
Reconsidering the role of brainstorming in the marketing of technology-driven innovation

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Abstract: Establishing a perfect link between technology-driven innovation and user needs exploration has long been a controversial issue. This is particularly true and important in the era that technology development itself can no longer guarantee the creation of new markets. How to determine the potential of a new technology for which no market yet exists, therefore, becomes a vital but challenging task. The current study put its emphasis on designing a user-centric approach for product innovation based on lead user method, and on examining whether such an approach is helpful in maximising the success rate of technology innovation as well as the potential for market launch. A pilot project of designing mobile and internet products and applications derived by the proposed approach was conducted to scrutinise the feasibility and plausibility of this approach. The role of brainstorming in the marketing of technology-driven innovation is especially reconsidered and highlighted. Findings and suggestions are provided at the end of this article.

Keywords: technology-driven innovation; lead user; brainstorming; marketing; methodology.

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1 Introduction

Innovation is an economically motivated activity (Morrison et al., 2000). Strategies, policies, and regulations, therefore, have been formulated by practitioners and the governors for triggering innovation. However, owing to the variety of innovation in its very nature, it then results in more debates than agreements on the innovation process (i.e., close vs. open innovation), the innovation target (i.e., non-technical vs. technical innovation), and the innovation design strategies (i.e., discontinuous vs. disruptive innovation, and technology-push vs. market-pull innovation) in recent years.

When looking into the typology of innovation, technology-push and market-pull innovations are always distinguished in literature. Generally speaking, the potential markets and applications are usually unknown for technology-push innovations, owing to the features of breakthrough and uncertain of high-tech (Henkel and Jung, 2010). How to

capture the potential of a new technology that no market yet exists, thus, becomes a challenging but vital task for practitioners before investment. Identifying a perfect link between technology innovation and user needs exploration, then, becomes of great interest for both practitioners and academia.

However, Moore (2005) argued that, owing to the paradigm shift in high-tech industries, more and more commonalities among technology and non-technology innovations could be identified. If such argument is held true, the claimed possible paradigm shift of high-tech may have serious influence for practitioners on the way of pursuing technology-driven innovation. Furthermore, it might imply that, the current best practices for general innovation processes might be applied for technology-driven innovations after minor revision. In particular, in the customer-oriented era, if such practice can help firms efficiently utilise ideas and knowledge from users, it would be of great help for establishing a perfect link between technology innovation and user needs exploration.

The current study adopts Moore's (2005) viewpoint by arguing that the lead user-based approach first proposed by von Hippel (1986) may be helpful in shaping successful marketing strategies of technology-driven innovations. Therefore, this research puts its emphasis on designing a user-centric approach based on the lead user approach, examining whether such an approach is helpful in maximising the success rate of technology innovation as well as the potential for market launch. Given that once a firm has identified the target technology for research and development (R&D), the authors are interested in the following three research questions:

- 1 How to design a user-centric approach for technology-driven innovation based on lead user approach?
- 2 What are critical issues and values of user-centric approach for marketing and designing technology-driven innovation?
- 3 Is it possible to identify roadmap-based strategies suitable for technology-driven innovation on product development and market penetration based on such approach?

2 Literature review

2.1 Technology innovation and corresponding methods

According to the literature, a variety of frameworks can be found for classifying different types of innovation. Within those frameworks, one fundamental distinction is made between technology-push and market-pull innovations. Based on Schumpeter's argument that innovative products are often created in the absence of well-defined market demands, technology-push refers to 'technological opportunity', whereas market-pull refers to 'calling forth' (Henkel and Jung, 2010). Generally speaking, technology-push innovation was defined as an innovation that starts with the development of a certain technology (Chidamber and Kon, 1994). The most obvious case of technology-push innovation is the debut of entirely new technologies originated from science. Traditional technology-push innovations are found to be more often breakthrough innovations, which imply a higher failure rate due to higher uncertainty. Therefore, in contrast to market-pull innovations,

potential markets and applications are usually unknown in the case of technology-push innovations.

While both mechanisms (i.e., 'technological opportunity' and 'calling forth') might occur jointly, there clearly are cases in which inventors searching for market opportunities for a given technology. However, Newbert et al. (2007) showed that firms pursuing technology-push strategies performed better than firms implementing demand-pull strategies. Moreover, literature regarding to the methods suitable for identifying market opportunities for new technologies is lacking. The following is a brief review on those methods provided from the literature.

Souder (1989) developed a three-step method for technology-push innovation. The first step is to identify potential applications by analysing the technology's attributes such as unique features and customers' needs that could potentially be satisfied. The second step aims at maintaining a user mentality to innovation by integrating the demand side into the innovation processes. Brainstorming with interdisciplinary teams and morphological analyses are encouraged methods to be implemented at this step. As for the final phase, it deals with the evaluation of the identified application areas (i.e., prediction of the market potential) (Henkel and Jung, 2010).

Lynn et al. (1996) suggested a probe and learn process-based approach. Their approach makes obvious sense once an idea exists for a product incorporating the new technology and a market to be served. However, it cannot be applied for technology in the early R&D stage. This is mainly because that, especially for radical technologies, the potential of possible products and the targeted markets cannot easily to be identified in early phases.

Herstatt and Lettl (2004) proposed an exploratory and creative process, and identified market opportunities by using anticipatory, exploratory market research methods. However, this approach utilised internal resources or experts to conduct a Delphi study to discover market demands or needs. It implies that this method does not really integrate users' opinions in its very nature.

To deal with the problem of high failure rate of technology-push innovation for market penetration, Henkel and Jung (2010) proposed a new tool called T-PLUC. T-PLUC is developed based on the insights from user innovation and lead user research. T-PLUC borrows several steps from von Hippel's (1986) lead user method but with different starting point, and is composed of five steps. The first step is to determine the relevant characteristics of the focal technology. The second step is to search for trends that are furthered by these characteristics. The third step focuses on identifying markets in which these trends matter. The fourth step searches for lead users, that is, users that are ahead of the market with respect to these trends. The final step puts its emphasis on developing product concepts jointly with these lead users.

To sum up, to cope with those challenges that most technology-push innovation suffers, different perspectives and approaches have been proposed and examined in recent years. Recognising the challenges and characteristics of technology itself, some scholars started to examine the feasibility of linking technology-push processes with lead user methods. Lettl et al. (2004), Gassmann and Wecht (2005), and Henkel and Jung (2010) are typical examples. Such a viewpoint helps raise the debate on one critical assumption: whether the critical factors for successful technology innovation are different from other types of innovation. According to Moore (2005), enterprises can hardly gain

competitive advantage or even win successful commoditisation by spending heavily on traditional technology innovation approach; Moore argued that as the technology becomes mature, there is no significant difference existed between technology innovation and other types of innovation (Moore, 2005).

A closer look at current proposed methods referring to lead user method reveals that, the importance of dynamics of customer needs and the leading edge of applications preferred by lead users are worth further investigation. In addition, these models referring to lead user method all tend to identify characteristics of technology at the first stage, which is different from that of the classical lead user method proposed by von Hippel (1986). However, owing to lacking of enough number of cases for validation, these models are still calling for further examination. In other words, the process of systematically linking lead users with technology-push innovation is still incomplete but calls for further work.

2.2 Lead users, lead user method and technology innovation

Traditional idea generation techniques based on customer input usually collect information on new product needs from a random or typical set of customers. The lead user process, on the contrary, collects information about both needs and solutions from users at the leading edges of the target market, as well as users in other markets that face similar problems in a more extreme form (Lilien et al., 2002).

According to von Hippel (1986), lead users are those who have the following two characteristics:

- 1 they expect attractive innovation-related benefits from a solution to satisfy their needs, and are more likely to innovate by themselves
- 2 they experience needs ahead to the majority of a target market (Morrison et al., 2000).

The proposed lead user process involves four major phases:

- 1 goal generation and team formation
- 2 trend research
- 3 lead user pyramid networking, a reversion of snowballing techniques
- 4 lead user workshop and idea improvement (Lilien et al., 2002; Luthje and Herstatt, 2004).

To explore the role played by users in radical innovation projects, Lettl et al. (2004) examined whether users are able to actively contribute to the development of radical innovation and which user characteristics are critical. By investigating the cross-sectional and longitudinal project data from 3M, Lilien et al. (2002) found that breakthrough ideas generated via the lead user process demonstrated good fit to existing corporate goals and competencies as ideas generated by traditional methods. Similar findings can be found in Lettl et al. (2004). According to Lettl et al. (2004), users with a unique set of characteristics can play a dominant role in the innovation process of radical innovation. These users have high motivations toward new solutions and possess diverse

competencies embedded into a very supportive context. Therefore, companies could gain competitive advantage by utilising those users for developing new products/services.

With regard to when to apply lead user method and whom to invite, Matthing et al. (2006) put their emphasis on the identification of innovative customers, and the effectiveness of employing such customers to generate new service ideas in a technology-based service settings. Their results indicated that technology readiness (TR) is a useful tool for identifying users with both innovative attitudes and behaviours. In addition, they found that users with high TR score are more creative, which can be reflected by the quality and quantity of new service ideas generated by those users. Moreover, Matthing et al. (2006) highlighted that, despite the widespread recognition in the literature that interacting with customers during the development process is critical for market success, new service/product development has generally proven to be a difficult task because of many hidden obstacles. Most of these obstacles are related to the lack of understanding about how to involve customer in the development process. What is more, these obstacles are particularly pronounced when developing new services and products that are technology-driven.

Morrison et al. (2000) argued that innovation could also occur among lead users in local communities when either or both of two conditions hold:

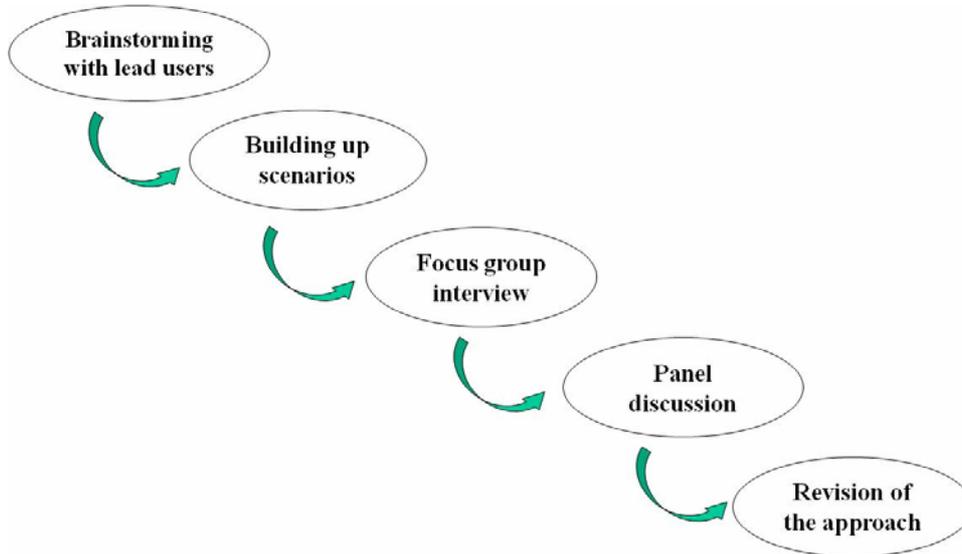
- 1 when a local community has unique needs
- 2 when it is cheaper to invent a new product than to search for and to acquire a needed innovation that may exist elsewhere.

Based on the their results, Morrison et al. (2000) found that many creative users would freely share their innovation with others; meanwhile, significant differences were found between users sharing information about their modifications and users who did not. There, two suggestions were provided for generating creative ideas with users. First of all, networking process might be a much more practical for efficient identifying lead users, in comparison with that of full screenings of user populations. Second, it is useful and valuable for firms developing systematic ways to acquire information about user innovations and modifications as an input to their idea generation processes, even if these firms collect only information from lead users in their local marketplace.

3 Research method

This paper aims to propose an approach for technology innovation by involving lead users. With regard to research design, the current study applied the action research method. The whole research processes of our work are summarised in Figure 1. The proposed steps undertaken here is a revision of von Hippel's (1986) lead user method and the industrial-oriented service innovation methodology (iSIM) proposed by Kuo et al. (2010).

As for the research target and content itself, a pilot research project sponsored by the biggest research institute in Taiwan was taken. The project was execute in 2009, with its goals on identifying the market potential as well as the core functions of image semantics for mobile and internet applications. The background information of the targeted technology (image semantics) and the research design/process itself are described below.

Figure 1 The research processes (see online version for colours)

3.1 *Image semantics: what is it and what are the challenges*

As multimedia (e.g., image, video and audio) becomes a key interface for human communication, valid semantics become vital. In the past, the common approach to make images embedded with contextual meanings needs to be done through the description of low-level features manually. However, such a practice is neither direct relevant to semantics, nor followed by nature language. Therefore, the new practice of image semantics is supposed to make future search activities more easily and efficiently.

On one hand, with regard to the technical challenges of the development of image semantics, the following challenges are highlighted in literature:

- 1 information search: which includes keyword matching, dealing with the web environment, processing various information items, and higher accuracy
- 2 image search: which includes resolving of heterogeneous between terminologies, and that with seasonal changes, shadowing, and lighting variations, thus calling for extra works for creating and maintaining the ontology, and compatible/suitable for image retrieval system
- 3 semantic modelling of multimedia: which includes context-dependency (e.g., semantics is not a static and intrinsic property, and the semantics of an object often depends on more factors), and modality-independency (i.e., media objects of different modalities may suggest the similar/related semantic meanings)
- 4 query of historical images: which covers how to use various query image sources much more efficiently, such as different satellite with different resolutions (Yang and Lee, 2008; Datta et al., 2008).

On the other hand, from the technological application development viewpoint, business models and applications of image semantics are still lacking. In general, image

processing technologies are mostly used in applications of search and surveillance, and with emphasis on pattern/feature matching. In contrast, less concern has been paid to image semantics and the corresponding application development (Yang and Lee, 2008; Datta et al., 2008). Not long ago, owing to some successful applications in security and medical areas, as well as the prevalence of image sharing over the web, applications and technical development of image semantics are gradually recognised by both practitioners and academia. Two well-known but still underdeveloped examples are Google Goggles and Nokia's Find-And-Point. However, from the very nature, how to shape successful image semantic-oriented product innovation is still unknown. It implies that the current story of image semantics can hardly provide practical guidelines for creating innovative products and services as technique not yet mature, thus calling for further efforts in this manner.

3.2 Research flow design

As depicted in Figure 1, the research was composed of five steps: brainstorming with lead users, building up scenarios, focus group interview, panel discussion, and revision of the approach.

At the first step (i.e., the 'brainstorming with lead users' step), we invited two types of lead users for brainstorming separately. Type 1 lead users were people who are experienced and heavy users of ICT products and services. Type 2 users, in contrast, were experienced product designers. During this step, the research team (which is composed of five people) invited six to eight participants of each type lead users for brainstorming. To ensure the variety within lead users, different interests and expertise of product category were expected from the lead users. The initial ideas gathering from two brainstorming meetings produced over 100 ideas. The research team then compared the innovative ideas collected with the demo cases proposed by leading companies around the world (looking for truly innovative ideas), analysed the differences between two lead user groups (seeing the similarity), sorted those ideas by a pre-defined innovation evaluation matrix, and finally clustered those ideas into several categories. The process of idea clustering was based on target user groups (e.g., for students, DINKs or disabled people), purposes (e.g., for learning or for leisure), and conditions of use (e.g., at home, at work, or at transportation); 50 ideas were selected at the end of this step.

The second step focused on building up scenarios for the selected ideas. We invited people who participated and aggressively expressed opinions during the brainstorming process to write scenarios through a group co-work approach. Referring to Kuo's et al. (2010) suggestion, a complete scenario here is required to include: the name of the product/service, value proposition, target customers, key value delivered to customers, core elements, core functions/features, time for use, the required device, inputs/outputs, and roles of image semantics. As well, to make each scenario more understandable and visualised, the research team asks for the help from painters; Figure 2 demonstrated some examples of the scenarios. By following the guidelines of content analysis proposed by Gilliland (2003), the research team tried to extract in-depth understanding on each scenario. Such in-depth information could then help highlight the core ideas, functions, and necessary conditions of those scenarios. At the end of this step, 10 to 20 value propositions for these candidate products were identified. To gather more information for the design step, the research team did not merge ideas with similar scenarios in this step.

Figure 2 Two visualised scenarios of the selected ideas of the research project

At the third step, the research team invited another two groups of lead users for collecting more user experiences through focus group interview. The invited lead users have the following four characteristics:

- 1 be heavy users of ICT products and services
- 2 be willing to spend much money on purchasing relevant new products
- 3 preferring communicating through visual-oriented manner
- 4 belong to the selected targets for at least three scenarios.

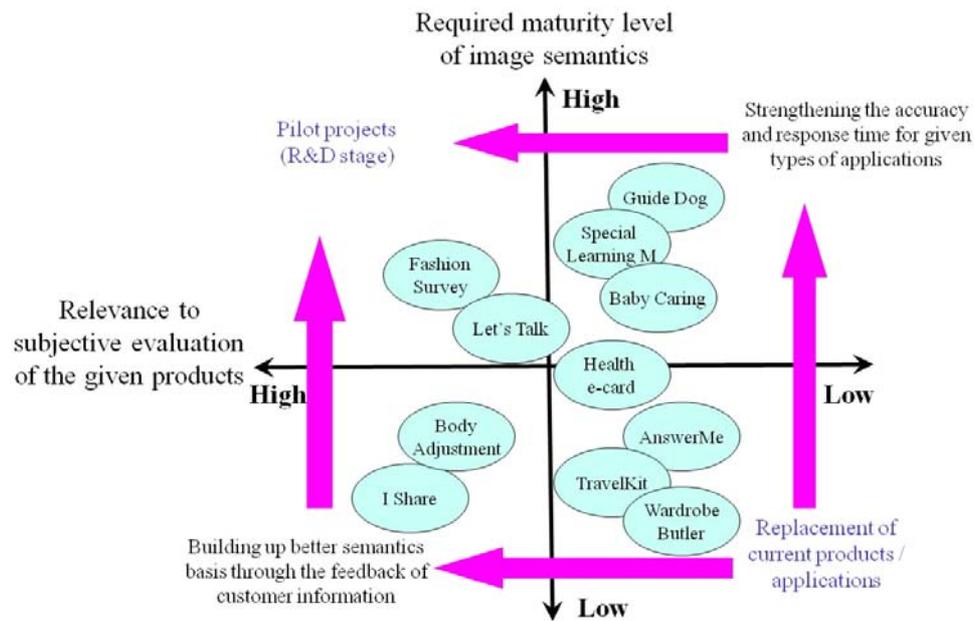
Two focus group interviews were conducted. During the interviews, the research team focused on collecting information about the preferences, concerns, willingness to pay, and intention to use from interviewees. For each focus group, participants were invited to build up their ideal products and corresponding user scenarios at the end of the section, based on the given template scenarios provided by the research team. Such a practice helps to embed the concept of value co-creation with customers inside at this step. After finishing two focus group interviews, the research team again analysed and compared the similarity, preferences, and differences at different stages and between different lead user groups. The corresponding critical factors and functions were also identified and highlighted. In this manner, the research team helped shape another type of brainstorming during this innovation process, which might be helpful for market potential validation.

The research team held a panel discussion in the fourth step. Image semantics experts from research labs and specialists from the business team highly relevant to internet or mobile industries were invited as panellists. Seven experts from different parties participated and contributed for the discussion. Comments (i.e., the willingness to take the ideas for development or commercialisation) of the panellists were taken as basis for evaluating the value of each idea.

At the final step, the research team re-investigated the suggested outcome from the panel, trying to identify the possible reasons or gaps that make ideas favourable or unfavourable. The research team then helped identify the roadmap for innovations of a given technology through identifying the key characteristics of the technology in the meantime. In our case, the research team first identified the following four characteristics as key factors in determining time-to-market of image semantic-based innovations: response time of image semantics, accuracy rate of image semantics, and readiness of devices for operating image semantic services, and completeness of ecosystem for

support. Based on requirements of each innovation, the research team then proposed the suggested roadmap and strategies in developing innovative image semantic-based products/services, as shown in Figure 3. Two routes and the corresponding strategies for developing image semantic-oriented applications and products were illustrated in this figure.

Figure 3 The proposed development strategy/roadmap for image semantics (see online version for colours)



4 Findings, contributions and implications

Making a perfect link between technology-driven innovation and user needs exploration is one of the hottest issues for practitioners as well as academia. However, such research issue is still under development. This study puts its emphasis on proposing a practical guideline for technology innovation, which helps bridge the gap between practices and concept models based on lead user method. In particular, we wish to contribute to the following two issues highlighted by Lilien et al. (2002):

- 1 developing new methods regarding to identify users holding leading-edge information of commercial value
- 2 building up new methods to obtain information from lead users and incorporate that information into commercially viable new product and service offerings.

Through an action research-based trial project, the authors finally propose an approach toward technology-driven innovation based on lead user method. In detail, the suggested revised approach is composed of six steps:

- 1 brainstorming with lead users (including both designers and intensive users)
- 2 benchmarking with ongoing pilots around the world
- 3 building up scenarios for ideas (which is helpful in highlighting the proposed targets, value propositions and required technical characteristics) and identifying key patterns by grouping ideas (through voting and clustering techniques)
- 4 validating the market needs and technical requirements through both focus group interview (with lead users) and panel discussion (with technical and business experts)
- 5 analysing the value of proposed applications and core requirements of new techniques, and form a series of innovative products that are relevant to one concept or to one target
- 6 identifying the roadmap and corresponding business models for market penetration, as well as key directions for technology development.

The proposed approach helps highlight the role of different stakeholders, as well as manners for interaction during innovation process. In particular, it helps emphasise the importance of a well integration amongst customer needs capturing, scenarios development, and business model design in new product design and development stages. According to our experience, it is found that the whole technology-driven product innovation process may be considered as a continuous interaction progress with different types of lead users. Such a progress can be then shaped as the platform for value co-creation and multi-staged validation. For instance, we can group ideas and identify possible target clusters through such an interaction process. In addition, critical functions for the technology in different ideas can be identified, thus helping technology companies realise the most possible directions for new product development even when the technology itself is not yet fully matured. Such a practice echoes concepts of value co-creation and open innovation. As well, such practice also helps enlarge the types, modes and values of brainstorming, thus helping re-identify and highlight the role and importance of brainstorming in the marketing of technology-driven innovation.

With respect to the philosophy of technology innovation, we find that the user-centric approach (or lead user, more specifically) approach works well in linking technology development and market potential through the whole research on image semantics. We thus suggest that owing to the fact that there are more and more commonalties between technology and non-technology innovation, the user-centric viewpoint may work well in this manner. Such an argument is in line with Moore's (2005) arguments on the evolution of technology innovation and Christensen et al. (2006) propositions on disruptive innovation.

If the practical issue (i.e., turning interesting ideas into the development phase) is considered, according to lessons learnt from this project, the authors suggested that once a panellist or project participant in the previous step is interested in any of the proposed ideas, it can then go through the development stage, thus speeding the time-to-market and maximising the potential of successful market launch.

When turning our focus on the implications for practitioner, the following issues are worth paying attention to:

- 1 contrary to traditional brainstorming, grouping ideas that help identify key target customers, defining core functions, and designing a series of applications (rather separate applications) are crucial
- 2 through the help of business model design and core function analysis, the disruptive innovation penetration strategy may be useful in bringing successful market launch for new technology-generated products
- 3 the strategy of bringing innovative products with more hedonic value than functional value to customers is especially encouraged.

More importantly, according to the lessons learned from the project, although the proposed approach is believed to be suitable for technology-driven innovations (at least ICT oriented innovations), we do not claim to offer a silver bullet, however. Instead, the authors suggest a contingent technology-market alignment perspective for those who are interested in technology-driven, lead user-oriented product innovation.

To conclude, the major contributions of the current study are to design a user-centric approach for technology-driven innovation, and to help identify critical issues for user-centric approach when dealing with new-technology-based product innovation. How to identify the roles, values and modes of brainstorming in marketing technology-driven innovation is especially discovered.

However, owing to the limitation of number of cases and that of industries, we suggest future studies that conduct longitudinal, quantitative analysis on image semantic applications, or apply the proposed method to other technologies, so as to generalise and validate the proposed logic framework.

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References

- Chidamber, S.R. and Kon, H.B. (1994) 'A research retrospective of innovation inception and success: the technology-push, demand-pull question', *International Journal of Technology Management*, Vol. 9, No. 1, pp.94–112.
- Christensen, C.M., Baumann, H., Ruggles, R. and Sadtler, T.M. (2006) 'Disruptive innovation for social change', *Harvard Business Review*, Vol. 84, No. 12, pp.94–101.
- Datta, R., Joshi, D., Li, J. and Wang, J.Z. (2008), 'Image retrieval: Ideas, influences, and trends of the new age', *ACM Computing Surveys*, Vol. 40, No. 2, pp.5:1–5:60.
- Gassmann, O. and Wecht, C.H. (2005) 'Early customer integration into the innovation process', *Proceedings of the 12th International Product Development Management Conference*.
- Gilliland, D.I. (2003) 'Toward a business-to-business channel incentives classification scheme', *Industrial Marketing Management*, Vol. 32, No. 1, pp.55–67.

- Henkel, J. and Jung, S. (2010) 'The technology-push lead user concept: a new tool for application identification', available at http://www.papers.ssrn.com/sol3/papers.cfm?Abstract_id=1399394 (accessed on 2011/03/10).
- Herstatt, C. and Lettl, C. (2004) 'Management of technology push development projects', *International Journal of Technology Management*, Vol. 27, Nos. 2/3, pp.155–175.
- Kuo, D.C.L., Chi, C.Y. and Yeh, B.H.J. (2010) 'iSIM: a proposed methodology for industrial-oriented service innovation', *Proceedings of the IEEE International Conference on Industrial Engineering and Engineering Management*.
- Lettl, C., Herstatt, C. and Gemunden, H.G. (2004) 'Users as inventors and developers of radical innovation', *Proceedings of the 20th Annual IMP Conference*.
- Lilien, G.L., Morrison, P.D., Searls, K. and von Hippel, E. (2002) 'Performance assessment of the lead user idea-generation process for new product development', *Management Science*, Vol. 48, No. 8, pp.1042–1059.
- Luthje, C. and Herstatt, C. (2004) 'The lead user method: an outline of empirical findings and issues for future research', *R&D Management*, Vol. 34, No. 5, pp.1–15.
- Lynn, G.S., Morone, J.G. and Paulson, A.S. (1996) 'Marketing and discontinuous innovation: the probe and learn process', *California Management Review*, Vol. 38, No. 3, pp.8–37.
- Matthing, J., Kristensson, P., Gustafsson, A. and Parasuraman, A. (2006) 'Developing successful technology-based services: the issue of identifying and involving innovative users', *Journal of Services Marketing*, Vol. 20, No. 5, pp.288–297.
- Moore, G.A. (2005) *Dealing with Darwin: How Great Companies Innovate at Every Phase of Their Evolution*, Portfolio, New York, USA.
- Morrison, P.D., Roberts, J.H. and von Hippel, E. (2000) 'Determinants of user innovation and innovation sharing in a local market', *Management Science*, Vol. 46, No. 12, pp.1513–1527.
- Newbert, S.L., Kirchhoff, B.A. and Walsh, S.T. (2007) 'Defining the relationship among founding, resources, strategies and performance in technology-intensive new ventures: evidence from the semiconductor silicon industry', *Journal of Small Business Management*, Vol. 45, No. 4, pp.438–466.
- Souder, W.E. (1989) 'Improving productivity through technology push', *Research Technology Management*, Vol. 32, No. 2, pp.19–24.
- von Hippel, E. (1986) 'Lead users: a source of novel product concepts', *Management Science*, Vol. 32, No. 7, pp.791–805.
- Yang, H.C. and Lee, C.H. (2008) 'Image semantics discovery from web pages for semantic-based image retrieval using self-organizing maps', *Expert Systems with Applications*, Vol. 34, No. 1, pp.266–279.