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A Lightweight Innovation Process for Software-Intensive Product Development

Tony Gorschek, *Blekinge Institute of Technology*

Samuel Fricker, *University of Zurich*

Kenneth Palm, *DanaherMotion Särö*

Steven A. Kunsman, *ABB Substation Automation Products*

An innovation process using face-to-face screening and idea refinement with heterogeneous audition teams can enhance the long-term perspective of product planning and development.

The product development environment facing most companies today requires not only having an ear to the ground to react to market trends ahead of competitors but also keeping a close eye on key customers to assure financial security. Having a long-term perspective featuring the conception and development of long-term innovations can be hard when close quarter bottom-line results dominate, because a dollar earned today is generally perceived as more than a dollar earned tomorrow. But without innovation, the competitive advantage will decrease over time,

and long-term productivity will drop to diminishing returns. This is especially true for companies producing software-intensive systems. Software is becoming a large part of the competitive advantage of traditionally hardware-focused systems such as cars, robots, and power systems, where feature sets traditionally offered and controlled by hardware are now run by software. In addition, the new features offer increased functionality. Just look at an automobile driver's environment and its evolution from a couple of mechanical switches to the fully integrated entertainment and control centers of recent years. Development companies can view the new functionality software offers as a revolution with almost no production costs.

However, most companies are devoting substantial resources to reactive development—that is, reacting to requirements coming in today. In

a market-driven environment, incoming requirements can number in the thousands or even tens of thousands per year, and a company must handle all this information without being overloaded.¹ This puts pressure on the product management organization, making it harder to see beyond today's needs and the narrow perspective of ongoing and soon-to-be initiated projects. The long-term success of any company depends on the continuous development of products and technologies that become the successful products in the portfolio—that is, the stars of tomorrow.

It's not all bad news, though. Most market-driven companies possess an often underutilized resource: the employees' capability for innovation. Market-driven organizations cater to a number of customers. So, the development organization must have a deeper, more diversified domain un-

Related Work in Innovation Management and Product Development

Research in innovation management recognizes that even if organizations covet innovation, enabling and supporting actual innovation is difficult as managers are often risk averse, preferring to invest in what they know. This is especially true for established companies with well-aligned processes and strategies.^{1,2} Andrew Van Den Ven confirmed this and identified two major challenges: creating an infrastructure that supports innovation and, when a new idea is elicited, getting the new idea realized in competition with everyday product development activities.³

Asea Brown Boveri and DanaherMotion recognized this *innovation imperative*,⁴ which is the basis for the development of Star Search.⁵ Star Search is based on, and inspired by, several innovation models and best practices (see Figure 2). The Star Search initiative didn't aim to reinvent innovation management but to build on established principles and concretely realize the sometimes abstract recommendations offered by innovation management models. Many innovation management models either are very abstract (covering general concepts—giving the “what” but not the “how”) or focus on how top management should enable innovation. Star Search focuses on a simple, practical process for eliciting innovation candidates, refining them, and ensuring that the candidates have champions so that they can compete for development resources that are often earmarked for short-term market-pull development.^{6,7}

General management and quality frameworks such as total quality management embody the principles of innovation with their motto of “delight the customer” and the utilization of ideation events at which new ideas are put forward. This is also true for process improvement models such as CMMI that include innovation enablers. The main issue with models supporting new-product-development management is that they're aimed at repeatability, predictability, and controllability, all targeted at increasing efficiency and shorter development cycles.⁸ In addition, the focus on enabling innovation in or close to projects is somewhat self-defeating because good ideas are often shelved that might negatively influence project schedules.⁸ An innovation management model focused on eliciting innovation candidates such as Star Search must be independent and a part of the continuous innovation effort, with a longevity superseding any one project or batch effort such as ideation.^{3,6,7,9}

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derstanding than any one customer. For example, a car manufacturer is well versed in production technology and the use of robotics, but a development organization developing robots for the automotive domain has probably accumulated experiences from many customers and domains. This makes the development company, which includes developers, marketing staff, salespeople, installers, and support staff very suited to not only interpreting incoming needs but also proactively suggesting innovative features and new products.

From a technology and software product management perspective, it's important to generate and select new product ideas that aim at strategic growth markets² and funnel them into development. This requires generating and capturing ideas for long-term innovations. It also requires creating proper decision-making processes and business justification materials that support realization of the ideas so they can survive the constant bombardment of requirements from external sources. Value propositions and business cases are a key factor in such decision-making processes. They help balance the considered long-term innovations with indispensable short-term development efforts.

The ability to encourage innovation from within the whole organization is crucial. Innovation requires input from research and development as well as from marketing and sales. Also, the process of eliciting, screening and selecting innovation candidates must be cost-effective to compete with short-term product development activities. The process must support decision support material that's good enough to support product management decisions and serve as the basis for estimating software development effort.

Star Search is a lightweight process that any company can use to maximize the continuous utilization of scarce resources for innovation. Star Search goes beyond a “new idea workshop,” making innovation a part of normal day-to-day business. Star Search was developed in close collaboration with, and subsequently piloted at, two companies, Asea Brown Boveri (ABB) and DanaherMotion (DHR). ABB is a leader in power and automation technologies. ABB develops software-intensive systems that help utility and industry customers improve their performance while lowering environmental impact. The ABB group of companies operates in about 100 countries and employs 120,000 people worldwide. DHR develops and sells software and hardware equipment for navigation, control, fleet management, and servicing automated guided-vehicle systems. DHR is a company with about 100 employees located in Sweden.

Short Term vs. Long Term

Star Search doesn't differentiate between product and process innovation,³ but this article focuses on product innovation. The key to a software company's survival is selecting new product ideas from a broad range of potential innovation candidates that support the business strategy and have the greatest financial impact. This is also true for catching and implementing suggestions for improving the development process itself. Using Star Search for process innovation is similar to the *Toyota string*—that is, allowing anyone to suggest better ways of working.

There are many types of new product ideas: a new software feature extending a present product offering, a completely new product, or even a new marketing or segmentation angle that could enable expansion toward a previously untapped customer base using present-day products. Other innovation candidates support internal innovation: improved development processes, reduced software design complexity, or reduced software product cost—for example, a candidate could make a case for software refactoring.

Before developing Star Search, ABB and DHR had several other innovation activities, each evaluated on-site and described in the next few sections (also see the sidebar “Related Work in Innovation Management and Product Development”).

Events for Idea Generation and Planning

These activities generally occur twice a year, involving key personnel such as technical management and senior department representatives. The format is a workshop in which participants bring or create new ideas. The potential drawback is that not everyone can contribute directly—that is, the invited participants decide what will be discussed; even if the idea is that department heads should convey good ideas from their departments. A one- or two-day meeting has to accommodate all new ideas, as well as compete with reactive issues and requirements from key customers. It is not unusual that the event participants run in and out of the workshop on the phone dealing with everyday job issues and ongoing projects.

The Idea Database

Most companies probably have one, or several, idea databases. In general these databases act as suggestion boxes where anyone can deposit good ideas and suggestions for innovation. Ideally, product managers regularly screen suggestions, singling out the best candidates for further investigation. In theory this seems fine, but in reality

several problems exist. Handling present-day reactive development and dealing with today's incoming requirements takes precedence over the perceived luxury of parsing a new source such as the idea database. This potential source of innovation thus turns into a black hole that isn't a priority. Consequently, people contributing to the database get no feedback and stop contributing.

Assuming that the database was screened regularly, the contents are often sparse compared to competing reactive ideas. For example, a key-customer requirement is backed by the immediate promise of sales and revenue (or their potential loss). It's often very easy and straightforward for product management, for example, to create a business case associated with such a requirement. On the other hand, a good idea scribbled down by a developer in the idea database might be very relevant (and have great potential) but isn't backed by anyone. This leads to an uneven playing field even if the idea database is in fact screened.

Also, identifying high-impact ideas requires an innovative combination of strategic, market-based, and technological aspects. Coworkers can achieve this by negotiating these aspects with each other through entering the problem-solving mode.⁴ The use of idea databases hinders effective cross-functional communication to resolve such conflicts.

A Dedicated Research Department

Many companies have dedicated resources for research and development of new ideas and technologies. Companies with the resources for corporate research have an advantage because they focus not on solving today's problem but on looking forward into technology enablers and predicted problems. However, corporate research doesn't utilize the practitioners of a company's operative parts—for example, developers, salespeople, installers, support staff, and so on. Most corporate research employees are bright scholars that often haven't been truly exposed to the company's products, product development, markets, and customer issues and demands. So, disconnects occur between the research and key business drivers.

Informal Communication

Any practitioner will tell you that the informal way of getting things done is often the dominant one. This isn't necessarily bad. In some cases, it can even compensate for a lack of scalable and realistic innovation processes. Problems are evident, however: people in power will get their ideas through, and the person screaming the loudest will be heard

The ability to encourage innovation from within the whole organization is crucial.

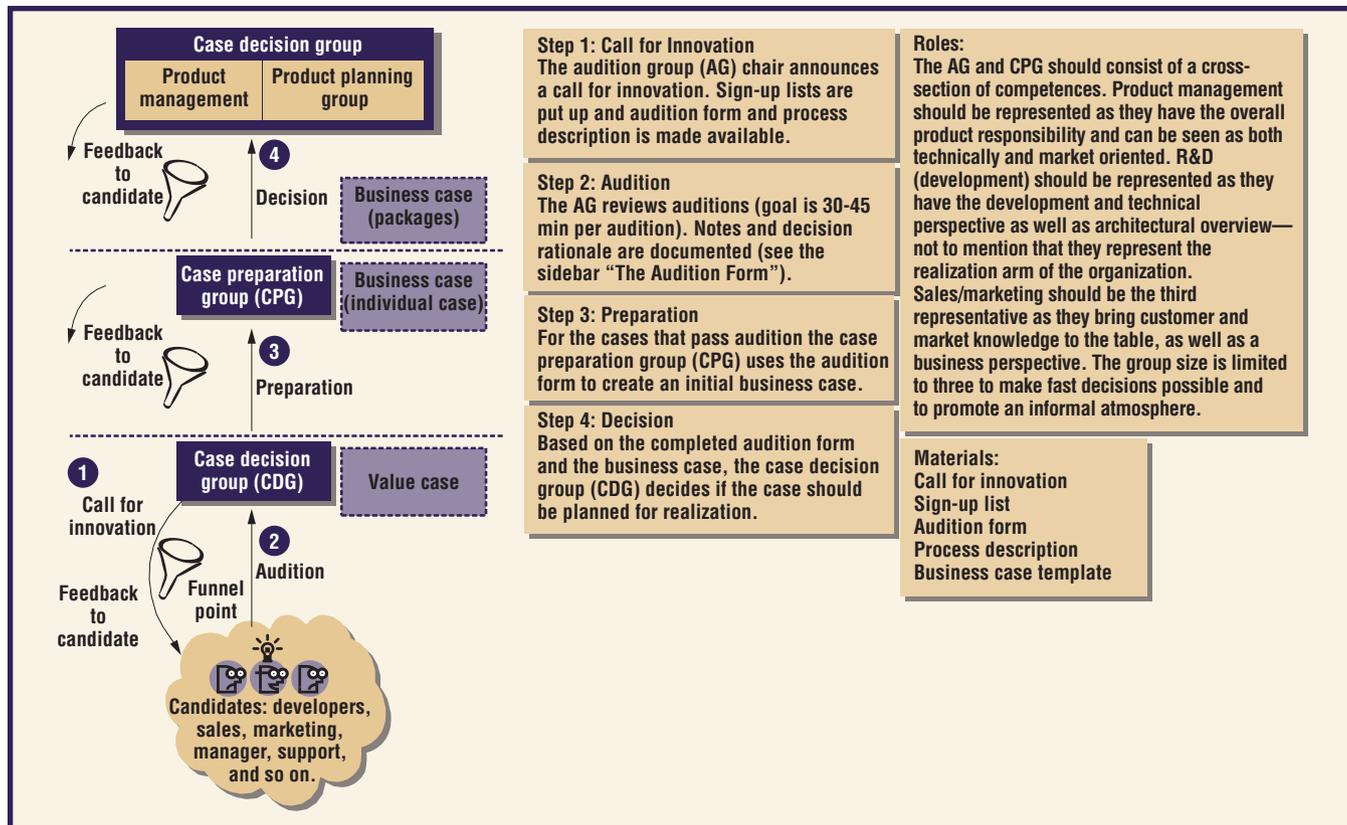


Figure 1. Star Search overview. Each step of Star Search is designed to elicit ideas and improve them as they move up the decision chain. Each step is well described and each participant has different roles to fill as shown in the figure.

first. This problem is especially important for global companies: distance hinders or even breaks such communication. So, organizations might not capture the best ideas at all or find the associated champion to support those ideas. In addition, the vast majority of practitioners won't be able to compete and therefore aren't motivated to raise ideas for consideration.

Star Search

Star Search consists of the four steps in Figure 1. Here, we describe each step, together with lessons learned. The lessons learned are a result of running Star Search over more than a year. We collected observations made by us and Star Search participants, and interviews were conducted with members of the audition groups and senior managers in charge of the innovation initiatives. In addition, each lesson learned is connected to the innovation management best practices summarized in Figure 2.

Step 1: Call for Innovation

The audition group (AG) chair announces a call for innovation. This entails sending out and posting information to all employees that the company has scheduled a Star Search audition at a certain time and place. People sign up to participate. If few peo-

ple sign up, the audition is short. If many sign up, the audition can be as long as necessary, even spanning multiple sessions.

Information about Star Search, the audition process, and its goals is important and should be made available and communicated during the call. The AG chair makes an audition form available that enables potential contenders to reflect on their idea and formulate it for the audition (see the sidebar “The Audition Form”). Contenders can present their ideas in many forms, depending on their preferences. They can prepare slide presentations and actively sell the idea, or just sit in front of the AG and present their ideas with little or no preparation other than the form.

The AG can formulate the call to premiere certain aspects; for example, a specific product line or development process can be the main focus. This serves two purposes. First, it can limit the number of innovation candidates. Second, it can focus on a specific area of interest to the organization. So, the AG can use goals related to company strategy to angle calls.

Step 2: Audition

The audition takes place in an informal setting with AG members and the contender. Each case is presented and discussed for a predetermined

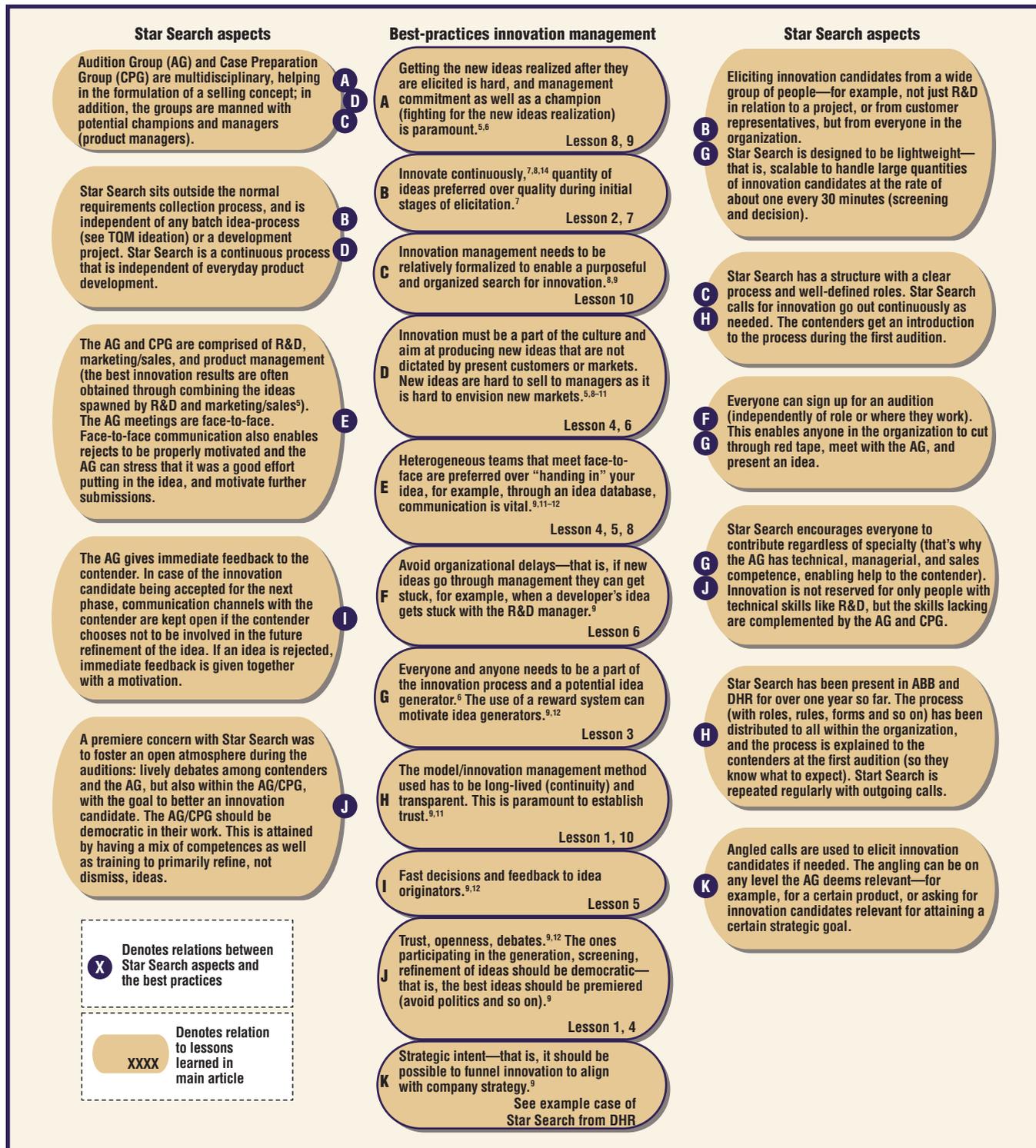


Figure 2. Overview of best practices in innovation management and relation to Star Search. The utilization of established innovation management concepts was central to the development of Star Search.

length of time—for example, a 10-minute introduction and presentation by the contender, followed by a 15-minute question-and-answer period. The audition's most important parts are the initial refinement and elaboration of the case

and the AG members' assessment of the potential business value. The AG members' job is to help the candidate refine and improve the case. A distant second objective is to dismiss ideas—that is, screening. Finally, the AG ensures that all fields in

The Audition Form

Here is an example of an audition form, which is the base for a value case. This is the minimum information a contender should have reflected upon as preparation for the audition.

- *Source.* The idea's source.
- *Title.* A short title of the proposal, idea, or innovation.
- *Description.* A general description of the idea.
- *Present products affected.* Because some ideas will be based on previous products or features, a short impact description could be relevant (at least a list of products potentially affected). One additional aspect is to think about value dependencies; that is, does the new idea compete with or cannibalize present products?
- *Why/benefit.* Who does the idea benefit? Why is it relevant?
- *Potential customer/market.* The candidate must have both the technical perspective and a marketing and sales perspective.
- *How to sell this?* A slogan or idea for marketing/sales.
- *Estimated cost.* A cost estimation (including a separate field describing what the estimate is based on—for example, previous experience).
- *Technical risk.* A short description of potential technical risks.
- *Infrastructure risk.* What's the risk to the company infrastructure; for example, can present sales and marketing staff handle the new idea or product?

the audition form are filled in properly and validated using the different perspectives represented in the AG, in effect creating a *value case*. A value case is a light version of a product or feature business case prepared by the AG. A full business case isn't prepared at this stage for reasons of scalability.

If the AG dismisses a case, they should offer a proper reason for this decision to the contender. The AG should also document all reasons to enable decision traceability. In addition, the AG should make dismissed cases available within the company to avoid repeated submission of an idea without refinement that takes the original decision into account.

Lessons Learned from Steps 1 and 2

We learned five lessons from steps 1 and 2.

Lesson 1. Trust is an issue the first time a company presents Star Search to its coworkers. Practitioners are used to learning new processes and models, many of which initially don't lead to any real change and thus leave them disillusioned. This can lead to only a few people participating in the first calls. The management team must remain committed and demonstrate that it will repeat the process regularly—depending on people's interest in submitting new ideas.

Lesson 2. Real gee-whiz ideas are thinly spread. So, involving as many idea contributors as possible is crucial for high-impact idea generation.

Lesson 3. A reward system can improve motivation and show that the organization values idea input. If salesmen get commissions on sales, why shouldn't engineers get rewards for innovation? In addition to monetary bonuses, symbolic rewards are also motivating factors. Simple recognition, respect from peers, or funding for a prestudy are rewards that work in practice.

Lesson 4. The audition group should be fair (democratic) in processing and evaluating ideas. It shouldn't dismiss good ideas, and it should foster a good atmosphere for the contenders. AG members sometimes have difficulty helping and refining the case instead of just critiquing. One reason is that many requirements compete for limited resources. One way to help (and essentially train) the AG to focus on refining innovation candidates is to have an external party available as a moderator. The researchers managed this role in our case. It took only a couple of auditions until the moderator was no longer needed.

Lesson 5. The AG's leader should dismiss ideas in a way that encourages future idea submissions.

Step 3. Case Preparation and Screening

The AG conveys the cases passing the auditions to the case preparation group (CPG). The CPG has two major functions: further refinement of the case and triage, if appropriate. As part of the refinement, the CPG prepares an in-depth business case. The CPG can call the case's originator (the contender) to answer questions and help with this activity. As the CPG prepares the business case, it should call additional experts to review and provide input and case improvements—for example, estimations, feasibility checks, risk analysis, and software architecture impact to gauge the technical long-term impact.

As experts perform more analysis, it's only natural that some reprioritization occurs. For dismissal, the same rules apply as during the initial audition: the decisions must have a proper motivation and the CPG should record the rationale.

The CPG should have the same background as the AG but don't necessarily have to consist of the same members. The cases can help indicate the type of competence the CPG will require. However, changing the group members from AG to CPG carries risks. First, people from the AG can act

Example Case from DanaherMotion

Figure A outlines the evolution of an idea presented by a candidate in an audition to develop software that would optimize the charging of automated guided vehicles (AGVs). The company had previously rejected this idea because the rate of optimization only resulted in small savings. However, during the audition, sales and product management staff added new arguments and features—that is, selling points for the idea—that the AG and subsequently the CPG documented by updating and complementing the value case. The AG passed the refined idea to the case preparation and screening step (Step 3), where the CPG put additional time on refinement and the creation of a business case that primarily focused on the environmental aspects of this solution along with cost savings.

During Step 4, the case decision group deemed the idea worthy (A) of extra analysis as the business case for environmentally friendly AGVs was interesting. After analysis, the case decision group gave the idea a new container when the original idea was proposed as a part of a new product line (Green Line AGVs). The product managers and product planning board searched the current requirements repository for features in line with the overall idea (B), and the product management organization ordered a new call for innovation with (C) the angle of Green Line AGVs to find more ideas for the new product line.

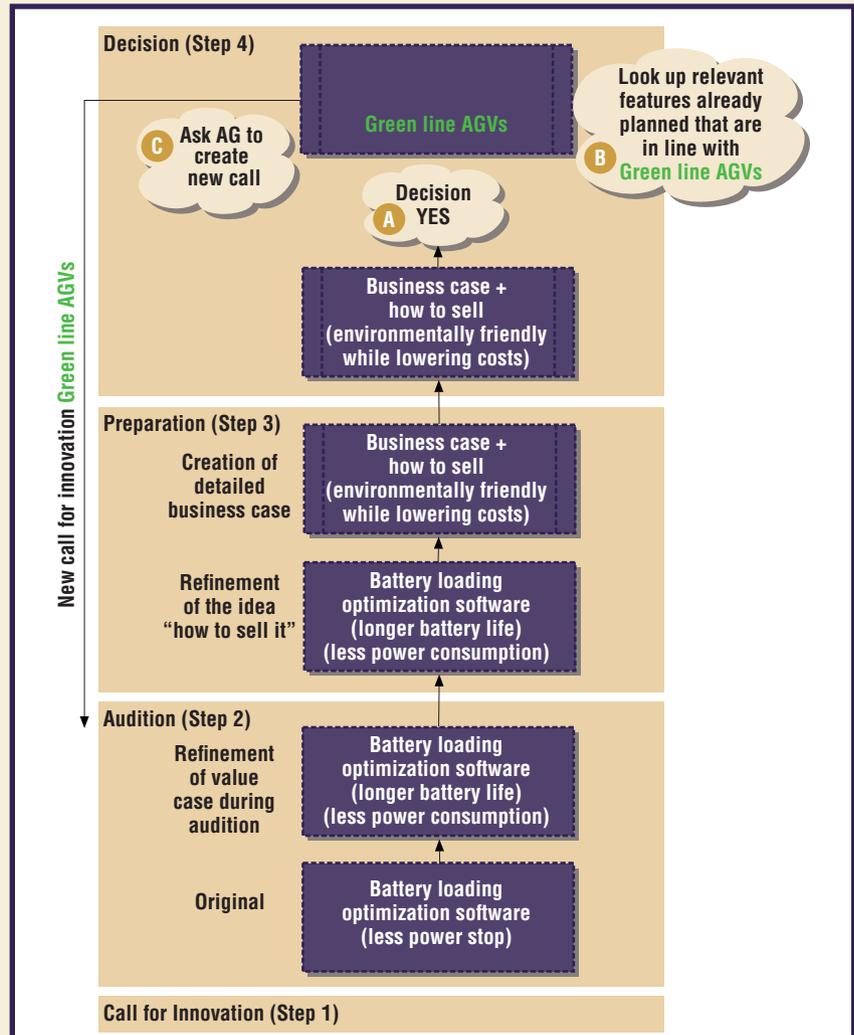


Figure A. An example from DHR shows the refinement of an idea, from a technical concept to a sellable and marketable product as Star Search team members add refinements to the original concept.

as champions of the cases they audition and don't dismiss. This effect can be lost when the organization changes group members. Second, new people need to read up on the case and might lose tacit knowledge.

Lessons Learned from Step 3

We learned three additional lessons from Step 3.

Lesson 6. If the contender has to assist the CPG with the review process, this shouldn't be done in addition to the normal everyday workload. It's important that a successful audition not be seen as additional work; rather, time must be budgeted to avoid the feeling of penalization. To support such

budgeting, upper management could give line managers goals stating the expected number of successful cases for their local organization to contribute in a year.

Lesson 7. The level of refinement—for example, how detailed the business case is—should be good enough for assessing its potential benefit, reward, and risks. An indicator that we used was the level of refinement performed under normal circumstances (outside of Star Search) when product managers and the product planning group consider a new software product or feature.

Lesson 8. The main goal of Step 3 is to ensure

Out of all the items in the site's development pipeline, 25 percent are based on innovation candidates from Star Search.

that the cases prepared are well understood and documented at least as well as all other requirements coming from customers and stakeholders. The key is that the best ideas should be selected; lack of information or analysis due to bad preparation shouldn't be a major determinant for dismissal later in the process. In addition, during Step 3 the AG or CPG should establish a champion for the innovation candidate. If this can't be done (a champion can't be found in the AG or CPG, or by the AG or CPG), chances are that no one really believes in the idea to begin with.

Step 4. Case Decision

The CPG passes the now-refined cases to the case decision group (CDG). This group already exists in every software development organization. It's the group that prioritizes and selects the requirements to implement. It can be product management or a product-planning group. Star Search should reuse this infrastructure. The only difference is that the CDG has new cases coming from Star Search as input to their release planning and prioritization work.

Lessons Learned from Step 4

We learned two additional lessons from Step 4.

Lesson 9. One potential problem is that cases from within the organization can lack the backing of a champion. This can become a threat during the last phase, when the CDG selects cases for implementation. Star Search can alleviate this threat. First, the level of refinement and analysis of Star Search cases is often better than those performed on normal requirements, which improves the accuracy of estimates and risk analysis. Second, the professionals working in the Star Search audition and case preparation steps already support the case. Otherwise, they would have probably dismissed it. This gives the case backing, which would be lacking if, for example, a developer just submitted an idea directly to product management.

Lesson 10. Transparency of the overall Star Search process is paramount. Transparency motivates participation. The Star Search leaders (for example, AG and CPG members) should keep idea contributors informed about where their idea is in the process and give them insight into the reviews and rationales for any decisions taken.

General Results and Conclusions

With most process improvement initiatives, quantifying the value and effects is difficult. This is also

true for many innovation initiatives.¹³ However, we can observe some indications (also see Figure 2). For reasons of anonymity, however, we can't state details and exact mapping to companies.

One site increased the number of innovation candidates that have been auditioned, refined, and selected for realization (put on the product roadmap) by over 25 percent after instituting Star Search. No innovation candidate has gone through the development process owing to the short time Star Search has been in place. However, the share of new ideas in the site's product development plans has increased. Out of all the items in the site's development pipeline, 25 percent are based on innovation candidates from Star Search.

One site reports a submission rate of innovation candidates of about 10 percent each year—that is, one innovation candidate per 10 employees. Out of these, about 25 percent were selected and underwent prestudy. Of these elaborated innovation candidates, about 20 percent ultimately made it to market after development. So, a total of approximately 5 percent of the innovation candidates make it through the entire innovation process to the marketplace while competing with short-term customer needs.

One site reports that the theme of submitted innovation candidates influenced the candidates' success rate. A theme in line with the company's product strategy significantly increased the success rate.

One site reports 30 to 60 minutes of audition time (initial screening, step 2) per innovation candidate. Whether this is lightweight, and scalable, depends on the organization's point of view. We feel that this is a reasonable effort. However, none of the sites perceived the handling of innovation candidates as a problem.

The number of innovation calls going out depends on the company's related processes—for example, budgeting and development cycles—and on domain. Domains with low innovation rates (mature markets with very long product life cycles) have few calls, whereas other cases have about six to eight per year.

Several contenders commented on the positive effects of face-to-face meetings. They preferred an in-person innovation process over submitting ideas to a database or a passive manager. Fast feedback and immediate discussion of the innovation candidates were considered more important than thorough evaluation.

Finally, several contenders who got their ideas past the screening phase did so even if the same basic idea had been sitting in idea databases (submitted!) for a long time. The general perception among

practitioners is that the face-to-face refinement performed during the audition (and made possible by the AG) increased the candidates' competitiveness in relation to short-term customer requirements.

The survival of any software company depends on listening to customers and market demands. However, true innovation comes from not only solving problems or satisfying customers in a new or better way but also enabling change. For example, 3M had a hundred scientists working in their fluorochemical program for eight years without discovering any new applications, and then developed several groundbreaking innovations.¹¹ These innovations weren't a result of customer demands; rather, they were examples of technology-push, not market-pull. Software companies must continually renew the passion for innovation and technology-push so that it becomes a part of day-to-day work.

Innovation through dedicated research works well in some cases. But the luxury of a dedicated research organization is often left to larger companies. For small and medium enterprises, innovation in day-to-day operations is necessary for survival. This implies utilizing every bit of the employees' creativity, whether they're engineers or line support personnel. For larger companies, this prospect is also appealing because getting ideas from many employees can mean a lot of innovation, if they're used correctly. This is especially relevant owing to the increasingly quicker turnaround demands on time-to-market and increased competition as globalization spawns not only new markets but also new competitors. The effective utilization of every resource is paramount for survival. 

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About the Authors



Tony Gorschek is an associate professor of software engineering at Blekinge Institute of Technology (BTH). He has also worked as a consultant for over 10 years as well as the initiator of several start-ups. His research interests include requirements engineering, technology and software product management, process assessment and improvement, quality assurance, and innovation. Most of the research is conducted in close collaboration and cooperation with industry partners such as ABB and Ericsson. Gorschek has a PhD (Tekn. Dr.) in software engineering from BTH. He's a member of the IEEE and the ACM. Contact him at tony.gorschek@bth.se or visit www.gorschek.com.

Samuel Fricker is a senior consultant at Fuchs-Informatik AG, a leading Switzerland-based company in requirements engineering consultancy, and research assistant at the Requirements Engineering Research Group at the University of Zurich. His work includes standardization activities for the software product management field. Fricker has a Dr. Inform. from the University of Zurich. He's a member of the IEEE and a supporting member of the International Requirements Engineering Board. Contact him at fricker@ifi.uzh.ch.



Kenneth Palm is a product manager at Danaher Motion, responsible for the AGV controls product line. His technical interests include the innovation process, requirements management, robotics, and navigation technologies. Palm received an engineering degree from Fässbergsgymnasiet. Contact him at kenneth.palm@danahermotion.com

Steven A. Kunsman is group assistant vice-president, head of global product management at Asea Brown Boveri (ABB). He is responsible for ABB's Substation Automation Products portfolio management worldwide and is interested in the further development of idea generation and overall requirements management. Kunsman has an MBA in management of technology from Lehigh University. He's an active member in the IEEE Power Engineering Society Power System Relaying and Substations Committees, a USA delegate to IEC TC57 in the development of the IEC61850 communication standard, and UCA International Users Group Executive Committee cochairperson. Contact him at stevan.a.kunsman@us.abb.com.



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