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# Using functional approach to increase effectiveness of open innovation in chemical engineering

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ABSTRACT

Open innovation has been widely discussed ever since P&G publicly pronounced that "Open innovation is a way for companies to avoid the stale, repetitive thinking that can happen when employees are accustomed to their internal ways of solving problems". The goal of open innovation is to connect innovation problem to the best existing technical solution to this problem that can be found outside of company's R&D. The general concept of open innovation has been widely accepted and practiced. However, in practice, open innovation frequently works inefficiently because problem at the input is not formulated properly or is a wrong problem to be solved. The objective of this article is to discuss this challenge of open innovation and demonstrate – through the prism of chemical engineering – how one of the main TRIZ tools, functional approach, can increase the effectiveness of open innovation.


## 1. Introduction to open innovation

Companies have always been going through transformations to keep up with the ever-changing world of technology changes and customer demands. Today, however, the world of technology is changing faster than ever and the pace of change is accelerating (Kurtzweil, 2005). Different industries go through transformation at different pace driven by different forces and challenges (IT companies faster than industrial engineering, for instance). Some of the notable driving forces/challenges that make present-day chemical industry innovate faster are:

- Ecological and environmental concerns result in great demand for new materials and chemicals (e.g. biodegradable materials) (Chemical Top-Trends, 2014).
- Health concerns lead to increasing demand for new truly hypoallergenic and non-toxic materials and consumer products, such as cosmetics and food. (Erickson, 2014).
- Increasing demand for innovative nano-materials that have very attractive new features, such as self-healing materials (e.g. car paint) (Woodford, 2014).

Being able to make quick adjustments to account for these and other challenges will become a differentiator for chemical companies in the next several years. Agility is especially important considering that, compared with companies in other industries, chemical companies' returns have fallen over the last 20 years for a number of reasons including waning interest in base chemicals and softening demand for agrochemicals and fertilizers (though the overall returns in the industry remain strong) (Gocke et al., 2013).

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Outside chemical industry, no matter where you look, product development cycles are shrinking, the number and complexity of products is increasing, manufacturing revolution is happening (additive manufacturing being a prime example), natural resources are decreasing, turnover rate is increasing and global competition puts more and more pressure on companies.

One way to minimize risk associated with these changes, and innovation in general, is to utilize resources available through so-called "open innovation" (OI), i.e., to leverage knowledge (technologies and ideas) that exists outside your company's R&D. Henry Chesbrough, who coined the term, defines open innovation as "the use of purposive inflows and outflows of knowledge to accelerate internal innovation and expand the markets for external use of innovation" (Chesborough, 2003).

Ideas and/or technologies in OI can come from individuals, universities or companies (conceptual design firms, crowd sourcing firms, start-ups and even competitors). Most people today equate OI with crowd sourcing (i.e., soliciting ideas from a large group of people, very often by internet), while, in fact, different formats can be employed (e.g., hiring a firm specializing in OI or a university professor).

Open innovation (OI) offers a number of advantages for corporations:

- *Access*: OI presents an opportunity to involve more brains from different disciplines/industries, and, as a result, dramatically increases pool of potential solutions. This is especially relevant today considering exponential growth in the number of technologies over the last half-century.
- *Speed*: OI presents an opportunity to accelerate innovation as internal development can take much longer than external.
- *Reduced risk*: solutions from outside need to be adopted rather than invented from scratch, and adaptation is inherently less risky than invention.
- *Flexibility*: effective size of R&D becomes instantly scalable depending on the needs of today.
- *Cost*: consultants costs are often much lower than hidden costs associated with internal expenditures.

To summarize, open innovation can and should be a great resource for product development and process improvement because it lowers the risk/cost of innovation while simultaneously increasing the benefit. There are indeed a number of examples of how OI has helped companies like, for example, GE and P&G achieve great results (e.g., Stinson, 2014; Huston and Sakkab, 2006).

Leveraging external knowledge (as technologies or ideas), however, is not as simple as it sounds. After initial euphoria that OI concept had brought into the corporate world, a lot of early adapters of OI are having a serious "buyer's remorse" because what had been promised to be easy, cost effective, easily adaptable and overall efficient turned out to be quite demanding in resources, generating a rather low yield and indeed requires special skills and organizational rearrangements. Thus, there is a strong desire and need to make OI widely accepted effective tool to accelerate the R&D process.

This paper focuses on one of the most significant challenges presented by OI – how to properly formulate the problem – and demonstrates how GEN3's functional approach helps overcome this particular pitfall.

## 2. What is the right problem for open innovation?

The goal of open innovation is, at the high level, to connect innovation problem to the best existing solution to this problem. In other words, OI can be viewed as a matching function between problems (inputs) and existing technical solutions (outputs). As such, OI challenges fall into five general categories: (1) How to properly formulate the problem? (2) How to access relevant pool of solutions? (3) How to find the best solution? (4) How to adapt identified solutions to the specific requirements of the original problem? (5) How to do the above effectively and efficiently.

While addressing organizational challenges (e.g., how to ensure alignment of capabilities, how to find the right external partner), legal challenges (who owns IP?) and "soft" challenges (e.g., how to deal with the "not invented here" syndrome) of OI is an important topic, this paper focuses on a particular challenge that, from our experience, technical professionals are dealing with most of the time. This challenge is how to properly formulate innovation problem for OI.

Our research and practice have shown that there are typically four major issues that need to be addressed during problem formulation:

(1) The originally stated problem is usually not the one you really need to attack. Typically, innovation problems are ill-defined and/or open-ended, ranging from strategic (e.g., "What is the next generation of products in my category?") to technical (e.g., "How to considerably reduce losses of energy during production of paper?"), or consumer needs-driven (e.g., "How to make commercial canned food taste like home made?"). Innovation challenges formulated in such way are not a proper input to some models of OI such as crowdsourcing because they are not specific or precise; they require too much contextual knowledge and are too high level.
(2) As discussed in the paragraph above, open-ended or ill-defined innovation challenges are rarely used as input to OI. Instead, specific narrow problems with clearly stated requirements and constraints are typically posted (e.g., Stinson, 2014). Such high level of specificity in problem formulation, however, implies tight connection to the specifics of the industry the problem originates in. In other words, if problem formulation uses language specific to a particular industry, technology search becomes largely limited to a search within company's own industry. This defeats the whole purpose of OI because the probability of finding a new solution in your own field of expertise is inherently low.

In other words, OI presents an interesting contradiction: on one hand, the problem has to be specific to avoid irrelevant solutions, but, on the other hand, the problem cannot be too specific because specificity often prevents technology search outside the industry that the problem originates from.

(3) The purpose of OI is to find solutions outside company's R&D expertise. However, the search field becomes almost infinite if you are trying to search for the right solution/technology outside your own area of expertise – i.e., output has high level of "noise". Companies can receive several thousand submissions to a given problem through