Accelerating customer integration into innovation processes using Pico-Jobs

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Abstract: The internet enabled new forms of crowdsourcing by introducing electronic marketplaces for services that could hardly be traded before. Market places such as Amazon's Mechanical Turk install a member base for third parties, where they can offer small, highly structured paid tasks which can hardly be solved automatically with ICT which we call *Pico-Jobs*. In this paper a new method for systematically utilizing the creative potential of the users of these market places for new product development is illustrated. We elaborate the characteristics of Pico-Jobs by reviewing leading crowdsourcing marketplaces. Our real-world case with OSRAM then pinpoints the potentials of Pico-Jobs for idea generation and validation such as the speed and the dynamic of involving customers into innovation processes. The article concludes with a discussion of potentials and limitations for companies applying Pico-Jobs. The article contributes a new concept for conducting open

innovation and shows possibilities for future research in this area.

1 Introduction

In the 20th century, many leading industrial companies generated, developed and commercialized ideas for innovations in self-reliance. Nowadays, companies are increasingly rethinking the fundamental ways of managing their innovation activities (OECD, 2008). Opening up company boundaries in order to utilize external resources for innovation activities becomes more and more important. For this emerging competitive strategy of Open Innovation customers are frequently seen as enormous potential for generating innovations (von Hippel, 2005, Kristensson et al., 2002).

In literature and practice four core practices for integrating customers into the early stages of the innovation process, where ideas for innovations were generated, are discussed. These are the Lead-User-Method, Internet-Toolkits, Ideas Competitions and Ideas Communities. The Lead-User-Method implies systematic identification of innovative customers, so-called lead users, and their integration using workshops in order to generate ideas and concepts for new products or services together with companies' employees (Von Hippel, 1988). With the help of Internet-Toolkits, customers are asked to design concepts for new products via an Internet application (Von Hippel and Katz, 2002). By conducting Ideas Competitions (Walcher, 2007) and building Ideas Communities (Bretschneider, 2010), companies attempt to collect innovative ideas from customers.

In conducting these methods, firms aim to integrate customers in the process of gaining and generating new innovation ideas in the early phases of new product development. By opening up the innovation activities to customers more perspectives and ideas for creating innovations can be gained. In other words, the amount of innovation potential that is poured into the innovation funnel is increased and hence the likelihood of developing disruptive innovation rises. Thus, utilizing the "collective intelligence" or "wisdom of crowds" of customers is the underlying principle of customer integration into innovation processes (Libert and Spector, 2007, Surowiecki, 2005). Therefore companies begin by and by to exploit this phenomenon of group intelligence in order to change the traditional way R&D departments used to function. Open innovation companies as InnoCentive, a platform on which companies can post R&D problems as challenges that are open to solve for anyone, and prediction markets as the Iowa Electronic Markets, for example, capture collective wisdom by creating networks of individuals with special knowledge and thus help companies to solve their most sophisticated scientific problems or provide accurate predictions. For instance, Boeing, DuPont, and Procter & Gamble regularly use the InnoCentive platform to find solutions for some of their most ornery product development issues. On average, more than 30 percent of the posted tasks are

being solved, which is "30 percent more than would have been solved using a traditional, in-house approach" (Howe, 2008).

On the internet a new type of market place for crowdsourcing has evolved in order to make the collective intelligence of internet users utilizable to companies. Websites like Amazon's Mechanical Turk (mturk) install a member base third parties can offer small and structured tasks which cannot be solved automatically that we call *Pico-Jobs*. In this paper a new method for systematically utilizing the creative potential of the users of these market places for new product development is illustrated on the basis of a real case.

The paper proceeds as follows: In section two our research approach is described. In chapter three leading crowdsourcing marketplaces are analysed and the tasks posted on them are defined as Pico-Jobs. Chapter four links Pico-Jobs to the innovation process and chapter five reports on a case study at OSRAM showing how Pico-Jobs can be used for generating and validating new product ideas. The results of our research are discussed in chapter six and implications for academia and practice are pinpointed in chapter seven.

2 Research Approach

In order to research the application of Pico-Jobs as a new method for integrating customers into the innovation processes this paper addresses two prevalent research questions. Firstly, what are the characteristics of Pico-Jobs and how can they used in the innovation process. For answering these questions several research methods and data sources have been combined. Due to method triangulation a detailed and holistic picture about Pico-Jobs and their application in the innovation process shall be rendered (Altrichter et al., 1996). Method triangulation comprises the combination of several research methods for explaining the same phenomenon (Denzin, 1978) and allows to enhance the accuracy and validity of the results due to overlapping research approaches (Jick, 1979).

In the first instance, leading crowdsourcing market places in the German and English speaking Internet such as Amazon Mechanical Turk (mturk) have been analysed regarding their size, the offered tasks, the characteristics of task solvers and providers as well as the process of offering jobs. Based on this analysis, the characteristics of and a definition of Pico-Jobs have been worked out. The platforms have been identified conducting expert interviews and doing Internet research in the German and English-speaking Internet. Included were all platforms that offer paid tasks and act as intermediary between job providers and solvers. For each platform 30 randomly selected Pico-Jobs were content analysed and categorised regarding their structuredness, variability and complexity (Krippendorff, 2004).

Based on this analysis a case study at OSRAM was conducted using the linear but iterative process from Yin (2009) . A case study approach was chosen in order to analyse the application of Pico-Jobs in an organizational context. In the scope of this case study several interviews with innosabi, a German innovation consultancy that is specialized in open innovation, that applied Pico-Jobs for developing new applications of LED light bulbs together with OSRAM were conducted. Moreover, the artefacts of this workshop as well as the Pico-Jobs used in this case study were content analyzed.

3 Analyses of Crowdsourcing Market Places

In this section leading crowdsourcing market places are compared regarding their size, the type of offered tasks, the characteristics of task solvers and providers as well as the process of offering jobs in order to work out the characteristics of Pico-Jobs. In table 1 a brief overview of the investigated platforms is given.

Table 1 Investigated crowdsourcing marketplaces

	Mturk	*Clickworker*	*Bitworxx*	*Shorttask*	*Livework*	*Klickwork*
Origin	USA	Germany	Germany	USA	USA	Germany
Online since	2005	2009	2008	2009	2009	n.a.
Members	>400000	>4000	>10000	>20000	>53000	n.a.
# Jobs	>100000	>1500	n.a.	>100000	>50000	n.a.

Source: www.mturk.com; www.clickworker.com; www.bitworxx.com;
www.shorttask.com; www.livework.com; www.klickwork.com

The **jobs** on the investigated market places comprise of a high thematic variability reaching from tagging and categorizing photos, any kind of content creation, market research, translations to responding surveys. According to Laux/Liermann (2005) tasks can generally be characterized regarding their structuredness (degree to which tasks can be broken down into independent solution steps that are required to solve a task), variability (amount of changes that are required to solve a task) and its complexity (amount of decision problems and decision variables that have to be taken into account solving a task). A typical job that can be found on the crowdsourcing marketplaces comprise of categorizing content such as websites or photos (cf. figure 1).

Figure 1 Task posted on Mturk

Source: www.mturk.com (assessed on 21.04.2010)

As shown in this example, most jobs consist of only one or very few steps in order to get successfully completed. Due to this reason, the jobs are very structured. Moreover, the job solvers have to repeat the same task very often to accomplish the job. Thus, variability of the jobs is rather low. Due to the high structuredness and the low variability, the results of the jobs are generally well defined. The task's target groups vary vastly. Whereas some tasks address only a single person or a small group of persons with very specific skills (e.g. in case of English-Chinese translations of technical manuscripts), others address a large crowd of task solvers (e.g. in case of tagging photos). Task

complexity is strongly depending on the platform on which the jobs are posted. On mturk most tasks have a low degree of complexity. However, on other platforms such as livework task complexity is higher with tasks deriving from auditing, healthcare or legal.

Table 2 Characteristics of the jobs posted on crowdsourcing marketplaces

	Mturk	*Clickworker*	*Bitworxx*	*Shorttask*	*Livework*	*Klickwork*
Structuredness	high	medium-high	n.a.	medium	high	medium
Variability	low	Low	n.a.	low	low	low
Complexity	low – medium	medium – high	n.a.	low	high	low – medium

Source: www.mturk.com; www.clickworker.de; www.bitworxx.com; www.shorttask.com; www.livework.com; www.kickwork.com

The **process** of solving jobs is quite similar on all investigated platforms. Generally, all job solvers can pick the jobs they like to process from a central idea pool in which all open jobs are stored. The same tasks are generally processed simultaneously and independently by several job solvers. For each successful completion, job solvers get money or points equalling money credited to their user accounts. In case a certain amount is reached, e.g. USD 10 in case of mturk, the money can be transferred to the user's bank account. Usually, the job solvers receive a couple of cents for each task – money is earned due to repeating the same tasks very frequently. In the above mentioned example in figure 1, the job solver receives USD 0.01 for each product that has been categorized correctly with more than 160.000 products to categorize.

All platforms employ a quality assurance system consisting of an approval rate and qualification tests. Job providers can require job solvers to have certain qualifications that are needed in order to process a job. On mturk there are 3088 different qualifications that job solvers can achieve such as *automotive categorization qualification test*, *BTTS English/French fluency - L1 translator* or *audio transcript verification* that is defined as "a qualification for correctly rating the quality of an audio clip and its transcript for use in speech recognition training" (mturk 2010). Job solvers have to pass well defined qualification tests in order to achieve these qualifications. Job providers can rely on already existing qualifications or define new qualifications they want their job solvers to have. Moreover, job providers can reject the results of the job solvers after job completion in case the work is of poor quality. For each job solver an approval rate that is usually defined as the ratio of successful job completions is calculated. Besides qualification tests job providers can require a minimum approval rate for the employed job solvers.

Regarding posting jobs two major patterns can be found. Most platforms offer description forms which contain a job description, required qualifications, the job solver's remuneration and other job related information. On these platforms job providers have no constrained solution space so that the task can be defined totally free by the job providers. In contrast Bitworxx offers a set of well defined tasks to job providers. In this regard, this platform is more comparable to a traditional service company that sells services that are delivered by the job solvers.

The **job solvers** are usually private persons. According to Villaroel/Tucci (2009) mturk members are predominantly female (about 59%), employed (about 71%) and well educated: 64% of respondents have a college degree or higher. Their professional background spans various industries, e.g. ranging from scientists, to lawyers, engineers, and teachers. According to mturk about 46% of job solvers are Americans and 34% are Indians. Most job solvers are motivated by earning money and fun. Another reason for participation is spare time (Villaroel and Tucci, 2009). However, another interested target group is reached by the German platform Bitworxx: besides private persons the jobs are offered to call center employees in order to utilize over capacities.

The **job providers** mostly comprise enterprises and freelancers. Private persons post jobs only occasionally. The content analysis of the investigated jobs revealed that job providers span various industries, albeit IT-related industries are dominating.

Summing up our analysis, three major characteristics of the offered jobs can be defined:

(1) The jobs are small, highly structured, repeatable and yield a well defined result.
(2) The jobs are processed asynchronously and distributed for remuneration.
(3) An online platform acts as financial and operational intermediary between job solvers (usually private persons) and job providers (usually corporations) and defines the process of cooperation.

Synthesizing the three major characteristics of the jobs posted on crowdsourcing marketplaces we define them as *Pico-Jobs*: repeatable, highly structured, small tasks that are processed asynchronously and distributed for remuneration via intermediary platforms on the Internet.

4 Application of Pico-Jobs in the innovation process

Pico-Jobs as an application of crowdsourcing can support external input in innovation processes, from problem definition and environmental analysis, idea generation as well as idea and concept evaluation.

According to Howe (2008), the notion of crowdsourcing encompasses a number of different approaches, which vary according to the nature of contributions made by the crowd. For this reason, the choice of an appropriate model or a combination of models primarily depends on company's needs and goals to be achieved via a crowdsourcing initiative. Crowdsourcing activities can be subdivided into crowd wisdom, crowd creation, crowd voting, and crowdfunding.

The major idea driving crowdsourcing and in particular its **Crowd Wisdom** model is that groups of people accumulate more knowledge than single individuals. "The crowd possesses a wide array of talents, and some have the kind of scientific talent and expertise that used to exist only in rarefied academic environments" (Howe, 2008). This aspect of crowdsourcing is often also called collective intelligence (Bonabeau 2009). Crowd Wisdom implies that the crowd is a source of creative energy and thus can be highly useful for such activities as producing effective TV commercials, making language translations, or improving audio components. Examples of Crowd Creation with Pico-

Jobs are translating texts, writing product descriptions, as well as describing and tagging pictures.

Crowd Voting is another category of crowdsourcing, which "uses the crowd's judgements to organize vast quantities of information" (Howe, 2008). Evaluations of alternative designs or ideas for concepts represent examples of Pico-Jobs for crowd voting.

While the Crowd Wisdom model focuses on aggregation of widely dispersed information with its subsequent utilisation and therefore disregards communication within individuals, **Crowd Creation** "involves cultivating a robust community composed of people with a deep and ongoing commitment to their craft and, most important, to one another" (Howe, 2008). Pico-Jobs for utilizing Crowd Creation allow companies to gather customer inputs, consolidate and evaluate these inputs very fast, in order to flow those findings back into further Pico-Jobs. Companies can use Pico-Jobs to react very fast to dynamics in innovation processes by many, short feedback cycles, e.g. for generating an understanding of customer perceptions or identifying applications for new technologies. For improving an existing product, companies can e.g. ask customers firstly for an emotional evaluation of the existing product, secondly how they actually use the product, and thirdly for ideas of novel applications. In every step, inputs from the previous step of all participates – so called crowd - can be recognized.

The fourth model of crowdsourcing is **Crowdfunding**. "Crowdfunding taps the collective pocketbook, allowing large groups of people to replace banks and other institutions as a source of funds" (Howe, 2008). Compared to the other three models of crowdsourcing, crowdfunding is not relevant in the context of Pico-Jobs.

Crowd Wisdom, Crowd Voting as well as Crowd Creation can be utilized by Pico-Jobs for innovation processes. We suggest analyzing each phase of the innovation process in order to identify opportunities of using crowdsourcing with Pico-Jobs. Our analysis is based on the innovation process of Tidd and Bessant (2009), which consists of four phases:
- Search – how can we find opportunities for innovation?
- Select –what are we going to do – and why?
- Implement – how are we going to make it happen?
- Capture – how are we going to get the benefits from it?

In the phase of **Searching**, companies are scanning their internal and external environment for relevant signals about threats and opportunities for change. Pico-Jobs can here help to use crowd wisdom to identify those signals by asking corresponding questions about needs, beliefs or change of customers' behaviour. In addition, information about usage of and experiences with existing products as well as suggestions for improvement can be used by companies as signals. All information can be gathered by Pico-Jobs. Furthermore, companies can use Pico-Jobs to find people around the world to research for specific, especially local, information. Crowd creation and crowd voting is not yet applicable in this innovation phase because companies do not even know what they will innovate. Main contribution of Pico-Jobs in this innovation phase is to understand the customer.

In the next phase, **Select**, companies decide on the basis of strategic view which of these signals to respond to. Here again Pico-Jobs can utilize collective intelligence for generating and evaluating possible innovations. On the one hand, Pico-Jobbers can generate own ideas for innovations, and on the other hand, Pico-Jobbers can evaluate or comment ideas from experts. Crowd voting is a great possibility to get feedback from Pico-Jobbers about innovation ideas and to support the selection process during the Select phase. Focus is on discussing with customers.

Implement is the third innovation phase and contains translating the potential in the trigger into something novel and launching it. The greatest potential for Pico-Jobs in this phase is crowd voting. Experts can give Pico-Jobbers the possibility to vote and comment on designs and prototypes. Other crowdsourcing market places like InnoCentive are more useful for those tasks. In summary, companies can provide customers the possibility to participate in decision making about the solution.

The last phase of the innovation process is called **Capture** and focuses on how companies are going to get the benefits from the innovation. Thereby, Pico-Jobbers can mostly contribute through content creation. The innovation is already launched and must be enhanced continuously. Pico-Jobbers can help e.g. with translations, generating content on websites or forums, writing recommendations of products or tagging pictures.

The following table summarizes the opportunities of Pico-Jobs across all phases of the innovation process.

Table 3 Potential of Pico-Jobs to integration customers in innovation processes

Innovation process following Tidd and Bessant (2009)			
Search	**Select**	**Implement**	**Capture**
- Needs, beliefs - Perceptions - Experiences with existing products - Suggestions for improvement - Information about usage - Evaluation of ideas other Pico-Jobbers - Evaluation of ideas of experts - ...	- Suggest ideas for innovation - Evaluate or comment ideas for innovations - ...	- Voting of designs - Voting of prototypes - ...	- Conducting translations - Generating content - Writing recom-mendations - Tagging pictures - Describing products - ...
Main opportunities of Pico-Jobs			
Understand the customer	Discuss with the customer	Participate the customer	Integrate the customer
Esp. Crowd Creation	Esp. Crowd Creation and Voting	Esp. Crowd Voting	Esp. Crowd Wisdom

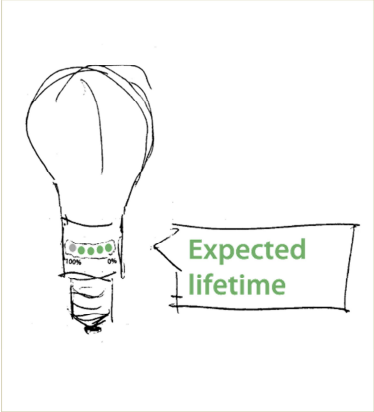## 5 Using Pico-Jobs in practice at OSRAM

Innosabi applied Pico-Jobs for developing new applications for Light Emitting Diode (LED) based light bulbs at OSRAM, a leading manufacturer of light system solutions. In contrast to traditional incandescent light bulbs, LED bulbs do not create light by a glowing wire. LED light bulbs have a common shape but comprise of several LEDs on the inside. The LED technology results in longer lifetimes and smaller energy consumption. Moreover, LED enables wholly new lightning applications such as smart light applications adapting to their environment (Schubert and Kim, 2005). However, developing new applications for light bulbs is difficult as customers are very price sensitive and alternative lightning solutions as energy saving bulbs are frequently suffering from a bad image (Diekmann and Preisendorfer, 2003).

For these reasons, OSRAM engaged in integrating customers into the development of new applications for LED-based light bulbs. In the first instance, Pico-Jobs were used to get a deeper understanding of how customers use light bulbs in general and how different types of light bulbs are perceived. Therefore, Pico Jobbers were asked to describe situations in which they directly interact with light bulbs. For solving these Pico-Jobs an approval rate of 98% was rewired as qualification. In return, Pico-Jobbers earned betweeb USD 0.10 and 0.50 for each completed Pico-Job. Moreover, Pico-Jobbers were rewarded with a bonus of USD 0.50 for outstanding work. Due to this surplus, fast response times and high quality of results could be warranted.

The results of these Pico-Jobs were content analyzed and used to deduct assumptions about usage patterns of light bulbs. These assumptions were again translated into Pico-Jobs and placed on mturk. Using this storytelling approach with a magnitude of iterations a holistic comprehension of the needs and the associations of light bulb users could be gained (Zaltman, 1997). Altogether about 150 Pico-Jobs were posted and 1889 responses be gained. Content analyzing these responses, a model for explaining usage behaviour and perceptions of lightning bulb customers could be gained. Based on this model search areas for new LED applications were defined. For instance, a magnitude of customers stated that they are frustrated with light bulbs going broken, because light is generally needed in the moment the light bulb burns out.

In a second step, these search areas such as "avoiding customer frustration" were used as starting point for a brainstorming workshop with marketing and R&D employees of OSRAM in order to generate new product ideas that highlight the benefits of LED bulbs. For instance, several ideas for light bulbs displaying the light bulbs remaining life time were developed. During the workshops all developed ideas were instantly evaluated using Pico-Jobs resulting in 50 to 100 evaluations for each idea. These validated ideas then were used as stimuli for refinement of the ideas and generation of new ones (cf. Table 4)

Table 4 Example of a Pico-Job and corresponding answers

Pico-Job	
Answers	*"OMG!! I would love this bulb. I am caught without bulbs sometimes and I think this would actually make me remember to get some." (anonymous Pico-Jobber)* *"Maybe a visual change in color, that the light bulb emits when it is getting close to expiration would be better"(anonymous Pico-Jobber)* *"Why would I want to grab a ladder, remove a fixture cover, and check my bulbs on a regular basis when it's much easier to wait until one requires attention?" (anonymous Pico-Jobber)*

According to OSRAM the results developed with this Pico Job approach (cf. figure 2) provided high value for the entire new product development process and allowed an effective integration of a magnitude of customer responses.

Figure 2 Application of Pico-Jobs at OSRAM.
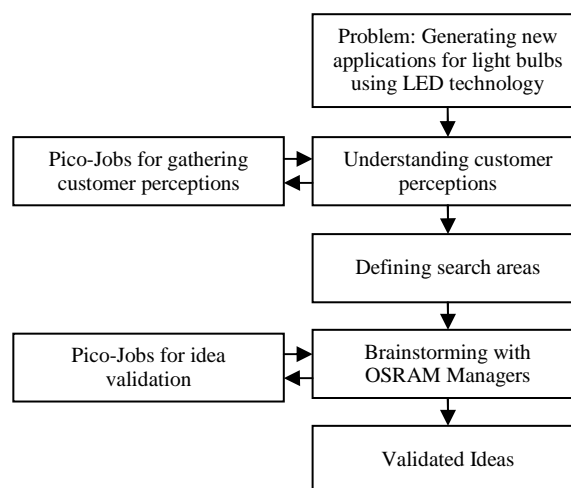
6 Discussion

The case illustrates Pico-Jobs as a new phenomenon for customer integration into innovation processes. On the one hand, several advantages emerge for companies and job providers. Firstly, the amount of time could be radically reduced. In comparison to web based idea competitions (Blohm et al., 2010, Ebner et al., 2009, Leimeister et al., 2009) or surveys, only very little amount of time and costs for pre and post processing incur for the job provider. Secondly, the job provider gets the results quickly due to a very short response time of the job solvers. In our case more than 100 answers could be gathered within a couple of hours. Thirdly, Pico-Jobs reduce the cost risk to a minimum, because no overhead costs incur for the job provider and one only has to pay for useful inputs exceeding a minimum quality defined by the job provider. Fourthly, the job providers don't have to reveal their identity and the single Pico-Jobs are fragmentized so that third persons cannot estimate what the job provider is working on. Due to this reason as well as the remuneration intellectual property can easily be transferred to the job provider. Furthermore, job providers get access to a big group of customers, which results in a variety of inputs from many different perspectives. On the other hand, a high variance of input quality resulting in high efforts for data analysis and self-selection effects of job solvers seem to be limitations of Pico-Jobs. Especially Pico-Jobs for crowd creation bear the risk of imprudent and untrue answers because on the one hand it is difficult to verify them and on the other hand Pico-Jobbers are interested in solving as many jobs as possible to maximize their remuneration. There are also some disadvantages for the job solvers. They often can only choose from simple and click-based tasks and are sometimes poorly paid. Otherwise, Pico-Jobs offer also advantages for job solvers. They get the opportunity to work from home, choose their own working hours, get paid for doing good work and can choose out of many different tasks.

Bonabeau (2009) emphasized various biases that can be reduced by the use of crowdsourcing applications: On the one hand people tend to seek information that confirms their assumptions and to maintain those assumptions even in the face of inconsistent evidence by generating solutions. On the other hand, in matters of the evaluation of solutions, people tend to perceive patterns where none exist and to exorbitantly influence by the presentation of the solution. The case shows that Pico-Jobbers mitigated those and further biases e.g. by obtaining diversity of assumptions, anchors and beliefs.

7 Implications

Our research shed light on the phenomenon of Pico-Jobs and their application in innovation processes for the first time. The case demonstrated the applicability and practicability of Pico-Jobs for innovation processes. However, there are still open issues to be solved. The following research questions refer to different aspects of Pico-Jobs that are still unsolved: Which types of task are applicable for Pico-Jobs and why? How should tasks be broken down for Pico-Jobs? How can results of Pico-Jobs be combined and consolidated towards a valuable result for innovation processes? What is an appropriate setting of Pico-Jobs to ensure multiple iterations (input-output constellation)?

8 Conclusions

Pico-Jobs are a new application for open innovation and utilizing crowd wisdom, crowd creation and crowd voting for innovation processes. Typically, Pico-Jobs focus on content generation in the Capture phase of the innovation process, e.g. tagging pictures, describing products or translating texts through Pico-Jobbers. Our case illustrated the potential of Pico-Jobs for crowd wisdom and crowd voting in the earlier innovation phases.

Two of the main benefits of Pico-Jobs are the fast response time and low costs for pre and post processing. Both help companies by integrating customer insights more frequent into their innovation processes in order to get fresh ideas or shorten feedback cycles. Both aspects help companies to handle dynamics of innovations.

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