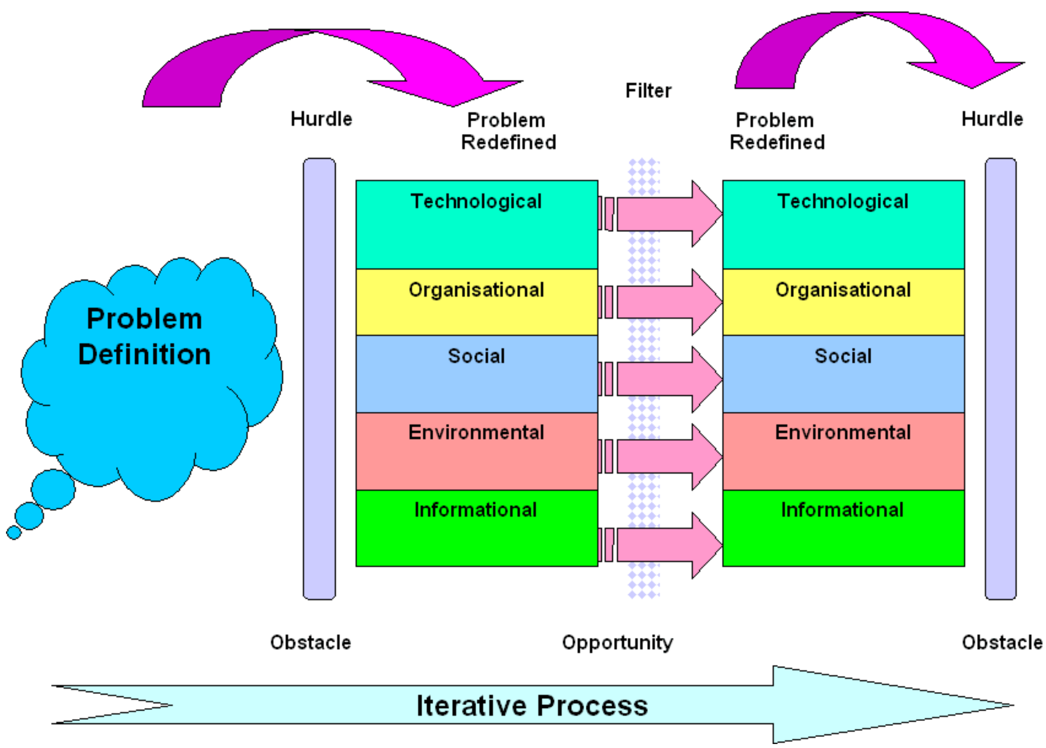

Figure 4: Innovation Hurdle/Filter Schema
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may experience hurdles that affect: incentives for innovation such as short compliance timeframes: sensitivity to incentives for example, culture of compliance; idea formation such as employees do not appreciate benefits of innovation; implementation for example product quality concerns (Scott et al., 1998).

The hurdles mapped can then be analysed and filtered as to their potential impact on the implementation of identified solutions. The system also enables us to identify the hurdles that do not have an impact on the implementation of identified solutions. The first step in using the Hurdle Filter System is to extract one of the identified specific problems from the Concurrent Problem Definition tool. This specific problem is then entered into the Innovation Hurdle/Filter pro forma.

It is recommended that a small cross functional group from different disciplines carry out this phase of the problem definition process. This will ensure the cross fertilisation of ideas and functions.

The group should focus on applying innovation hurdles to the problem definition. This should enable the team to eliminate those hurdles that are not relevant to further defining the problem space. It should also enable suggestions made by the team members to be eliminated or selected for filtering to the next phase of the problem definition process. This is an iterative process which when exhausted will enable the team to better quantify and identify the problem space

For each hurdle the 5W and 1 H questioning process should be applied in a systematic manner:

1. **What is the specific nature of the hurdle?**
2. **Why does this hurdle exist?**
3. **Where does the hurdle occur?**
4. **Who is causing the hurdle?**
5. **How can this hurdle be overcome?**
6. **When can we overcome this hurdle?**

Future Work

The tools described represent part of a suite of novel mapping tools that can be utilised in better defining the innovation space. Further articles will build on this suite of tools and describe their application to actual case studies.

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