Industrial Design Thinking at Siemens Corporate Technology, China

Xiao Ge and Bettina Maisch

Abstract The innovation challenges for a foreign business-to-business company in China are huge. It has to quickly respond to the diverse and rapidly changing customer needs in the large emerging market, while facing strong competition from both local newcomers with disruptive threats and other established global players. To build up its innovation capability, Siemens Corporate Technology China has developed a practical innovation methodology adapted from Design Thinking and integrated with the best practices of other user-driven approaches, to adjust to both China's and industry requirements. A training/coaching program has also been created to support real business projects and other innovation activities at Siemens. The article includes (a) the overview of the Industrial Design Thinking (i.DT) program and methodology at Siemens and a highlight of its uniqueness compared with traditional ways of research; (b) the step-by-step i.DT process and methods explained with project examples; and (c) knowledge about critical i.DT innovation projects success factors at Siemens in China. By sharing the i.DT practices at Siemens in China, we hope to provide valuable insights into the development of creativity and innovation capability, as well as the adoption of Design Tinking or other user-driven approaches in industry.

Keywords Innovation methods • Multinational organization • Training • Coaching • Management • Creativity • Human-centered • Implementation

From the perspective of the innovation driving force, there have been two typical innovation models—vertical and horizontal innovation. Vertical innovation is technology-driven (push): with predetermined topics in a certain discipline, in-depth research is conducted to generate new theories, new scientific findings

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and new technologies which will drive commercial applications. Examples of technology-driven innovation are mobile communication and touch screen technology. Horizontal innovation is market-/need-driven (pull). Understanding of user needs is the key to the assessment of such innovations, which often entail the integration and fusion of cross-disciplinary technologies and a new business model to best satisfy user needs. Steve Jobs' revolutionary innovations of an easier-to-use Mac-intosh, as well as the iPod that allows music lovers access to thousands of songs anytime, anywhere, exemplify this type of innovation.

China is an extreme market for Siemens in many ways. To sustain business in such an environment requires a strategic innovation methodology and its management. Siemens Corporate Technology (CT) China has developed a combined vertical and horizontal innovation system driven by the needs of customers in the extreme environment in China, that also takes advantage of Siemens' global technology strengths. This integrated approach aims to generate innovations with disruptive potential for China, and from China to the world. It asks Research and Development (R&D) to build empathy with the extreme user of emerging markets, provide quick solutions by a mix and match strategy and then develop sustainable innovations by furthering technological strengths in a viable business model. Such an innovation approach will not only give Siemens a competitive advantage in the emerging markets, but also in mainstream markets.

In addition to establishing the right innovation ecosystem, the key is to systematically train development teams in a need-driven innovation approach; traditional innovation education has a deep-set bias towards cultivating technology-driven abilities. Thus, Siemens Corporate Technology developed the i.DT (Industrial Design Thinking) program to systematically build up innovation leaders by (a) enhancing horizontal, need-driven creativity with China's vast and diverse user needs, and (b) strengthening vertical, technology-driven creativity through the integration and fusion innovation—combining existing and/or new technologies, as well as a sense for the market to generate value for unmet needs with innovations with disruptive potential in a new way.

i.DT Program at Siemens CT China

The initial impulse to develop a specific user-driven innovation approach for Siemens in China came from former Head of Corporate Technology in China, Dr. Arding Hsu, and former Senior Innovation Consultant, Dr. Gautam Bandyopadhyay. The theoretical basis of i.DT is "Design Thinking", advocated by Stanford University and the design and innovation consulting firm IDEO. Design Thinking has gained huge popularity since the success of Apple's products and services, as well as the huge investment of one of the founders of SAP, Hasso Plattner, in financing the d.school at Stanford University and at the University of Potsdam.

i.DT introduces systematic principles and applications based on the human-centered approach of Design Thinking. It is distinctive for addressing the industrial or business-to-business (B2B) markets in China, as well as optimizing creative learning for Chinese development teams.

The projects executed between 2012 and 2014 were selected largely from existing R&D projects in Siemens China, with particularly strong links to business units (BU) and market needs. Four teams from different technology fields were selected to work in parallel on project topics of the involved BUs. The project duration was 4 months; each team had a dedicated workspace in the i.DT lab—Tian Gong Guan, which can be translated as "Innovators' Heaven". The goal behind locating the teams in one space was to increase the exchange of information within each team, but also between the different teams to get outside-the-box inspiration more easily, as well as to improve the quality of the project outcome through internal competition. Interdisciplinarity of engineers and BU people has been strongly encouraged in each team, not just for cross-field inspiration, but also to overcome the challenges of implementing the project outcome.

The team typically consisted of a team leader and two to four team members. Most of the team members were R&D engineers, experts in a specific technology domain. Involvement of marketing, sales and distribution was requested and highly recommended but not always possible. The team members generally spent around 50 % of their effort on their specific i.DT projects, because their time had to be split among multiple activities (as is often normal in an industrial environment), due to the strong demand for their expertise and experience. Two dedicated i.DT method experts facilitated the learning of the methodology through weekly training, as well as giving hands-on support in project execution through intensive coaching. The aim of the i.DT program in Siemens CT China was to cultivate development teams capable of user-driven innovation, as well as providing promising, innovative solutions that would become part of their product roadmap and deliver value to Siemens and its customers. Table 1 shows the unique approaches applied in the i.DT program based on the accumulated experience by i.DT method experts. These unique approaches, combined with i.DT process and methods, are introduced in detail in the following chapters, showing how i.DT has reduced obstacles to innovative thinking and acting in development teams at Siemens and facilitated the generation of sustainable innovations with disruptive potential.

i.DT Process and Methods

As Fig. 1 shows, in the i.DT process, each project starts with the business goal from a BU, which is aligned with its innovation roadmap. The process incorporates five steps, as shown in the colored rectangles: defining, needfinding, brainstorming, prototyping and testing. The results of each step, shown in the rectangles, are ecosystem, opportunity areas, unique ideas, low/high-resolution prototype and, in the end, after several quick iterations, a validated functional prototype which should

Table 1 Uniqueness of the i.DT training program and project execution

Category	Elements of i.DT (process, methodologies, training program and project execution)
Industrial business	Develop systematic "step-by-step" and "hands-on" need-driven innovation training and coaching courses customized for various complex industrial projects Provide a platform and encourage development teams from different disciplines to communicate with, challenge and learn from each other to think outside their technology field and in a system level Set up interim Steering Committee to involve high-level management, on a regular basis, to review, evaluate and guide project team with their insights on Siemens business, technology and market experience
Idea implementation	Train/coach along real projects with the goals of training development teams as well as generating need-driven innovation with business value for Siemens and its customers Build systematic training/coaching structure, including support from high-level management, close collaboration between CT and BU, etc. to enable the potentially disruptive project outcome to overcome implementation barriers and increase the go-to-market rate
China markets	Set a short-term (e.g. 4 months) training/coaching model to quickly understand the market breadth and depth, and generate innovations for the unique market needs in China
Development teams	Focus on R&D managers and engineers, instead of marketing people, in order to purposely train technical experts to think from the user perspective (horizontally) and to build up T-shape talents Focus on open-minded leaders to quickly spread and pass along i.DT methodology and its application Build up a database of case studies for i.DT methods and projects, in order for teams to best learn from example Empower teams to apply the i.DT methodology in their own future projects, generating business value

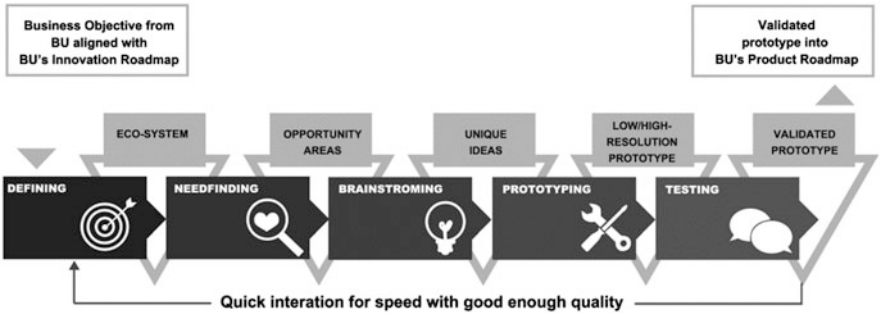

Fig. 1 The i.DT process

Table 2 Comparing i.DT with traditional R&D in terms of process and methods

Phase	Traditional R&D	i.DT
Defining	Define project topics with technology requirements	Gain a holistic project perspective through visualization of the ecosystem with all stakeholders involved and their relation to each other. Define project objective with Job-to-be-done from the perspective of user instead of technology
Needfinding	Focus on decision makers on the customer side and their requirements	Broaden the attention to all important stakeholders in the project innovation ecosystem, with comprehensive needfinding
	Focus on mainstream users or target group of users	Use extreme users to effectively find out hidden needs in the vast and diverse markets in China
Brainstorming	Idea generation sessions are often not structured. The efficiency of such sessions is low in terms of numbers as well as uniqueness of ideas generated	Ideation tools/methods that fit with the learning style and thinking mode of Chinese, e.g. interactive storytelling, brainwriting, etc. to stimulate teams to think out of the box, to express ideas even when they are immature
Prototyping	Time-consuming functional prototype building, simulation and testing, in order to validate the feasibility of the technology	Incorporate different levels of prototyping (from low to high resolution, etc.) and different stages of prototyping (Critical Function/Critical Experience Prototype, Dark Horse, etc.) to speed up the innovation cycle, especially on complex projects
	Start prototyping only when ideas are mature and specifications are complete, which happens nearly at the end of a project, resulting in costly big changes late in the process, caused by hidden problems that should have been discovered earlier	Build to think, and make ideas tangible immediately, especially in early stages, through low-resolution prototyping, to rule out risks as well as maximize learning experience
Testing	Within R&D, focus on functional testing to ensure feasibility and validate requested requirements	Test not just for technical feasibility, but also for human desirability and market viability
	Test within the project team	Test with peers from other disciplines for feedback from different angles, and test with high-level management for strategic guidance
	Technical feasibility is tested via simulation, functional prototyping or commissioning of pilot project	Technology feasibility is not enough. The competitiveness of the outcome is improved with two special testing criteria in China: unique ("not-me-too") ideas and "not easily copied" ideas

(continued)

Table 2 (continued)

Phase	Traditional R&D	i.DT
	Conduct benchmarking mostly about the features, functions and price on solutions of top players/competitors in the field	Three types of benchmarking are introduced: market, function, and experience benchmarking across boundaries of disciplines
Iteration	Try to perfect an idea with over-analysis and documentation before getting feedback from stakeholders	Fast iterations are enforced to quickly redefine challenges, re-synthesize user needs, explore possibilities and identify most promising solutions

be taken over by the BU as a part of its product roadmap. This iterative process involves a huge amount of work in exploration, convergence and readjustment with regard to potential user needs and innovative ideas.

Compared with traditional R&D in the industry, the process and methods of i.DT are featured in Table 2.

Defining for a Holistic Understanding of Project Scope from Stakeholders' Perspectives

In the "defining" phase, the project team starts by building an innovation ecosystem around the innovation challenge taken from a BU, mind-mapping different stakeholders and making the relations between each other visible; based on the initial understanding of the facts, barriers, and opportunities of their challenge, the team visualizes full-size personas for the identified key stakeholders. This first empathy-building activity enables the team to put themselves in the shoes of the persona and have an initial understanding of what the stakeholders' "Job-to-be-done"—a concept popularized by Clayton Christensen of Harvard University—could be. For example, for a project with the initial innovation challenge to "develop a urine strip reader for the Chinese market with a cost lower than €50", the team got a holistic picture of medical care in China by broadly mapping the different players, from the local government to patients' families, in an innovation ecosystem. This drew attention to medium/low-end markets for rural hospitals, where supply fails to satisfy demand due to huge patient flow. To have a clearer picture of the target user and his/her needs, the team created a persona—a visualized and detailed description of a typical user for whom the team designs. The persona in the urine project was a young physician in a rural hospital in Anhui Province named Dr. Wang. Putting themselves in the shoes of their persona and having empathy with him, the team understood that the "Job-to-be-done" for Dr. Wang had to be "to provide fast and accurate urine tests for indigent patients", instead of providing a cheaper urine reader device.

Rather than providing solutions to the initial innovation challenge, innovation ecosystem asks the team to take one step back. With "Job-to-be-done", the team is

guided to resolve the right problems by understanding the fundamental needs of the key stakeholders. An accurate and final "Job-to-be-done" usually cannot be achieved right away at the beginning of the project. With an initial assumption of the "Job-to-be-done" made from a preliminary analysis, the team experiences the whole i.DT process, during which they conduct observations and interviews, brainstorm, prototype, test, and redefine the "Job-to-be-done" based on their learning. Through several iterations of the process, the team's understanding of various stakeholders' needs is deepened, even changed fundamentally, and their final functional prototype is expected to be validated in terms of user desirability, technology feasibility and business viability.

Needfinding to Identify Critical and Hidden User Needs

Siemens' i.DT needfinding stage has two distinctive features: the first is to emphasize extreme users and the second is to engage R&D engineers, rather than people from marketing or sales, to conduct needfinding in the field.

Extreme Users

The method used in Design Thinking is to study the two ends of the bell curve of the user span to uncover hidden needs of mainstream users more easily. Mainstream users usually don't realize, or cannot communicate, their potential unmet needs, whereas the needs of extreme users are amplified and easier to study.

The concept of extreme users is extended and systematically developed in i.DT: Sorted by the frequency of using certain products or services, extreme users can be frequent users, less frequent users, or non-users. As for user experience, extreme users can be hackers or novices. Considering other aspects, extreme users can be the ones who use products in an unconventional or wrong way (e.g. WLAN as a product used by miners to communicate, locate or conduct rescue in extreme conditions of coal mines). Extreme users can also be defined as those who use alternative products to serve needs that might be shared by the mainstream (for instance, in the miner localization project "DigitUp", the team studied ants as extreme users who have lived for hundreds of millions of years as "miners" in order to explore all possible solutions of communication for coal mines; another team that researched shop lighting made some interesting observations and interviewed users in a "dark restaurant" where clients dine in complete darkness).

In the project CEEB—"Cozy and Energy-Efficient Building", a building management project, the typical users of the building's control systems are building managers and staff in the control room. The development team broke the thinking box of focusing on "central control system", and instead, investigated extreme users: home dwellers and office staff. To take the temperature control system as

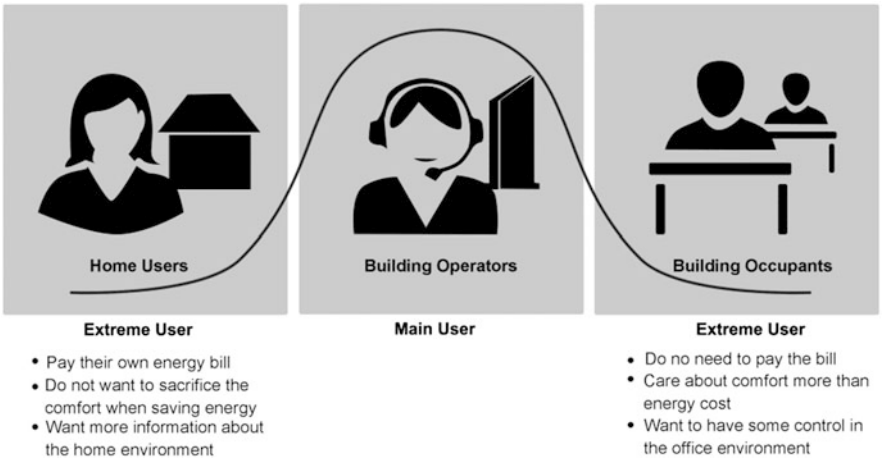

Fig. 2 Extreme users in building temperature control

an example, energy-saving and environmental protection are both hot trends in the area of smart buildings. But just as Fig. 2 shows, building occupants do not care about the energy bill because they do not have to pay it, but they care a lot about their personal comfort. In observation and interviews, the team recognized that, particularly, female office workers in a high-rise building feel too cold in summer and put blankets on their desk. The team made another interesting observation that some of the office staff "go against" the smart system. Some office staff blocked the smart curtains that fall automatically for shading the sunshine in the summer, just because they wanted to enjoy the sunshine!

There are different levels of needs, which make it harder to identify the hidden needs. For example, the basic need of the office staff in Fig. 2 is "to control temperature", which is easy to meet, but products that only meet the basic needs are not competitive enough. A higher level of the needs—"to conveniently control temperature" would rule out some products with low usability. Moreover, the ultimate goal is to find out the meaning behind the user's needs, which enables the team to think beyond short-term solutions. For the employees working in smart buildings of tier-one cities in China, they typically pursue premium purchases and seek highly-rewarding lives. Thus, only when "temperature control" is linked with "high-quality life" can the hidden needs of the office staff be met. In this case, "to have enough freedom to adjust the surrounding environment to their comfort" was the basis for the team to look for opportunity areas and move on to brainstorming.

Needfinding Conducted by Engineers

Most of Siemens CT's R&D personnel are experts in a certain technology field and hold a Master's or Ph.D. degree. Contrary to the stereotype of experts sitting in front of computers, or conducting experiments in labs to solve a technical problem, engineers in i.DT projects must go into the field to face end users and other stakeholders. The development team collects first-hand information on the real situation through carefully prepared and conducted observations and interviews. The resource from Siemens marketing is certainly important, but the goal is not only to uncover real hidden needs, but also to enable a development team to create innovative products through strong empathy with their users, rather than simply satisfy rigid product requirements delivered to them. This qualitative approach to collect needs of extreme users by engineers has proven to be very powerful. "It took this young team in CT just 3 months to get such a thorough understanding and many insights about the market, while it usually takes more than a year for a mature marketing department to do it", a manager said during an inspection of an i.DT project.

Brainstorming to Generate Unique Ideas

i.DT brainstorming is designed to fit with the learning style and thinking mode of Chinese, encouraging leading experts to think out of the box and stimulating them with inspirations for unique ideas. Examples of brainstorming tools are: inviting colleagues from other technology fields, thinking by action: sketching and prototyping, interactive storytelling, "yes, and" rather than "yes, but", as well as brainwriting. Most Chinese engineers are reserved, and tend to keep any thought to themselves unless it can be deemed perfect. But most brilliant ideas are incubated by collision of thoughts from different people. How might we encourage teams to express their immature ideas?

Taking "interactive storytelling" as an example, team members are asked to tell different stories about their project stakeholders through role-playing. Freeing their bodies helps to build a lively brainstorming atmosphere and stimulate ideas through stories. For example, in a medical care project, the team members conducted brainstorming sessions in this interactive way to find breakthrough ideas about how to provide fun medical services for child patients. A female engineer, over 30, assumed the role of a 7-year-old patient talking with her mom at home when she received regular urine tests. The engineer recalled that "I am a mother of a 5-year-old boy, so I supposed I had a pretty good knowledge of what he thought every day. To my surprise, it still brought me many new ideas and inspirations in the story-telling exercise." She found out that, in the world of the little girl, the household urine test equipment was old-fashioned and scary, although she was always awarded with candies after every test! If the process of a urine test could be

designed as a relaxing chat, resembling one between the girl and her Barbie, then the urine results would be much easier to get, and moreover, the experience for both the mom and her child would be much more enjoyable.

i.DT method coaches have developed different brainstorming methods and workshops customized for the needs of different types of projects and teams. The ideas from brainstorming are converged and selected by criteria: user desirability, technology feasibility and business viability.

Low-Resolution Prototyping and Testing to Speed Up the Innovation Process and Mitigate Risk

Benchmarking is conducted along the project to evaluate and further develop ideas. i.DT benchmarking is not just about product positioning vs. competitors (market benchmarking), but also about particular functions (function benchmarking) and user interaction (experience benchmarking). In one example of experience benchmarking, fast-food chains like McDonald's are famous for the speedy convenience brought to clients; it became one team's benchmark for setting up high-volume processes in Chinese hospitals for well-developed health care procedures in brain stroke care.

In addition, prototyping and testing are extensively applied to verify and explore of ideas and user needs. In i.DT's 4-month training/coaching program, needfinding serves as the basis, brainstorming serves as the medium and prototyping serves as the framework. Prototyping tasks are assigned every month to achieve different goals and motivate teams to study the project topic from different angles. For each prototyping stage, the team is expected to go through the whole i.DT process, and in the end, four iterations of the i.DT process are completed to achieve a validated functional prototype.

The four prototyping stages are adapted from the ME310/Engineering Design Thinking course at Stanford University. The first prototype stage is Critical Function/Experience Prototype (CFP/CEP), which asks the team to get started beginning with the one or two most critical aspects, rather than trying to conquer the whole innovation challenge at once. After the first round of prototyping, teams usually tend to focus on a certain solution, ignoring other opportunities in the project. The second Dark Horse Prototype lets teams put existing findings aside, pick a different critical aspect not yet considered, investigate needs of corresponding stakeholders, and develop wild idea-based prototypes with a low assumed likelihood of success. The first two stages are in the diverging phase of the project, whereas the last two stages, the FunKtional Prototype and FunCtional Prototype, are in the converging phase. During FunKtional Prototype, teams ought to crystallize their learning and ideas into one to two system-level prototypes that do not have to function completely. At this point, teams should take into consideration requirements from people, technology and the market. In the final phase, an original functional project

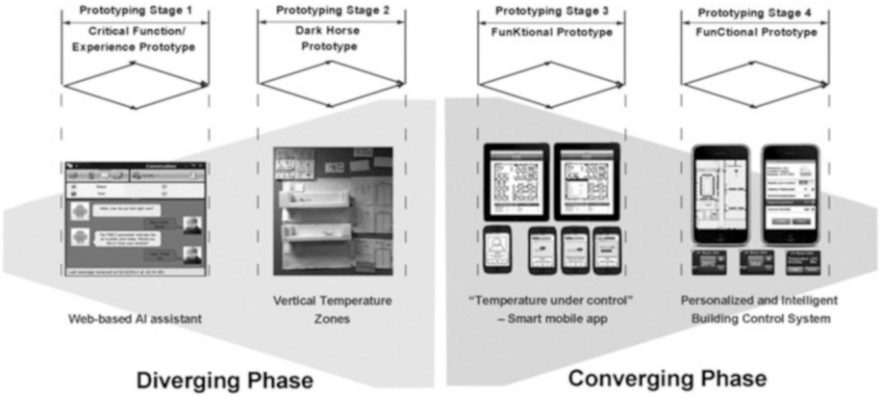

Fig. 3 Prototype stages of the building management project "CEEB—Cozy and Energy Efficient Building"

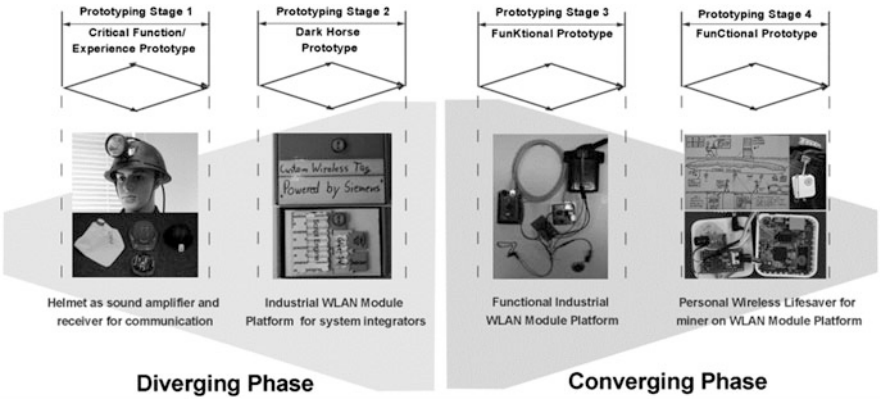

Fig. 4 Prototype stages of the miner project "DigitUp"

outcome with disruptive potential is expected, which should be presented with a practical business model, ready to convince the BU about user desirability, technology feasibility and business viability. The four prototypes from CEEB, as shown in Fig. 3, exemplify how development teams, by following the iterative i.DT process based on different prototyping tasks, can effectively develop innovations with disruptive potential.

In i.DT, a prototype is not used for verifying technology feasibility (e.g. whether the structural strength of gas turbine blades meets standards or not), but as an effective tool to communicate ideas, lubricate brainstorming and get feedbacks. Figure 4 shows several examples of the concept prototype from miner localization project "DigitUp". Rather than spending several weeks of hard work with hardware assembly and software programming, this project team put together some paper

models costing only one fun hour to make their ideas tangible, enabling them to test their ideas with system integrators to get timely and critical feedback.

Testing is not only a way to get feedbacks from users on whether a solution is desirable or not, but also a way to test products' technological feasibility and commercial viability. i.DT propels teams to use "not-me-too" and "not easily copied" as principles to come up with competitive ideas and prototypes. This usually requires strategic feedback from upper management and business experience shared with the BU. The i.DT training program provides a platform for innovation where ideas with disruptive potential could become more than just patents: actually a part of the business roadmap, and later on, new products or features for products in the market.

i.DT Outcome

In the previously mentioned building control project, CEEB, the team un-earthed one need of extreme users: "to have enough freedom to adjust the surrounding environment to their comfort". Through several iterations of the i.DT process, the team consolidated their innovative ideas: to provide building users with a personalized and intelligent control system. In a building with Siemens' smart building management system installed, the interior space is virtually divided into a number of sub-spaces; each employee—as a building user—can personalize temperature, light, even the health index of the surrounding environment, simply on their smart phones. The building management system will design the sub-spaces according to each user's locations and personal preferences, so that users can directly interact with the building and enjoy a better working environment.

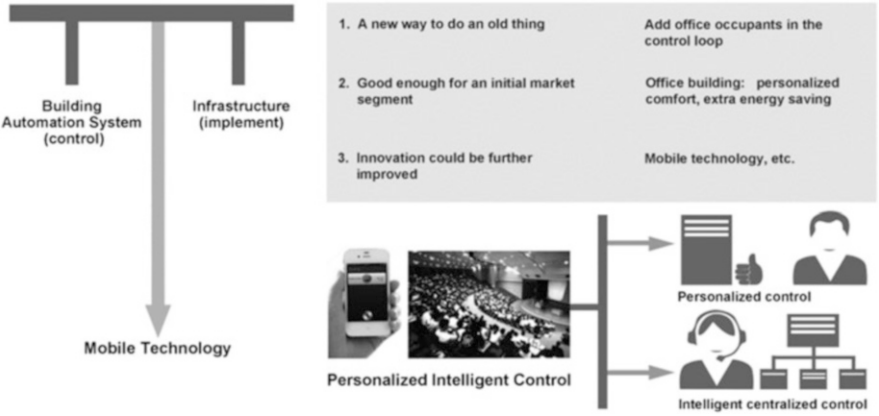

Fig. 5 The integration and fusion innovation in the building management project CEEB: starting horizontal with market-/user-needs and going vertical through technological strengths

As Fig. 5 shows, this innovation outcome has overthrown the first generation of personalized, but general control using control panels and the second generation of smart, but centralized control using control centers. To develop sustainable innovations, the team went into great depth and identified vertical technologies that could be continuously improved by leveraging Siemens technological strengths in areas like mobile technology. Moreover, based on the concept of accurate energy distribution that fulfills users' different needs, the innovation outcome also satisfies the needs of other stakeholders (government, building owners, etc.) by saving 15 % more energy than the existing smart building control system.

i.DT projects always have two goals: the first is to provide an innovative outcome with disruptive potential that becomes a part of the BU product roadmap. The second goal is to have trained team members able to apply a need-driven i.DT approach in their future projects and disseminate i.DT methods and mindset to the innovation community in Siemens.

Learning and Future Plans

Supportive Innovation Management and Supportive Ecosystem Are Critical Success Factors of i.DT Innovation Projects

The validated functional prototype as the outcome of the i.DT process is expected to return to the BU for implementation and commercialization, to create real business value. For any innovative ideas to traverse pre-development in the R&D department and enter the development stage in the business unit (valley of death), the challenge in a multinational company like Siemens is to have strong upper management support, as well as close collaborations between Corporate Technology and the various business units. To reinforce supportive innovation management, the i.DT expert team has set up a Steering Committee with stage-gate project reviews to encourage active participation of upper management from the project's starting point. The project development teams are also urged to build up strong networks with upper management teams from both CT and BU to guarantee both access to critical resources and their commitment in decision-making processes. But in the entrenched business culture defined by hierarchy, discipline and profit, establishing such management support and empowering network is extremely difficult, as is ensuring that any original idea can survive from the bottom up.

Thus, it is critical to build up a strong database of case studies to establish i.DT's reputation through successful projects. In the absence of data for direct comparison of project outcomes with and without the intervention of i.DT, as well as long-term evidence of increased patents, publications or increased new products coming from i.DT-based innovations, the i.DT expert team has nonetheless built a framework for each distinctive case and extracted best practices from every project. The i.DT

program, with its process and methods, is exemplified by these case studies that have had impressive positive impact in upper management meetings and new rounds of i.DT training. In addition, extensive research has been carried out to collect case examples of human-centered B2B development projects from external resources, to convince internal upper management from both CT and BU.

The i.DT expert team has also been committed to strengthening the necessary support for project development teams by fostering the innovation ecosystem. Since the beginning of the program, the i.DT lab Tian Gong Guan has been designed as a busy and colorful workspace, where teams from different departments come to work together. Over time, this space, the creative atmosphere and design artifacts from former projects, like personas and prototypes, have proved to be very interesting to various internal departments, as well as external media and governments. After 3 years of successful project development in the creative working environment, it has now expanded to the whole first floor of Siemens CT China. The new i.DT space consists of a multifunctional workshop space, three project rooms and a professional machine shop for advanced prototyping.

To cultivate the i.DT innovation culture, an innovation community was also set up, in the form of an informal lunch meeting each Thursday at noon. The innovation community has reacted quickly, with more and more former i.DT team members involved in the loop. Moreover, the activities during the lunch meeting have expanded from the early-on improvising exercises to more diverse events that empower interdisciplinary collaborations. For instance, different research departments have volunteered to present their ongoing project activities in show-and-tell form, and researchers invited from Tsinghua University shared their interesting projects. Such events, traditionally held in closed-door meetings with decision-makers, have given free access for the audience spanning numerous disciplines, including healthcare, city and infrastructure, industry, energy and personnel from Intellectual Property, Human Resources, etc.

But this is still not enough. There are a number of different innovation initiatives within the huge global network of Siemens; the i.DT expert team believes future collaboration with these internal innovation initiatives will be as important as cooperation with external innovation communities.

Customization of Innovation Programs Is Critical for Industrial Business in China

The innovation program was initiated as a systematic short-term (4-month) training program, with four teams working in parallel on four distinct topics. The program's short time horizon was determined by the profit-driven business environment that demands potential business value for ramp-up. It was also intended to reinforce speedy iterations of the innovation process, which is especially critical in the rapidly growing markets in China. But early on, the i.DT expert team figured out

that a fixed training duration was impossible in a business environment where different research projects have different timelines and the availability of researchers is highly unpredictable. And, usually, further support from i.DT method experts is needed after the completion of i.DT training, which marks the start of a new project to nail down user requirements, technical specifications and a business plan. Thus, more flexible i.DT training, from short-term introductory workshops to long-term collaborations, has been designed and provided.

An intentionally diverse team from different departments (R&D engineers from CT and BU, marketing, sales) is hard to fulfill, sometimes because of the lack of resources and availability, but also because of internal competition and the discrepancy of interests among decentralized departments of a big company. But interdisciplinary collaboration has been proven to be very powerful, even when different teams sit in the same workspace, occasionally exchanging thoughts. For instance, one team working on indoor navigation was inspired by a shop lighting project team to use light as a tool for navigation. The i.DT expert team has thus designed several cross-team collaborative exercises to encourage such outside-the-box inspirations.

In addition, the training program has been customized to incorporate hands-on training and coaching with teaching-by-doing. Unlike university students who regard learning as the key driving force for projects, most project teams expect i.DT to be an effective tool to better deliver business value. Many new team members are skeptical about i.DT upon entering the lab. Learning an ambiguous innovation process is not simply about knowledge delivery; the team has to learn by doing, with interest and motivation. Thus, the i.DT expert team acts more like an active participant in the project team, going together with the team into the field, conducting brainstorming with different stimuli, and building low-resolution prototypes with them. For instance, in a past medical care project, the team had made little progress for 2 weeks in terms of needfinding, since they were reluctant to reach out to hospitals to get first-hand information about the environment, stakeholders and processes; one i.DT expert took them into a hospital on the following Saturday. By observing patients and talking with the patients' families in the brain stroke inspection ward, the team found many unexpected insights, especially about how completely ineffective the current pre-hospital workflow was. Such hands-on training and coaching gradually changed the team's mindset to actively apply i.DT methods in their project.

Building up case studies with close relations to Siemens businesses is also a big part of the i.DT training program. As mentioned before, the case study is a powerful tool to secure business collaboration supported by upper management and it has been used as intuitive training material for teams to quickly learn by example. The most frequent question the i.DT expert team faced by team members has been "Have you got a successful example using this methodology from a project similar to ours?" The i.DT expert team believes that human-centered design innovation exists everywhere, from gas turbine to IP services, but if documenting and sharing learning stop, method experts and development teams will have to start from scratch and will not be able to build on it and speed up the process.

Useful and Unique User-Driven Innovation Methods Are Critical to Cultivate Innovative Thinking and Doing

To cultivate innovative thinking and doing of the development teams, the i.DT expert team had to first prove the innovative nature of i.DT methods. Taking needfinding as an example, if the experienced marketing departments have already collected so much data about user needs, what is the point of starting over again? How can we prove that hidden needs can be retrieved through i.DT needfinding rather than traditional marketing? By resolving such questions, the i.DT expert team has consolidated some unique user-driven innovation methods proven to be useful for development teams in the Siemens environment in China.

For instance, the "Job-to-be-done" is early in the first phase of an i.DT project to transform the development team's business objective from the perspective of technology to a focus on users. The immediate overturning of the original innovation challenge at the beginning of the process effectively encourages participants to start thinking unconventionally throughout the project process.

Many useful and unique lessons were learned from experimental exercises in one project and were immediately applied to others in the program. The development of the brainwriting method is such an example. Brainwriting asks the team to write, rather than talk, to communicate and generate ideas, which is especially effective in Chinese teams, where members are often too reserved to talk. Later, the i.DT expert team also found out that brainwriting can be a powerful idea generation tool to overcome cultural barriers in ideation sessions.

Some of the lessons-learned are yet to be built into the methods database for training innovative minds. For instance, many i.DT team members have used other innovation tools before: TRIZ, which provides successful principles in innovative problem-solving of a particular problem; SCRUM, which is a powerful agile approach to deal with complex projects in software development; and Six Sigma, which is an analytic tool to systematically improve existing products. These innovative approaches are not mutually exclusive with user-driven innovation processes and methods, and should be intelligently incorporated together, to facilitate better innovation outcomes.

The i.DT expert team has kept updating the useful and unique methods in the industrial environment in China that have become important assets for cultivating innovative thinking and doing of the people. To foster this approach within the talent pool, the i.DT expert team is also working closely with the Human Resource department and offering workshops, as well as short-term projects, with the Siemens People Development Program.

The world has been changed by innovation; so has innovation itself. The innovation model of i.DT, developed by Siemens CT China and based on China's innovation environment, has achieved initial success. Corporate Technology in China has over 400 employees, issued more than 1500 invention reports and has had a great impact on Siemens global and domestic business. Through i.DT alone,

nearly a hundred managers and researchers have been trained, with more than 13 business projects conducted. Many of the graduates from i.DT are now leading i.DT innovators in their own areas of research. In addition, a number of "not-me-too" innovation outcomes are in the pipeline of business implementation.

i.DT is still evolving. Development of i.DT itself is a human-centered project in which the i.DT expert team is constantly adjusting existing methods and creating new approaches, as well as developing programs to foster the generation of innovations for Siemens' customers.