TOWARDS A NEW FORM OF IDEAS CONTESTS IN HIGH-TECH ENVIRONMENT: DESIGN COMMUNITY BUILDING IN DOUBLE UNKNOWN

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Abstract:

Following the open innovation paradigm, many technological firms organize idea contests to surface bright ideas for new products, services or business models. This article focuses on a new form of innovation contest: the generic technology idea contest, which aims to design technological platforms that can enable emerging applications in various business domains to be economically addressed. Based on the analysis of a series of innovation contests conducted by STMicroelectronics, this research points out main elements of the generic technology ideas contest: challenge initiation, idea generation and collection, genericity identification, enrichment and its reward system. The findings indicate that such innovation contests do not fundamentally establish commercial relations between seekers and solvers as usually described in the literature. Rather, this type of contests aims to build design communities who are able to collectively explore the potential of technological platforms. Managerial recommendations, key mechanisms for enhancing the genericity of ideas and probing questions are formulated to facilitate the organization of generic technology innovation contests by high-tech firms.

Keywords: innovation contests, creativity, generic technology, co-design, double unknown, institutional logic

1. Introduction

Organizing ideas contests (ICs) to attract contributions from wide-ranging participants has become more and more popular. To discover new ideas for future business and R&D effort, technological firms often organize internal brainstorming sessions (Schulze and Hoegl, 2008), crowdsourcing with universities (Perkmann and Walsh, 2007), industrial partners (Eickelpasch and Fritsch, 2005) and potential customers such as BMW (Füller and Matzler, 2007), IBM (Bjelland and Wood, 2008) and Siemens (Schepers et al., 1999). ICs are widely deployed in industrial contexts, and so have gained increasing interest from economic and management scholars (Adamczyk et al., 2012).

Technological firms and ideas contests in which organizers attempt to overcome particular technological lock-ins or open up new application areas have a long common history: we mention just few examples. In 1913, the International Association of Recognized Automobile Clubs announced in Paris that they were offering a prize of $100,000 (nearly $2.5 millions nowadays) for the best fuel (other than gasoline) to use in internal combustion engines in an effort to address the rapidly increasing price of gasoline by interesting chemists developing “a fuel which cannot be rigged or cornered by any nation or combination of national interests”. In 1959, the physicist Richard Feynman offered prizes of $1,000 for the development of the first motor measuring less than 1/64th of an inch on each dimension, and for the first text written at 1/25,000th scale (see (KEI, 2008)).

This paper focuses on idea contests in the case of ‘double unknowns’. Double unknowns (or ‘unk-unks’ (McGrath, 2001) or unforeseeable uncertainties (Pich et al., 2002)) are high uncertainty situations in which neither technologies nor markets are yet known. This does not mean, however, that technological development starts from a green field: rather, in many cases, a profusion of potential technologies are evolving from existing, known seeds. But how they should be developed, which factors really matter, are quite unclear, so that, even if a panel of likely technological candidates can be predefined, the technology is still considered unknown. Markets are likewise unknown, due to the extremely low probability of success. In such cases, of highly uncertain exploration, both usage and technical domains are unstable (Gillier and Piat, 2011).

While such double unknown situations are difficult to manage (Eisenhardt, 1989; Hillson, 2010), they open the possibility of designing technological platforms for emerging market needs. This paper employs the definition of a platform as "a set of subsystems and interfaces developed to form a common structure from which a derivative products can be efficiently developed and produced", echoing those proposed by (Gawer, 2010; McGrapth, 1995; Muffatto and Roveda, 2002). Such platforms allow generic technologies (GT) to be built where the latest can create value across a broad range of applications (Bresnahan and Trajtenberg, 1995).

This article aims to examine the use of ICs in the specific case of double unknown situations via which firms aim to pursue the development of GTs. Surprisingly, the literature on ICs provides few recommendations regarding the double unknown situations. Innovation contests are often organized either in situations where the technological aspects are considered as being known, or users or markets as having been identified. For example, the case where both market and technological uncertainties are high is not represented in the IC typology proposed by (Terwiesch and Xu, 2008) (Figure 1). The literature usually defines the IC as an exchange between a seeker who faces an innovation-related problem and offers an incentive award and a solver who provides the best solution. From this economic perspective contests in double unknown give any value promises neither for seekers nor for solvers.

Our findings indicate that the idea contests in double unknown situations can exist if it follows an institutional logic (Coriat and Weinstein, 2002; Kanter, 2011). Institutional perspective determines the social context in which the various agents operate. These actors can be individuals and groups (Hartley et al., 2002). Institutional theory emphasizes that the organizations are more that just a means to produce goods and services, they represent also social and cultural systems. Suchman (1995) pointed out that the actors in this case do not just compete for resources but also seek legitimacy. They appear as “vehicles for accomplishing societal purposes and providing meaningful livelihoods for those who work with them” (Kanter, 2011). This logic could help us to gain the insight on the premises of the ICs in double unknown and define the appropriate form for the ICs targeting the design of platforms that enable the development of GTs.

The paper is organized as follows. The first part clarifies the specificities of GT development, and more precisely the particularities associated with platform design. It then continues with an overview of the organization of idea contests in technological contexts, and goes on to outline more fully the problem of organizing and defining ICs that result in the development of GTs and their incubation in high-tech firms. An analysis framework is built based on the main criteria of IC in high-tech firms, and the difficulties and specifics of idea contests appropriate for developing GTs are then considered. Given the exploratory nature of this research, a case study approach was chosen, and research questions derived from the literature are investigated empirically by analyzing the case of a series of ICs organized by the semiconductor manufacturer STMicroelectronics. The semiconductor industry is particularly relevant for this investigation, as it often has to engage in double unknown explorations, and the pervasiveness of their use makes semiconductors a prime example of general-purpose technologies (Miyazaki, 1994; Olleros, 1986; Wessner, 2003). This study establishes a new IC process that focuses on building generic technologies and enables the transformation of individual ideas into new technological platforms. Overall, this paper proposes a way to encourage joint exploration of the technological and the market domain by introducing the concept of ICs for generic technologies. The originality of these contests appears in creation of coalitions that collectively explore and prepare future generic technologies exploration by mutually improving the quality of submissions.

2. Theoretical background and hypothesis. Ideas contests in high-tech firms

This section begins by laying out the theoretical dimensions of the research. The first part deals with the features of GT development in double unknown situations, and demonstrates the importance of ICs pursuing GTs. The second part presents a review of the existing literature regarding ICs in high-tech firms. Two forms are described: user- and technology-driven ideas contests (UIC and TIC respectively). Finally, this part considers the limits of the classical ICs for GT development and deduces research questions.

2.1. Creation of generic technologies by platform design

Generic technologies have been defined as technological platforms whose exploitation can "yield benefits for a wide range of sectors" (Keenan, 2003). GTs are more likely to emerge in fast-paced dynamic environments (Cantwell and Qui, 2009; Maine and Garnsey, 2006; Miyazaki, 1994): semiconductors, biotechnology, electricity, nanotechnology are domains which are *a priori* well positioned to take advantage of GTs, given their wide industrial application areas, technological diversity and rate of scientific breakthroughs (Bresnahan and Trajtenberg, 1995; Moser and Nicholas, 2004; Shea et al., 2011; Youtie et al., 2008).

Various benefits of GTs to new companies who develop and exploit such technologies have been noted, among them: the flexibility to extend the scope of initially considered market applications, including to markets of various maturity levels and across various domains; to share risks and decrease R&D costs between several applications; and to help attract venture capital and large corporate investment (Maine and Garnsey, 2006; Shane, 2004). For instance, suppose there are 20 independent niche markets, each of which has a 20% probability of emerging. The probability of at least one market emerging at the end is equal to $1-(1-0.2)^{20} \sim 0.98$. Thus, if there is a platform that addresses parts of all these markets, its applicability is virtually guaranteed (with a probability of 98%) to emerge in at least one market. By exploring GTs, companies could design solutions suitable for several uses, and so increase company benefits, making the development and diffusion of GTs a key area of their strategy interests.

The literature on generic technologies mostly deals with those GTs that already exist, and prior research has mostly focused on their dissemination and commercialization, providing extensive analyses of GTs from an *ex post* perspective, i.e., once the technology has been shown to be generic, commercialized and its value been acknowledged. For instance, David (1990) indicates that the dissemination of electricity was driven by the invention of the dynamo, which promoted the development of light bulbs and electric motors, and innovations in plant and urban design. This research proposes dealing with GTs at an earlier stage – by studying the design of novel GTs themselves.

For GTs to gain wider diffusion, and thus greater market penetration, their adaptation must be cost-effective, i.e. reach certain levels of efficiency so that they trigger further innovations (Youtie et al., 2008). In this case, their exploration is no longer grounded on a single root technology, but rather involves creating and managing technological interdependencies, so that the initial generic technology gives birth to a richer technological platform (Tierney et al., 2013). In this process, the role of platform owners becomes crucial in encouraging platform adaptation (Rochet and Tirole, 2003) and flexibility, so that its application to another domain does not involve a complete and costly redesign.

Novelli (2010) named two pre-conditions for building a successful generic technological core: that it is based on scientific principles that pave the way for the development of additional knowledge that will enrich the technology; and that it encompasses multiple distinct technologies that can be combined in various ways to catalyze subsequent development. Generic technologies are more likely to emerge in the case of high-tech companies with advanced internal R&D centers, joint explorations with R&D partners and diversified technological portfolios.

Still, the exploration process for developing generic technologies is often unclear. As Gambardella and McGahan (2010) suggest, businesses problems can arise from the lack of techniques for effectively designing and putting GTs to use, which can require both overcoming existing technological lock-ins and simultaneously investigating new uses. Subsequent challenges include how to transform an emerging technology into a future GT, and how to organize a development process that can broaden the technology's genericity.

2.2. Innovation contests: the special case of GT in double unknown situations

2.2.1. Innovation ideas contests – analysis framework

Idea contests are organized to explore both new uses and new technologies. Terwiesch and Xu (2008) argue that ICs can be modeled as mechanisms by which a seeker (a company, a research center, an ecosystem of actors) facing an innovation-related problem broadcasts the problems to potential solvers, and offers a reward to whoever comes up with the best solution. Various types of systems for managing such ICs exist, including anonymous online contributions, employee-driven idea systems, web-based idea collaborative contests, innovation tournaments organized within or beyond companies, crowdsourcing with external collaborators (Gorski and Heinekamp, 2002).

The literature identifies the following elements of IC organization: challenge initiation, idea generation and selection, idea development (Bjelland and Wood, 2008), while Malone et al. (2009) determine the ideation phase as including organization, collection and collaboration; the phase of ideas selection; and their incubation processes. Regarding challenge initiation and idea collection, Jeppesen and Lakhani (2010) emphasize need for openness in innovation challenges, and demonstrated that broad participants' involvement can offer considerable benefits. Terwiesch and Xu (2008) give insights into the problem solving efficiency of idea contests focusing on costs and the number of problem solvers, demonstrating that the applicability of the type of challenge vary according to technological and market uncertainty. Moreover, the authors demonstrate that the award system should take into account the type of the innovation problem that seekers face. Levels of managerial support, resources and awards, competitive or collaborative environments can influence participants' motivation and the final results of the challenge (Bullinger et al., 2010; Neyer et al., 2009). The advantage of ideas contests to support new business development at the early stages is widely underlined in the literature.

Evaluation criteria need to be established for the idea selection phase, and various criteria have been suggested: Poetz and Schreier (2012), for instance, report an example where the quality of ideas was measured according to their novelty, customer benefit and feasibility. The idea development or incubation phases then seek ways to create better value from the ideas, by exploiting them either externally and internally (Alexy et al., 2012).

2.2.2. Innovation ideas contests in technological contexts: user- and technology-driven ICs

Our literature review enabled us to distinguish two types of ideas contests organization in technological contexts: user-driven (UICs) and technology-driven contests (TICs) (see Figure 1).

UICs are generally open to large audiences, and so have also been labeled "crowdsourcing" (Penin and Burger-Helmchen, 2011). The themes are often broad, simple and easily comprehensible, and the technological principles involved, their limits and advantages are often well-known in advance. Kristensson and Magnusson (2010) argue that it is better to avoid prescribing technical details *ex ante* if users' imaginations are to be stimulated. In this case the exploration process aims to re-use the principles underpinning an existing technological portfolio to create new uses and functionalities (Stopford and Baden-Fuller, 2006). In this manner, Bluetooth hold an annual contest to generate new product ideas that use Bluetooth v4 in conjunction with low energy technologies. The 2012 winner created the CoreMD device, which can sense temperature, heart rate, or interstitial glucose, alert the user that a certain threshold has been reached, and even administer drugs such as insulin, glucagon, or amylin (Bluetooth, 2012). User ideation contests (UICs) target a list of new product offers, new applications that the seeker can develop using existing technological solutions. UICs are often launched during the fuzzy front end phase of new product development (Reid and De Brentani, 2004) where a technology is pre-defined, and the uncertainty is in the possible markets, so the aim is to identify previously unexploited market applications: thus deploying a ‘technology push' logic (Linton and Walsh, 2008). The challenge in such ICs is to find new market functionalities, new uses, to offer new products to existing markets, or even to develop new products which will create new markets: managerial support mostly concerns challenge evaluation and creating a competitive atmosphere.

The openness of such contests is high in order to find wider functionalities, so the requirements for entering the competition are low (Dahlander and Gann, 2010). For instance, Magnusson (2009) showed that pioneering users’ ideas can bring higher user value and originality, and can even break the dominant logic of a company. Once the idea collection process is over, the competition support team evaluates the ideas based on classical value management criteria (e.g., Net Present Value, probability of success), and those selected are developed during an incubation period. Still, solvers experience uncertainty in seekers taste, in their preference. Rewards can take various forms: financial rewards in the case of crowdsourcing, increased reputation in the relevant user community, or even the possibility of employment as part of a new product development effort to commercialize the idea (Piller and Walcher, 2006). User ideation often solves problems in the short-term, offering high number of incremental and achievable innovations: the results will depend greatly on the users abilities and proficiency (Heiskanen et al., 2010). There is risk of choosing a technology that will not generate enough applications and results, and in developing functions, which are too specific and cannot be reused to address a wide range of other needs. 'Ideas from the crowd' are often criticized for their immaturity and low degree of elaboration, or even because the solutions proposed are too far from the companies' existing strategies (Bayus, 2012; Magnusson, 2009). Penin and Burger-Helmchen (2011) have shown that crowdsourcing can be best applied when a problem can be clearly defined and the solution legally protected. UICs resemble the "ideation project" suggested in (Terwiesch and Xu, 2008) framework which deals with uncertainty in the performance function - on whether or not the user/seeker will like the solution (see Table 1 for UIC description).

The second type of idea contest (TICs) entails more technical investigations. When it comes to high-tech exploration areas the problem complexity increases, since innovations in such areas often require specific technical expertise to recognize and exploit ideas, so such contests are usually restricted to narrower audiences. These are expert-based challenges, which aim to upgrade – perhaps significantly - the technologies currently applied to given applications or contexts, or even to solve technological lock-ins. This resembles (Terwiesch and Xu, 2008) model of trial-and-error project which seeks solutions to well-defined problems, where there is high technological uncertainty about whether the solutions will work. In TICs solvers cannot anticipate performance of future solutions, the landscape appear to be extremely rugged and experimentation is required.

For instance, a contest was organized in the well-known global innovation marketplace InnoCentive, to identify a method or technology that could accurately detect and locate small losses of pressurized fluid from supply networks (Innocentive, 2012). In this case, the context parameters were fixed, and the aim of the challenge was to discover new technology features which could open new market opportunities or improve existing applications. Likewise, NASA launched a new open innovation challenge to find a solution to maximize the amount of solar energy that the International Space Station could harvest: the challenge was open to anyone, with a $30,000 award to the winner (Bratvold, 2012). In these examples, the seeker pursued new technological solutions to resolve identified problems: both the field of exploration and the future uses of the discovered technology were already known.

The aim of TICs is to develop technological prototypes, obtain proof of concepts for market applications or contexts of technological uses that are specified in the challenge. The goal is to find more robust and better performing solutions, and the logic can be seen as 'market pull' (Brem and Voigt, 2009) – as exploration to find the most suitable technology to address market needs. The uncertainty is in the technology, and the process can be formulated as: given defined market areas and scopes of use, the seeker aims to discover new technological principles that can lead to new technical solutions or can significantly improve the performance of existing ones. For instance, the seeker in one InnoCentive Challenge - United Healthcare - desired prototypes of novel combinations or modifications ('mods') of existing, off-the-shelf technologies (including computer software and smartphone applications) that could be used to motivate people to make healthier lifestyle choices and/or help manage chronic health conditions more effectively (Innocentive, 2013). Since new or updated technological solutions need to be developed, these challenges require more specific expertise, so the openness of the contest low. Due to the need for proof (via demonstrations or prototypes), the duration of the challenge is also usually longer. The goal is to discover more innovative and higher performing technologies at reduced development cost to the seeker (Baldwin and von Hippel, 2011; Moseson et al., 2012), and the support team evaluates the ideas based on performance and robustness criteria. The incubation phase consists of technology development (See *Table 1* for TIC description).

Insert Figure 1 about here

2.2.3. Towards a new logic for ICs in case of double unknown: form economic to institutional perspective

The classification of innovation challenges adopted in this study corresponds to that proposed by (Terwiesch and Xu, 2008), who defines three types of projects according to the market and technological uncertainty facing the seeker: trial-and-error (similar to TIC), ideation (UIC) and expertise-based projects (Figure 1). The expertise-based challenges are relevant when seekers and solvers have similar beliefs. According to (Terwiesch and Xu, 2008), in this case seekers face uncertainty regarding the future performance of proposed solutions.

We are interested in identifying a type of IC that is adapted to the case when both markets and technologies are highly uncertain (unknown), which have not yet been analyzed in the literature. In this double unknown situation, ICs need to cope with situations of simultaneously unstable markets and technologies, and where both dimensions are likely to be evolving at the same time (Gillier et al., 2010). Thus it is hard to predefine desired technological principles so as to involve users in the ideation process from the beginning (as in UIC – see Table 1), and user involvement is also tricky in high-tech contests due to the lack of understanding of future uses for identified technologies. For instance, it would have been difficult to foresee how the piezoelectric vibration principle could be used to deliver a haptic feedback featured in various tablets and smartphones, or the light emitting polymers now widely deployed in flat panel organic light emitting diode (OLED) displays. To predict such outcomes would have required very high levels of expertise in both marketing and technological areas. The classical ICs are based on the established seekers – solvers relationships where the latest are attracted by the appropriate rewarding systems. Then, from the economic point of view the ICs in double unknown does not bring any commercial value:

1) there is no potential market value or clear market needs; 2) technological performance and even the technological alternatives are unknown. Thus, It appears extremely risky for seekers to launch the contest in this situation. Moreover, the incentive award schemes to motivate the solvers are not evident to establish. We claim that institutional logic can provide new insights on the definition of ICs in these cases. In fact, the scholars have pointed out that innovation is not only driven by an economic logic (Kanter, 2011; Suchman, 1995). Aside from the economic issues, innovation can also be beneficial for institutions through the actors' interactions which are involved in the production, the diffusion and the management of scientific and technical knowledge (Bjerregaard, 2010; Hargrave and Van de Ven, 2006) Sociologists view markets as social institutions that are constructed in culturally specific ways (Slater and Tonkiss, 2001). Innovative explorations tend to be characterized by a division of labor to attain mutually beneficial divisions. By studying the institutional and organizational dimensions of the innovation, Coriat and Weinstein (2002) show the importance of the institutional approach to explain the variety of firm patterns, their evolution and determine the social context in which the various agents and primarily firms operate. While taking the institutional lenses, we could gain a new perspective to the ICs definition, its motivation in case of generic technologies exploration and propose a mechanism of institutional support.

Insert Table 1 about here

In situations of the dual exploration of both markets and technologies (Sanchez, 1996), one way to deal with unknowns and ensure long-term growth is to design generic (also known as general purpose) technologies that can address many emerging markets. The organization of idea contests that favor such technologies would decrease the risks of developing single market failures and increase technologies application areas. The participants involved in such ideation could enrich future ideas by better defining GTs, and by associating them with new applications, thus opening up emerging markets or developing new needs, bringing new technological aspects within the scope of traditional projects and attracting additional investment. But - do such ICs that are specifically organized to conceive generic technologies *ex ante* exist? If yes, what is the logic behind and the motivation of both seekers and solvers to launch this type of contest?

To summarize, the existing typology of idea contests has not taken double unknown situations into account (Terwiesch and Xu, 2008). The forms of ICs identified in the literature so far (i.e. UICs and TICs), and their evaluation criteria and incubation processes, seem inappropriate to the process of simultaneous technology and market exploration for developing generic technologies. There is no evidence of serious attempts to organize idea contests designed *ex ante* to produce generic technologies when both market uses and relevant technological principles are unknown (see Figure 1). The goal of such generic technology idea contests (GTICs) would be to design genericity itself: the object of this research is to determine an appropriate form of ICs for creating GTs. The general framework we suggest involves the examination of each ICs element: thus our research question can be decomposed in four sub-questions: (1) In which contexts could GTICs be organized? (2) What criteria are relevant for selecting ideas that could form the basis of generic platforms? (3) How should generic platforms be explored and implemented in high-tech firms? (4) What are the collectives of seekers and solvers and what is the seekers motivation system associated to this kind of context?

3. Research settings

3.1. Context and Data Site

Given the exploratory nature of this study to describe the specifics of GTIC, we adopted a case study methodology as an appropriate research approach (Yin, 1994). This method enables us to examine GTICs in their natural setting, and is relevant since our goal is to gain insights into the organization of such contests, rather than to validate hypotheses. The study setting is the semiconductor industry, an environment which faces high rates of both innovative technology development and of new market creation (Teece, 1986), and where the probability of GTs existence *a priori* is high (Miyazaki, 1994; Olleros, 1986).

STMicroelectronics (ST), Europe's largest semiconductor company, has organized ICs of various types: for instance, the Innovation Cup - a UIC organized in 2011- involved students from different European countries in imagining new applications for ST products. The R&D centers of STMicroelectronics' existing business units are leading many innovative activities to explore various new product development and technologies for the markets which they address. It was felt, however, that these innovation processes were leaving out innovations which could deliver potential solutions for several market areas, but which would not promise to involve volumes big enough to be financed by individual business units. To allow for the development of such "transversal" innovations, two French STMicroelectronics sites - at Crolles and Grenoble in the Rhone-Alpes region (known as the 'French Silicon Valley', specializing in microelectronics and nanotechnologies) employing between them over 6400 people - decided in 2009 to develop a unique idea contest named Business Innovation Process (BIP). BIP aimed to run a series of challenges which would target transversality, ecosystem development and value for users (and for ST) by developing future innovative solutions designed to address several business areas, and was launched:

> *"to boost Grenoble and Crolles' sites contribution to ST value creation through better innovation and better use of local clusters" (BIP, 2009b)*

An internal ST magazine article announced the first innovation week and further challenges thus:

> *"Up to now we haven't fully taken advantage of either (1) the complementarities*

of the two sites: Crolles (expertise in development of technological platform, device design flows, and manufacturing) and Grenoble (expertise in advanced packaging completing the technological offer with marketing, design and sales of our products); or (2) the presence in the Global competitive cluster of Minalogic and other industrial leaders such as Schneider Electric, Becton Dickinson." (Cogez, 2010a)

The two sites involved in this IC specialized in very diverse technologies, so the contest was very open on the technology side, and (as noted in *Appendix A)* the wording regarding the target markets and uses allowed for a wide variety of solutions. Initially restricted to company employees, the idea submission process was later on open to regional university students, who were also given the opportunity to accompany some of the selected proposals through the idea development phase, which allowed for the integration of knowledge from other domains and enlarged the exploration area. So the overall process was clearly positioned to address the double unknown situation.

3.2. Data collection

To analyze STMicroelectronics' series of innovation challenges thoroughly, we collected data over 3 years of challenges from 2009 onwards, which were entitled "Real Sense", "Green Energy" and "Make life easier and better for everybody". 36, 18 and 67 participants submitted ideas to these challenges respectively (see *Appendix A* for further details), and participants could submit multiple ideas. We conducted semi-structured interviews with both seekers and solvers of the three ICs from Grenoble and Crolles ST sites, mostly ST employees and participants from the external research centres and regional universities involved in ideation process. Overall, we conducted over 30 interviews with specialists both from marketing and technical backgrounds, from strategic and operational units, from both Crolles and Grenoble sites and from external participants (intern students and universities involved in ideation), who were involved in submitting ideas, in organizing the contests, in selecting ideas, and in their subsequent incubation phases. The interviewees included idea submitters, commentators, project participants in projects developed from contest ideas, and members of the Core Innovation Team (CIT), who organized the contests and the Innovation Venture board (IVB) members, who played the role of internal customers for the proposed ideas. This allowed us to understand the multiple sources of influence on the challenges and revealed conflicting views on the issues analyzed in the paper. We reviewed secondary sources - supporting documents including internal press releases, innovation week programs, flyers, the three databases used to collect ideas for each contest, the evaluation committees' assessment reports, presentations of selected ideas at the various milestones, communication e-mails from CIT to company employees. We also ran an anonymous survey to obtain general feedback on the organizing process, including from contestants whose ideas were not chosen to be followed up. The overall rate of survey response was 50% (around 40 responses in total). See *Appendix A* for transcripts of the anonymous survey questions.

3.3. Data analysis

We triangulated our case study analyses against the internal IC organization data we collected to check the internal validity and reliability of our chosen methodology¸ and also triangulated our derived analysis against the BIP organizing committee's judgments. This enabled the continuous involvement of that committee, conforming with the guidelines of engaged scholarship (Van de Ven, 2007) and collaborative research (Shani et al., 2008). The third author was directly involved in the organization of all three innovative ideas contests, and was a part of CIT, which allowed us to gain insights into the entire process, from the ideas contest organization, the idea collection phase through until the end of the incubation period. The first and second authors analyzed the data independently from their external position. We shared our analysis of the projects that went through the BIP contest process with company representatives, which enabled us to identify the GT innovation patterns involved.

4. Case description. Business Innovation Process (BIP)

The following section describes the challenge according to the elements previously introduced in the Table 1, which we present and analyze separately.

4.1. Challenge initiation

BIP is an internal initiative organized by STMicroelectronics to support its innovation efforts by "*filling the gaps left by the division of internal innovation processes and managing transversality*" (Cogez, 2010b). BIP involved 3 annual innovation challenges starting in 2009 which each concentrated on different themes. The contests were announced via the company intranet, mail announcements, special posters and flyers and launched by innovations weeks designed to detail the particular challenges and suggest ways to tackle them. Various academic and industrial actors were invited to raise the awareness of ST employees at Crolles and Grenoble about innovation issues and processes. Plenary sessions were organized during lunchtimes to allow for wider attendance, and technological showroom visits and coached brainstorming sessions were also organized during the innovation weeks. The purpose was to increase the visibility of BIP and participation levels, and to identify people interested in tackling innovative issues. The innovation weeks also served as a basis to launch the collection of ideas.

The CIT, which involved around 15 specialists from ST business, R&D and strategic units departments, was in charge of both organizing the contests and evaluating the idea that were submitted. CIT members were responsible for putting the process and tools together, for sharing information and ideas, establishing relationships and networks, and collecting ideas from potential innovators and transforming them into innovation proposals, for tutoring project managers, for choosing which ideas were selected and transformed into exploration projects, and assisting in building project teams.

The first challenge - named "Real Sense" - organized in 2009 - was intended to:

> "*envision new uses, new user experiences, taking advantage of different mixes of 3D Technologies. Contestants should try to imagine what could be done by combining 3D video and graphic rendering, and 3D capture combined with innovative user interfaces (virtual touch-pad, virtual tablet, head tracking, …) all together*" (BIP, 2009a)

These solutions were to provide new user experiences by reusing combinations of emerging technologies that were mostly new to ST.

The "Green Energy" challenge (organized in 2010) aimed to explore two distinct areas of energy management leading to two sub-themes: 1) "Instant power, wherever I need it" - announced as:

> "*It is necessary to invent products, services, applications that transport us to the world where we will be able to access as much energy as we need for whatever we need it for. The ideas should address energy production or increase energy recuperation, or decrease energy losses during its transportation for various needs*" (Cogez, 2010a)

and 2) a "Master your power, yes we can" theme, asking contestants:

> *"to imagine the products, services, applications that enable us to control our energy balance sheet as a consumer or producer, and to explore new energy sources"* (Cogez, 2010a)

The 2011 "Make life easier and better for everybody" contest targeted ideas to:

> *"help people who are fragile in the face of their environments…by developing solutions that allow them to live easier and better. These solutions should have a potential to apply to everybody".* (LeServiceCommunication, 2011)

4.1.1. Analysis: IC for dual marketing and technological explorations

This step shows that all the three challenges sought to explore ideas in double unknown fields, where neither markets nor technologies were fixed at the beginning. So the general character of each exploration was quite open: each call was designed to attract new ideas in both technologies and usages. This was made possible by the challenges being organized at the ecosystem level, with experts from different BUs, R&D centers, regional universities and partner research centers from Rhone-Alpes region contributing to broaden contests areas and integrating knowledge and expertise from various domains to enable the pursuit of transversal exploration. Challenged by the market needs from the various BUs and technological constraints, participants were pushed to think ‘outside the box’ of their day-to-day work concerns, to consider emerging technological opportunities that could fit several BUs and even create new ones. By bringing people with different knowledge backgrounds to work together, keeping the challenge boundaries quite open and favoring long-term transversal innovations, CIT members anticipated both usage and technology explorations at the same time. ICs in this case do not correspond neither to the UIC where solvers aim to create the best possible presentation in order to attain higher potential benefit for a seeker; nor to the TIC where solvers experiment to find the technological alternative which provides the highest performance. *Here the effort is clearly made to motivate solvers to reuse the existing and emerging technological principles, to develop new ones and explore yet-unknown markets.*

4.2. Ideas generation and selection

The contest calls normally lasted 1-2 months, and ideas were collected electronically via the company’s intranet website: some that had been collected during the initial innovation week brainstorming sessions were submitted on the website in advance. The number of ideas collected from ST employees during each challenge was 33, 60 and 110 respectively. Participants could submit multiple ideas, or could submit single propositions collectively.

The idea contests were open to all the employees on both Crolles and Grenoble sites: they could participate and contribute by sending their own ideas, or simply by commenting on and thus enriching those already proposed. Submissions had to give precise details of the concept, proposed application areas, their source of inspiration (e.g., if similar concepts already existed) and the idea's potential advantage for ST by listing potential business units that might use it. The third challenge was also opened up to the innovation classes of several regional universities, which raised the total number of ideas collected to 128. During the collection phase, contestants, committee members and company employees had an opportunity to enrich, comment on or even challenge the ideas that had been submitted online. This phase was followed by evaluation and selection, after which the most interesting ideas were clustered into exploration projects. (The numbers of participants and number of ideas submitted, selected and clustered in each challenge are given in *Appendix B*.)

Submitted ideas were initially evaluated according to their originality, their potential applications, the opportunities they offered ST, the implementation effort they were like to incur in the long and short term and their transversality (meaning their breadth of application and involvement of different ST actors.

For instance, the 3DTouch idea came from the 2009 "Real sense" challenge, and the initially submitted idea gained high marks thanks both to its disruptive nature and its wide market potential:

> *"Based on the material's properties (tissue, wood, leather…), a MEMS actuator can simulate the surface of the object to the customer at home and help him to select/buy. This solution can be dedicated to medical applications to establish diagnostics at a distance, [to] e-commerce applications…"* (BIP, 2009a).

The idea involved using an active surface to simulate the haptic sensation of touch. Haptic technology is a tactile feedback technology that takes advantage of the human sense of touch by applying forces, vibrations, or motions to give such sensations to touch screens and video games. The proposition's breakthrough character set both technological and business model challenges and led to the pursuit of both market and technology explorations. Likewise, the Fourmis idea (submitted to the 2010 "Green Energy" challenge) proposed a breakthrough thermal–mechanical energy conversion technology to transform continuous heat flows into electricity. This was recognized as a generic solution (although the term was not used at the time) that could be used in many systems, and had the potential to address a wide range of market applications, such as mobile devices, intelligent buildings, structural monitoring, body sensors, smart grids, photovoltaic complementary systems, etc. In both these cases, the potential for these ideas to be developed towards generic technologies was evident in the originality of the initial ideas.

In other cases, ST adopted an alternative strategy to surface generic technologies. Some individual ideas that were close to each other were clustered together, and CIT members suggested to further develop them within a single project, also taking advantage of the feedback given by other users during the submission process, which enhanced the initial propositions. Participants who proposed similar ideas would thus often end up forming exploration groups together.

4.2.1. Analysis: Opening the scope of ideas submission through collaboration

Following the UIC definition, the selection committee would have to describe its preference towards a certain proposition using its potential market value or any other chosen criteria (e.g., proposition attractiveness, its clarity). By using TIC mechanisms decision makers would verify if the proposal corresponds to the desired performance, development and implementation costs. In BIP, the challenges were organized in collaborative manner: ideas could be commented on and enriched, and the openness of the contests to other participants' judgments helped to enlarge the market and technology areas that were explored (see

Appendix B). Some ideas initially submitted as single market ideas were enriched by the comments of other participants who recognized their potential value in other application domains. Technological ideas - which were mostly came from members of the R&D groups - were challenged by specialists from BUs as to their suggested application areas, particular in terms of their ability to meet client needs, and this feedback increased the probability of ST gaining transversal ideas, and thus of developing GTs. Participants had to state the value they thought their proposed innovations could bring to the ecosystem as a whole - not just to particular markets - which encouraged them refine their ideas submitted towards a wider, more generic scope. CIT members instead of selecting the best proposals privileged partnerships creation between solvers, motivate them to work together and aim to orientate exploration, while privileging learning to competition.

4.2.2. Analysis: From singular ideas to the emergence of platform ideas

While this was not explicitly stated during the discussions, CIT members favored those ideas that displayed generic potential, and tried to identify individual ideas that were more likely to be able to be transformed into generic platforms during the exploration process. We observed two ways in which future platforms were identified. In the first, the individual ideas already displayed generic potential (the '*4.2.2.1. Identification of singular ideas with generic potential*' section below exemplifies the identification of genericity), while in the second, similar ideas were transformed into generic clusters (the '*4.2.2.2. Generic Ideas from Clusters*' section demonstrates this clustering process).

A mechanism to match technologies and markets was needed to construct generic ideas. Kokshagina et al. (2012) showed that in double unknown contexts, even though both dimensions are highly uncertain, it is possible to predefine the set of functional combinations for emerging technologies and markets. The exploration phase can then be seen as a process of matching the potential functions that markets seek and that technologies can accomplish, which allows us to verify and characterize technologies and markets accordingly. According to (Gawer and Cusumano, 2008), a platform is a structure that has a common core which ensures essential functions and addresses needs that are common for several players. These functions are generic, so they ensure the diffusion of the platform and its adoption by market derivatives. In this case markets can by defined by the functions they seek to offer, and technologies by the functions they address. The notion of functions gives us the possibility of working on technologies and markets without directly considering technology-market couples. In this study, we consider generic ideas as proposals that attempt to build platforms and GTs. Generic ideas can be characterized by the markets they attempt to address M_i, the underlying technological principles T_i that need to be developed and the functions that T_i allows to fulfill, or that M_i is requesting. For example : the technological principles underlying "inertial MEMS" allow to fulfill the function "acceleration measurement", and the market "car safety" request that function (to detect the need for airbag deployment). In the following section, we describe how the 3DTouch project developed from the 3DTouch idea by specifically distinguishing T_i, F_i, M_i.

4.2.2.1. Identification of singular ideas with generic potential: The case of the 3DTouch platform

The key proposal of the 3DTouch project lay in the ability to physically sense the texture of an interactive device. The 3DTouch idea aims to transmit more complex information to the user than the simple acknowledgement of a command by using the high tactile sensitivity of the fingers, and attempts to develop a technology that provides rich haptic feedback via one or more vibratory actuators, which are excited by electrical signals. As initially submitted, the idea attempted to maximize the number of targeted environments including e-commerce applications (e-shopping for clothes, furniture,…) M_1, tactile keyboard elements integrated on the reverse sides of devices to enable faster navigation for consumers, automotive applications where vision is limited and 'typing blind' becomes necessary M_2, gaming M_3 to enhance immersion, gesture learning, medical diagnosis M_4 through surface simulation using MEMS or piezoelectricity actuators (see Figure 2). Each market environment requires different functions to be addressed, and adds particular constraints. The main idea is to use the active surface to simulate touch by integrating vibratory actuators into various objects of which some part is handheld. For instance, addressing M_1 by developing a tactile touch panel, which is associated with a tablet or smartphone display, or using an external device with tactile properties, requires the development of various functions. To enable different sensation effects on tactile screens vibration effects must be integrated by using piezoelectricity technologies. Moreover, a database of various vibration simulations according to the tissue properties F_1 should be built; actuators should be integrated and controlled F_3. For multitouch displays the touch layer needs to be transparent F_2, the surface should be capacitive F_4 and the solution must be low power and low voltage F_5. For M_2, M_3 actuators need to be smaller and their compatibility with capacitive sensors should be achieved at both screen and control levels. To develop a generic technology a solution should address all the functions identified as being required by the market domains M_1, M_2, M_3, M_4.

Even if all these market domains require haptic multitouch technology and seek for common functions F_3, F_4, F_5, some functions are specific to each application and can even appear to be mutually exclusive (i.e., screen transparency management and actuators management). Moreover, a technology that would explicitly address functions required by all identified applications requires a complicated and most probably expensive technological exploration. The goal is then to reuse the existing technological principles T_1, T_2, T_3 to form a platform that addresses generic functions F_3, F_4, F_5, and to address the mutually exclusive functions via separate modules once the platform is built.

The CIT members recognized the idea as generic since it demonstrated the ability to address applications in various environments with limited resources. In practical terms, the generic idea should indicate a method to develop a platform that is independent from the generic environmental functions and dissociates them from the modules that are adapted to address specific functions. Technological platform building realizes the generic potential of an idea, enabling existing uses to be enhanced and new ones developed. In this case, the prototype stage resulted in a generic platform which incorporated both transparency and multi-vibration principles with enhanced user perception and embeddable low power solutions (F_3, F_4, F_5). While this prototype could not address any market directly, it did create a GT platform with a high probability of being used in several applications.

Insert Figure 2 about here

4.2.2.2. Building generic ideas: cluster building strategy. The case of sensing detector network

We observed two modes of clustering single ideas: 1) cluster creation based on technological principles 2) cluster creation based on functional combinations. We discuss an example of the first below (for reasons of clarity), but cluster creation based on functional combinations follows similar processes.

In the 'Green Energy' contest, the individual ideas 1 - 3 (see Figure 3) were intended to address various applications: M_1 intelligent power management (Idea 1), M_2 smart building heat management (Idea 2), M_3 auto-management based on user preference and user detection in a room (Idea 3) using T_1 detector network based on different sensing techniques (motion, temperature, power consumption, etc.). Idea 1 attempts to integrate different types of detectors sensitive to motion, temperature, …(F_1) into a network (F_4) that gathers information for intelligent power management using software platform to track events, manage data (F_3) and so optimize power consumption (F_2). Idea 2 is based on the detection of various activities through sensors (F_3, F_4) to adapt the energy environment and manage power consumption

(F_2). Idea 3 for M_3 endeavors to recognize a user's position (F_5) and activity, and to autonomously analyze and manage their environments through establishing a system of network (F_4).

The CIT suggested regrouping these ideas based on the similarity of their technological principles, so the cluster was driven by common technological parameters to address various applications. In this case, cluster building was based on developing a sensing detector network for M_1, M_2, M_3 and all the emerging markets that might seek similar functions. Once a technology-driven cluster was identified, a generic platform to track events and manage data from sensor networks was refined. Ideas were clustered together by selecting the appropriate combination of two or more ideas, and so enabling more transversal ideas to be developed. In this phase, the platform was identified, the generic core was refined, future market products were identified and collaboration needed to gain expertise in new domain was highlighted.

Insert Figure 3 about here

Each selected project was assigned to a champion selected within the CIT community who supported project communication but was not necessary involved directly in the exploration efforts. As the examples demonstrate, the purpose of identifying genericity in both strategies was not to address the entire list of functions for all identified emerging applications, but to identify and solve the common problem(s): future innovation capability was a target of the exploration itself. This phase enabled the compatibility and the interdependencies between various properties to be maximized and common functions to be grouped as a generic technological core. The phase of ideas generation and selection appears to be quite different form the classical process of ideas selection. It is a process of co-development, which is orientated towards an elaboration of generic solutions.

4.3. Ideas development

The platforms that emerged from this process opened up new product development possibilities. Project teams then launched quick exploratory processes along 8 axes: prototype, customer value, degree of disruption, strategic alignment (with ST technical and marketing capabilities and strategies), value chain, selling strategy, financial implications and risks. The goal was to prepare the projects to be evaluated by a group of high level managers who were in a position to decide whether or not to finance them, and - if their assessments were positive - to provide the resources for further exploration during a so-called 'consolidation' phase that normally lasted 6 month and could be renewed after a further evaluation and if the platform had been enriched. This group was called the Innovation Venture Board (IVB) and represented a group of internal customers. Those projects to which resources were allocated had to design both technology and market options. At the end of the consolidation phase, a final committee evaluation could lead to projects being transferred to existing business units, to the creation of new units to handle them, to external transfers (e.g., via creating a start-up) or to the project being stopped. Given the relatively high number of ideas submitted in all three challenges (see Appendix B), surprisingly only 4 projects are still on-going. All appear to be highly generic and the enrichment of their genericity was mostly achieved during phase 3, which opened up new market possibilities that were unrecognized when the ideas were launched, so that the platform genericity identified at that stage was further improved by considering new application areas. Various projects issued from these 4 platforms are on-going within the company in collaboration with research partners, with the aim of both building new markets modules and further enriching the platforms. Brainstorming sessions were organized to find new ideas for potential uses and for how the technologies could be enriched after the first platform core prototype had been developed. Platform enrichment of ideas initially sourced from the ICs also led to the creation of several collaborative projects with both academia and private companies, and portfolios of patents were issued around each project.

4.3.1. Analysis: From upstream platform core identification to robust platform deployment

Following step 3, the genericity that had been identified needs to be developed and markets addressed through modular exploration. For instance, the 3DTouch project was approved by the IVB and resources were allocated to continue exploration (see Figure 4). Platform enrichment comprised both the creation and management of interdependencies to ensure the deployment of market complementarities, and the further enrichment of the generic core itself. Project enrichment was continued by developing specific functions to address a predefined list of market applications. For instance, to develop tissue sensing for e-commerce, the generic core had to be reused to create design catalogues or to ensure high-precision management and low power for consumer back-typing applications. In addition to the exploration of the identified market complementarities, new markets emerged that were potentially interested in the generic platform. For example, in 3DTouch the security, gaming, education markets appeared once a platform based on an 'active surface for haptic touch' had been built.

Further work was also undertaken to increase the genericity of the platform core. In the 3DTouch case, the screen flexibility (obtained through graphene sheets or OLED display) led on to the development of deformable transparent tactile objects. The proposed idea involved innovation at the system level that required the involvement of ST's clients and partners, and even led to the creation of a new micro-ecosystem around the emerging solutions. A generic haptic technology was developed via a cooperative framework between participants, in which collaborations with glass substrate suppliers, LCD screen makers, module makers, touch sensor makers, display assemblers and OEMs was crucial (see Figure 4).

Insert Figure 4 about here

The collaboration development within the company and externally was highly supported by both the CIT who facilitate beneficial division of labor and IVB members who were primarily responsible to support the costs of transaction to build the partnerships.

4.4 Combining organizational and institutional perspectives: seekers - solvers relations and their motivation

In BIP the role of seekers is played by the IVB team, which represents the pools of highly qualified specialists that internally could recognize the value of proposals and build an innovative ecosystem for further ideas exploration towards new markets. It is important to underline that seekers comprise experts with various profiles and none of them is a real buyer of a technology. Their goal is to constitute the *ad hoc* value of proposal for the future buyers. The IVB members did not provide any warranties to buy the winner solutions. Instead, they aim to deliver the appropriate financing for further ideas exploration. The corresponding cost transactions comprise the resources to establish the exchange interfaces within the external partners, to support mutual development. The CIT team appears as an organizational structure within seekers and solvers that drives the BIP institution. Despite the contest organization and deployment, they were managing the process of ideas co-development, privileged genericity, ideas clustering and joint team building. In the description of their mission, CIT members mention their aim in unlocking business potential, converting teams experience in valuable knowledge, overcoming obstacles. They privileged co-exploration to "picking a winner" cases. They attempted to integrate highly motivated individuals to launch projects exploration even if their ideas were not selected and thus, increase the quality of future proposals and enlarge the scope of ideas.

From the solvers side, in classical ICs they appear to be motivated by incentive rewards, which were absent in BIP. The participation was neither driven by the hierarchical order, nor by the career evolution expectation. The process appeared completely voluntary. Participants were actually motivated to constitute new teams, push their ideas towards new markets creation, new business models that go beyond the traditional ST business. Their motivation was in their expertise development; in potential benefits they would obtain ones their generic solution will appear on the markets or even in changing their role towards future project managers of their proposals.

5. Findings. Generic technology ideas contest (GT_{IC})

The findings presented below are organized around the research sub-questions previously posed and their analysis.

Context of GT_{IC} organization

We found that the ICs organized by STMicroelectronics did not aim at the development of specific technology-market couples, as in stage-gate processes, but attempted to explore both new markets and new technologies by privileging cooperation to competition. For instance, one of the ideas aimed at recovering energy losses was developed to address several emerging application areas like wireless sensors network, smart grid management, autonomous healthcare, thermal wall management, bionics, mobile devices. Project teams aimed to increase the total efficiency of energy generation, using an idea that proposed to use several multi-harvesting systems. By working on new forms of electronics that need far less power, the team developed a new approach to energy harvesting that generated electricity from small temperature gradients and at low temperatures, using a technology based on direct thermal-mechanical energy and mechanical-electrical energy conversions using piezoelectricity principles.

In double unknown situations, the exploration of new functions that the market seeks and the emerging technologies that could address them need to be prioritized: just developing new functions (as in UICs) or new technologies (TICs) by themselves is insufficient. The goal is to build flexible technologies that can easily integrate new functionalities in multi-market environments. To harvest the appropriate range of ideas, the challenge contest has to be open and to focus on both technological and market exploration. Collaboration between participants and organizers also appeared to be critical while pursuing genericity, and the outcome of the process should be the development of new technological platforms (see Table 2).

Insert Table 2 about here

Criteria for ideas selection: from isolated ideas to platforms

CIT did not simply select the best ideas according to commonly used criteria as in UIC and TIC challenges. Its members chose neither the most promising applications for already developed technologies (by maximizing net present value), nor did they seek to minimize the development costs for more promising selected market applications. They sought transversality of ideas to address several market areas (existing and new ones) and new original technological solutions, which were both flexible and robust to address several environments. They favored addressing a variety of market applications by reusing existing technological competences, and developing new ones with minimal adaptation costs between future modules. The criteria used in GTIC should incorporate the logic of value maximization through several market considerations and the construction of interdependencies between them (see Table 2).

The CIT regrouped submitted ideas to enable more generic ideas to develop, and targeted ideas with higher generic potential. This led us to identify two strategies for developing generic ideas: 1) Identification of **ideas with generic potential** that recognized ideas with higher intrinsic generic potential (in terms of both technological and functional parameters) and that could be transformed into platform ideas. Ideas of this kind contained generic technological concepts that did not just attempt to address several existing application, but also triggered the creation of new uses and new technological principles. 2) **Generic Ideas from Cluster building strategy** that lead to the creation of new uses rather than just the development of common solutions for the initially proposed contexts. As in the technology-market matching models, idea-clustering strategies can be achieved through grouping individual ideas into platforms either on the basis of functions or of technological principles. Moreover, as the idea collection process showed, the visibility of already submitted ideas to other participants, and their commenting and feedback on them, had a positive effect on the likelihood of deepening and widening of range of ideas' application areas.

The importance of adaptation process in case of GT development - Genericity building

Most of the generic ideas simply targeted several application areas which attempted to generate higher benefits. But the multiplicity of markets that each idea attempted to address made it difficult for the company to associate concrete units responsible for project development. These high-potential projects proposed both new technological concepts and new markets. It is important to underline that the generic ideas that stemmed from contests, were initially still too immature to pursue new product development directly. In the case of GTIC, the adaptation of ideas often takes a long time, but is crucial for successful genericity building. Because of the high levels of uncertainty involved, the development phase includes both the development and testing of applications and further genericity building, which comprises the enrichment of both the core and of the interdependencies designed to address predefined markets and to broaden exploration towards new applications that were not considered (or even existed) before the platform had been developed.

Risks associated with GT development in case of GTIC

The principal risk while pursuing genericity is to prevent specialization towards more promising market applications or dominant technologies at the early stages of exploration. There is a tendency to favor dominant market signals rather than to keep exploring genericity for still unknown markets, which could result in a rigid platform core: so the key role of CIT and project leaders appears to be to avoid hyper-adaptation.

The double unknown situation makes it possible for some projects to proceed towards GT development, to address multiple markets. Though these transversal projects offer solutions for several BUs, they can often also pose challenges in terms of the BUs' technology development investments, managerial responsibility and technology ownership. For instance, BUs need to decide how to share costs of platform development, and which other market modules they can develop based on the platform. GT managers need to manage these organizational risks to ensure platform adaption to various markets, and also to ensure the platforms can be relevant to both existing markets (to generate profit in the short-term) and to emerging markets to ensure the long-term growth of generic technologies.

Managerial guidance of GTIC innovation contest

The managerial guidance for GTIC organization includes probing questions at each step of ICs development (see Table 3) so as to estimate whether a GTIC is suitable to a particular organizational context and learn more about how to build successful GTs.

Insert Table 3 about here

From market based towards design community building

The presented in this paper innovation contests is designed to create partnerships. GTIC enable to improve the quality of submitted ideas and selected proposals through the process of collective exploration. The introduced GTIC contests aims to profit from competition to establish larger collaborative participants networks that work together to prepare future technologies and markets that would interest high number of buyers. Compliant with the findings of (Eickelpasch and Fritsch, 2005), our research provides incentives for selforganization and allow teams to build the organizations forms of innovative labor that suits their interest. Despite the absence of the incentive reward mechanisms, solvers of this contest pursue more strategic goal of their expertise building and their evolution towards the new collectives creation, extending their network.

6. Conclusion

6.1. Theoretical and managerial contribution

By dealing with the question of ICs from the institutional point of view, this paper demonstrates the interest in pursuing ideas challenges in double unknown. The relevance of innovation contests for GT development in high-tech environments is clearly supported by our findings. The evidence from this study suggests a form of GT innovation contest that is different from those driven by identified users or technologies in seeker – solver predefined relations. *The ICs defined in this paper appears as a new policy that aims to create the new design communities for joint generic technologies exploration*. The collective orientation of contests participants by the CIT members demonstrates how cooperation in the competitive environment of the contests leads to greater innovativeness and higher quality of propositions which according to the results of (Bullinger et al., 2010) could extend the boundary spanning perspective. The CIT team proposes a rather efficient mechanism of institutional support for GTICs by playing the important role of the construction of techno-economic role of an innovation.

The analysis of STMicroelectronics' business innovation process presented here gives important insights into the conditions that govern the emergence of generic technologies. Generally, the chances of developing a GT increase when the individual ideas can be transformed in a platform of multi-application ideas that use the same technological building block(s) (**'Ideas with Generic Potential'** strategy), but combining a group of ideas into a richer, broader concept can also result in GT development (**'Generic Ideas from Clusters'** strategy). To promote genericity, one needs to avoid the intuitive approach of adapting to already known market environments, which is easier and faster, but leads to developments that tend to be specific to single markets (that can also be successful, but more often in short term).

This idea transformation strategies proposed in this paper increase the probability of those ideas being accepted within a firm and facilitates the management of the absorption of unsolicited ideas, which as Alexy et al. (2012) note, is often problematic. Clustering facilitates the incorporation of highly disruptive ideas that are often rejected due to their 'double unknowns' and the consequent ambiguity of their chances of success (Sommer et al., 2009).

As demonstrated here, GTIC fosters the possibility of further genericity building through the continuous enrichment of platform and market modules. Platform enrichment is a crucial step to ensure the further exploration and on-going existence within the company of generic ideas that may still be too uncertain to be transferred to product groups. In contrast to classical ideas contests - which often stop with the selection of the winning ideas - organizers of GTIC contests have to facilitate the further enrichment of submitted ideas to develop higher genericity and successful market modules through collaborative open innovation processes (Huang, 2011). Fundamental knowledge acquired during platform building can both prepare for the company's long-term growth, and better equip it to respond rapidly to market changes (Kim and Kogut, 1996). Such contests as those reported here can be seen as opportunities for innovative ideas exploration for on-going platform enrichment (Boudreau et al., 2011).

This study yields important managerial recommendations and tools for practitioners attempting to explore both new uses and technological phenomena, which are especially relevant to the turbulent environments and high rates of competition in high tech industries (Duysters and Man, 2003; Tierney et al., 2012), and is consistent with a robust design approach that suggests the need for high variability of uses and application (Bstieler, 2005). From the human resources point of view, such idea contests enable a company to identify corporate entrepreneurs and experts within its workforce (Santos and Spann, 2011), to gather people with a range of various technical and commercial backgrounds together in the process of pursuing innovative technologies development, and to organize coaching sessions for such highly motivated people. The BIP contest series organized by STM enabled project leaders to develop their skills, to gain completely new expertise and to enlarge their networks within the company (Hennebelle, 2013).

The process that ST organized for collecting and developing generic ideas enabled the design of valuable technological platforms and the creation of important ecosystems for further technology development. The idea of GTICs identified here appears to be beneficial for new technologies whose maturity is low and market value is still uncertain (Mortara et al., 2013). Overall, this research shows the inappropriateness of the conventional user and technological driven contests to the challenge of developing generic technologies. It introduces a new platform building innovation contest process that can be combined with those classical contest forms to build richer technological platforms and address wider application areas, and offers useful insights to practitioners faced with the challenge of exploring technology and market 'double unknowns' in high-tech industries.

6.2. Limitations of the Study and suggestions for further Research

Obviously, the limitations of our methodological approach mean that we cannot provide decisive evidence on the effectiveness of the organization of generic technology ideas contests: the empirical applicability of our findings need to be tested on a larger sample of firms dealing with market–technology exploration in double unknown situations. Further work is also needed to pursue the development of a model of generic technology exploration, and to investigate whether the model we have observed is limited to the semiconductor sector or can be applied in various environmental contexts.

In addition, the transitions between phases of innovation contests that target genericity development remain to be investigated. Intuitively, the closure of each phase is based on the remaining uncertainties, resources and the appreciation of the results by CIT members and project leaders: but when exactly platform exploration should finish and the construction of market modules should start is not easily specified. More generally, when is it better to finalize genericity building? Is it just a matter of time - or which criteria should be used to measure the resolution of this effort? How can one best organize the adoption of generic technologies by business units or facilitate the creation of start-ups? Despite the advantages of GTs development, it is important to underline the problems of governance during the process of adopting transversal innovations in a company, the lack of appropriate business plans to manage uncertainty and the problems of managing generic ideas in general (Griffin and Hauser, 1996; Mason and Stark, 2004).

This work also poses questions about creativity of the process. How can innovative thinking on double unknown best be stimulated when the target is platform creation? Why do certain idea submitters favor generic over specific ideas? Are there methods which aim to overcome fixation effects, with suggestions including enhancing social interaction through communication (Purcell and Gero, 1996), boundary spanning (Rapp et al., 2013) or enhancing cognition (Agogué et al., 2012). But can these techniques enhance the degree of genericity of ideas? How can participants be stimulated to build genericity? And with which sorts of stimuli?

These research avenues should help adjust the model and enlarge the application areas of generic technology innovation contests.

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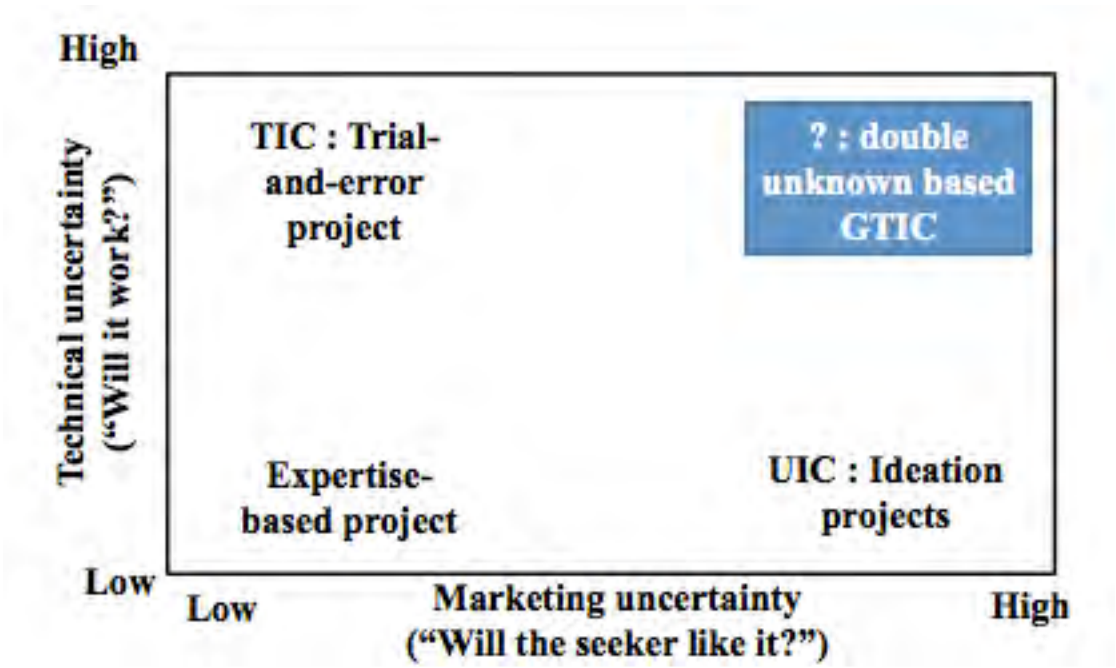

Figure 1 Typology of Ideas contests: the specific case of double unknown (adapted from (Terwiesch and Xu, 2008))

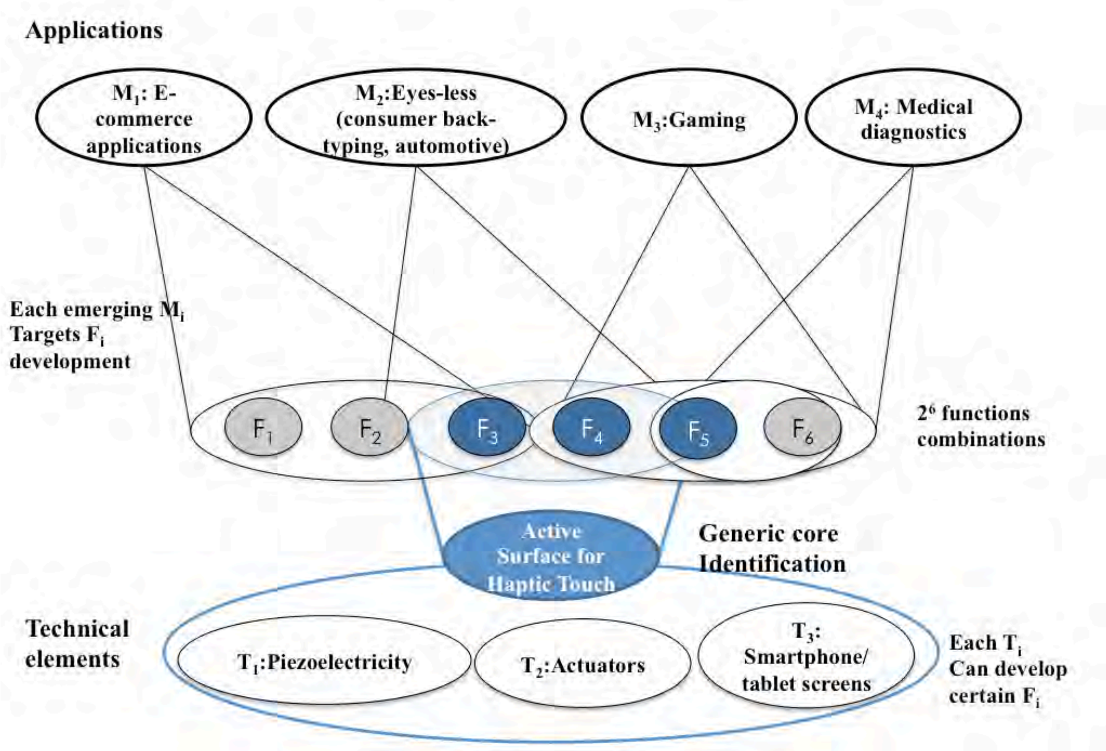

Figure 2 3DTouch generic ideas recognition - “Real Sense challenge”

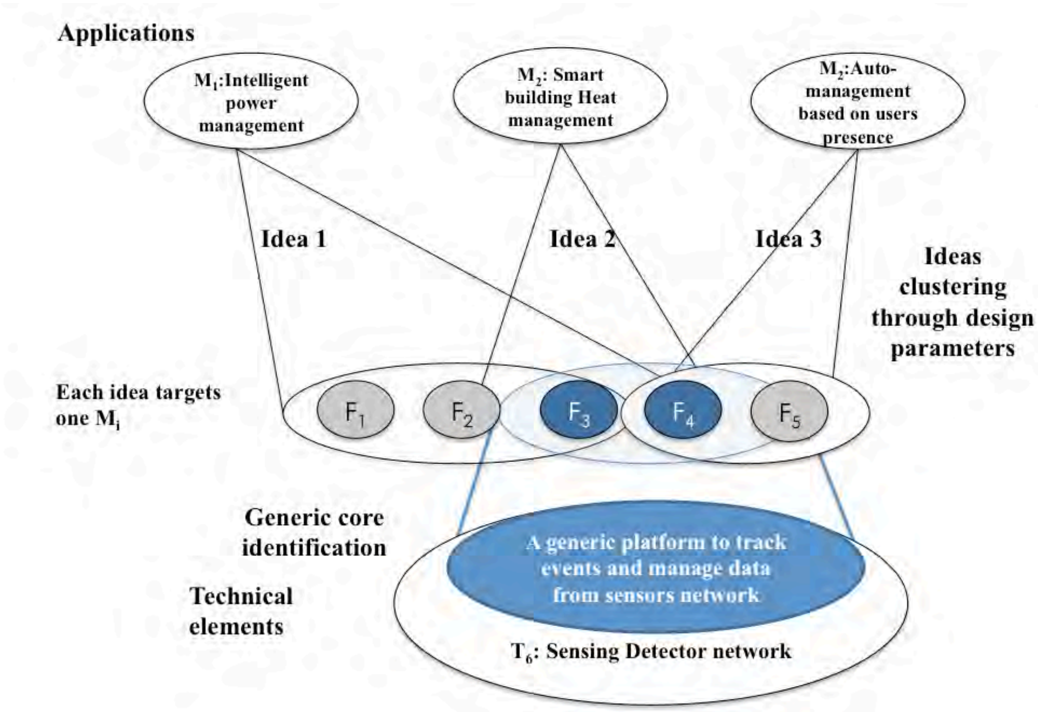

Figure 3 Ideas clustering through design parameters “Green Energy” challenge

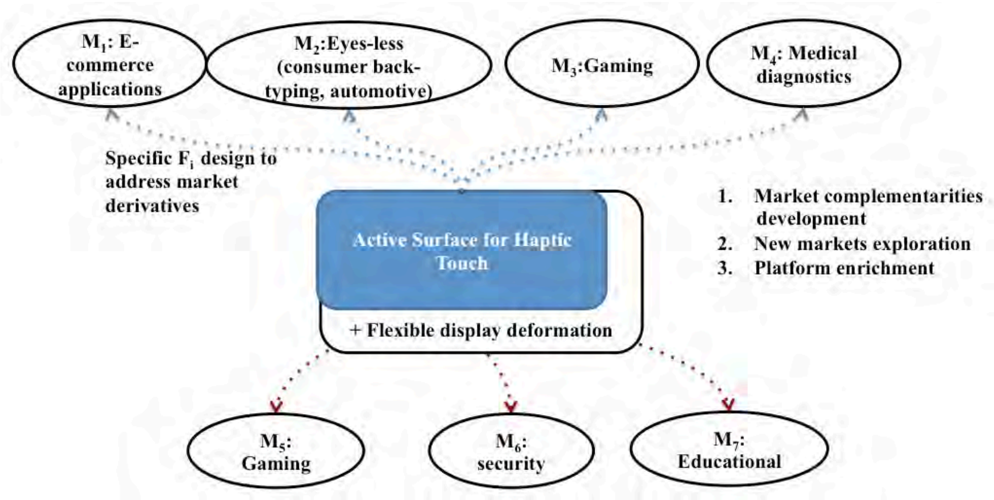

Figure 4 3DTouch platform development – genericity building

Table 1. Innovation ideas contests in technological contexts

Elements	**Parameters**	**User IC (U_{IC})**	**Technology IC (T_{IC})**	**Limits of U_{IC} and T_{IC} for GT_{IC}**
Challenge initiation	Context	NPD, FFE, New product offers, applications	Technological prototypes, proof of concepts, Robustness	U_{IC}: Too Specific applications T_{IC}: Too specific technology development.
	Uncertainty level	Market based uncertainty	Technology based uncertainty	U_{IC} and T_{IC} are not suitable when T and M are unknown
	Openness	High	Low	
Idea generation and selection	Evaluation Criteria	Max Net Present Value	Min Cost of development	For double unknown the combination of market driven and technological criteria need to be used
Idea development	Valorization	Chosen Product development	Technology development	U_{IC} and T_{IC} don't take manage product and technology diffusion together
Motivation	Reward System	Fixed-price awards	Performance contingent award	Fixed price awards are hard to determine before the challenge launch; Performance based awards could be suitable in unknown

Table 2. Generic technology IC contest

Step	**Parameters**	**GT_{IC}**
Outcome	Creation of design communities to explore technological platform, develop new business directions	
Challenge initiation	Context	Innovation capability, Genericity is a target
	Uncertainty level	Double unknown (Both Technology and markets are unknown)
	Openness	High to account for larger market area, low to design new generic technology
Ideas Generation and Selection	Evaluation Criteria	Variety of market applications, min cost of readaptation
Ideas development	Valorization	Platform opens up new possibilities for product development; Design modularity as well opportunities for new challenges type UIC, TIC while reusing core
Motivation	Joint Expertise Building	The primarily motivation is not to win the context but to build the community that facilitates the development of new business directions where they will play the key role.

Table 3. Managerial guidance for GTIC organization

GT_{IC} elements	Probing Questions
Challenge initiation	– Are all the stakeholders in line with GT_{IC} objectives? (i.e. developing long-term technological platform for several markets, focusing on breakthroughs innovation…) – Does the contest brief enable participants to cover different technological and markets domains? – Does the contest encourage multidisciplinary teamwork and the development of ecosystem?
Ideas generation and selection - genericity identification	– Are there transversal ideas or mostly functionally or technologically interdependent ideas? – Are ideas submitters stimulated to work together? Are there comments that add useful information on other application domains or technological alternatives? – Do single ideas have generic potential: seek to address several market needs? – Do several ideas seek to address or explore similar market modules? – Do several ideas seek to develop similar technological platform for various market needs?
Ideas development - genericity building	– Does platform ready to be commercialized (NPD)? – Are there specific functions to develop market modules? – Are there other markets modules that platform can address/create? – Is it possible to increase platform genericity by incorporating other functions leading to enlarge market area?

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Appendix A

Questionnaire submitted to IC participants (on scales of 0 to 5 for the evaluation questions with the possibility of leaving additional comments) – Internal Document

Profile:

1) What is your function within the company?
2) Seniority level?
3) In which challenges didn't you take part (Challenge 1: Real Sense; 2: Real Energy; 3: Make life easier and better?)

Feedback on the different phases:

1) Ideas collection
    - Was the challenge description and theme selection clear?
    - For the different ways of ideas collection did you prefer?
    - How do you estimate the efficiency of ideas collection?
    - Were the results on ideas collection and selection clear for you?
    - Other remarks and suggestions
2) Creation of possible platforms
    - Were the processes steps clear for you?
    - Was it useful to have external participants during the common meetings?
    - Was the fact of having external members in your project group positive for you: for personal development; for idea maturity?
    - Were these coaching sessions helpful for you in your everyday work?
    - Other remarks and suggestions
3) Support of Core Innovation Team (CIT) and Innovation Venture board (IVB) evaluation
    - How do you estimate support of CIT members (for networking, sponsorship of your project)?
    - Was the CIT feedback beneficial for your innovative project development?
    - Were there matching in between the given initially selection criteria and the final decision of IVB members?
    - Was the presentation of the final IVB results clear for you?
    - Other remarks and suggestions for the CIT support and the IVB selection

Vision and interest:

1) What do you think is an objective of this initiative? (open question)
2) Was a participation in this process positive or negative experience for you?
3) What will you change for this experience to be positive? (open question)
4) What motivated you to participate in innovation contest?
5) Will you encourage your colleagues to participate in a future challenge and its incubation phase?
6) Will you be motivated to participate again?

Appendix B Business innovation process Empirical comparison

Table B.1. Innovation challenges description

Innovation Challenge	**"Real Sense"**	**"Green Energy"**	**"Make life easier and better for everybody"**
Number of submitters	36	18	67
Period of ideas collection	December 2009 – February - 2010	April – June 2010	May – June 2011
Period of ideas enrichment (before incubation)	May - June 210	November 2010 – January 2011	September 2011 – December 2011
Step 2. Number of ideas submitted	33	60	128
Examples of issued Technological domains variety	Optical sensors, Image processing techniques, Communication technology, Haptic Technology, 3D, RFID, sensors, MEMS, radars, …	Heat to electricity converters, detector networks, eco-light bulbs, sensors, and batteries. Electric fuses, CPL networks, PV panels, filters,…	Sensors, Radars, LCD, optical sensors, Communication technology, organic solar cells, detectors, audio-video transmission,…
Examples of issued application domains variety	Consumer, Medical, Entertainment, Automotive domains, Gaming, Security, Retail, navigation,…	Energy efficiency through consumption control, automation, power and thermal management; Smart cities, Home automation, nomad devices, bio-energy, lightening,…	Health, Robotics, Security, Entertainment, Sport, Smart building,
Step 3. Ideas evaluation/number of projects selected	5 projects launched: 2 with generic potential and 3 clusters combined form 8 ideas	3 projects launched 3 of generic potential identified and 6 clusters from 25 ideas	6 projects launched: 5 clusters for 29 ideas, 1 generic potential