

SCIENCE AND TECHNOLOGY POLICY RESEARCH – SPRU

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Theme B: *The Use of Knowledge***THE CHANGING NATURE OF TECHNOLOGICAL SEARCH STRATEGY IN INNOVATING FIRMS:
THEORY AND EVIDENCE FROM THE AGROCHEMICAL SECTOR**by Surya Mahdi (*Ph.D Student Supervised by Prof. K.L.R. Pavitt and Dr. Paul Nightingale*)**EXTENDED ABSTRACT OF THE PAPER****OBJECTIVE AND KEY ARGUMENTS**

The proposed paper describes the evolution of “Search-Strategy” (style/method/mode of search) carried out during the process of product innovation in the Agrochemical sector. It argues that there has been an evolution of Search Strategy in the Agrochemical Discovery Processes, similar to that found in the Production Processes (e.g. Craft Production, Mass Production, Mass Customization). In particular, the paper argues that:

- Firstly, there have been inevitable variations over time of Search Strategy depending on certain capability factors that the product developers are able to use/apply in product development problem-solving.
- Secondly, the Search Strategy which is most frequently used in a sector of industry can be related to the strategy that can offer comparative advantages – in term of the effectiveness and/or the efficiency of search – from the other Search Strategies that may exist in that sector.

Using this account of “Variation and Selection” process, this paper takes a very different view of the Product Innovation/Development Process from the mainstream literature (mainly New Product Development literature – NPD literature) which does not accommodate the possible existence of various Search Strategies on their product development framework.

THEORETICAL FRAMEWORK

To support these arguments, this paper develops a theoretical framework, based on Cognitive Psychology, on how humans search for the solution to their problems. The basic principle of this framework is that knowledge guides search and therefore there will be variation of Search Strategy in developing new products depending on whether:

1. The product developers are able or not to organize their search by parsing their problem into more meaningful components of search that can be attacked at least semi-independently (Analytical Dimension).
2. The product developers are able or not to devise search technique that can be easily repeated many times in the event of repeated failures (Throughput Dimension).
3. The product developers are able or not to design/hypothesize beforehand a workable prototype of solutions to start with (Design Dimension).

The combination of these three capability factors creates the varieties of Search Strategy in the product development processes. Those varieties are Serendipity, Craft Search, Mass Screening, Multiple Screening, Recursive-based Simple Design, Precision based Simple Design, Recursive based System Design and Precision based System Design (see figure 1 overleaf).

METHOD OF INVESTIGATION AND DATA SOURCES

To assess the applicability of that theoretical framework in supporting the above argument, this paper will use the framework to explain the phenomenon of changing nature of technical problem-solving in the Agrochemical Lead Discovery Process. By mainly using Patent data about novel agrochemically active chemical structures, it will identify different varieties of Search Strategy which have been used in the Agrochemical Lead Discovery process. Then, to explain the changing nature of the Search Strategy, it will correlate the variation of the population of different Search Strategy with the emergence of certain knowledge and financial capabilities gathered from the Publication data on the field of Chemistry and Biology as well as from the data of R&D expenditure in the Agrochemical Sector. The data-set contains more than 1000 agrochemically active chemical structures which have at least entered development process from the ancient time up to the present time.

Figure 1: DIFFERENT STYLES OF SEARCH FOR NOVEL PRODUCT

MAIN FINDINGS

From this investigation, the paper will show that

- The Agrochemical Sector has experienced at least three different styles of lead discovery process which are Serendipity, Mass Screening (widely known in the Agrochemical Sector by Random Screening) and Recursive Design (widely known in Agrochemical Sector by Rational Design). The emergence of Mass Screening can be associated both to the organizational change in research where certain types of organizations – firms or other profit-seeking organizations – were able to use their financial capabilities to increase the throughput of Agrochemical experimentation and much more recently to the advance of High Throughput Screening and Combinatorial Synthesis techniques. On the other hand, the emergence of Recursive Design could be associated with the emergence of Computer related knowledge such as Molecular Modeling.
- The evolution of the Search Strategy in the Agrochemical Lead Discovery Process follows a process of Selection, Variations and Selections (see figure 2 overleaf). In the recent time, even though the emergence of Recursive Design during the last half of 1980s adds variation to the Search Strategy for discovering novel agrochemically active chemical structures, Mass Screening remains the most common strategy used up to the present time. This can be associated with the comparative advantage of Mass Screening comparing to the other Search Strategies in term of the search effectiveness.

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Figure 2: THE EVOLUTION OF AGROCHEMICAL LEAD DISCOVERY PROCESS