

Star Search – a Light-weight Innovation Process for Software Intensive Product Development

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The product development environment facing most companies today requires not only having an ear to the ground in terms of reacting 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, as a dollar earned today is generally perceived as more than a dollar earned tomorrow. The problem is that without innovation the competitive advantage will decrease over time and the long-term productivity will reach 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, or power systems where feature sets traditionally offered and controlled by hardware are transferred to software. In addition new features are offered for increased functionality. Just look at the driver environment of a car and its evolution from a couple of mechanical switches to fully integrated entertainment and control centers of recent years. The new functionality offered by software can be seen as a revolution with almost no production costs.

However, the reality facing most companies is that a substantial part of the resources are devoted to reactive development, in other words 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 needs to handle all this information without being overloaded [1]. This puts pressure on the product management organization, making it harder for them 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, i.e. the *stars* of tomorrow.

It's not all bad news though. Most market-driven companies possess an often underutilized resource, namely the employees' ability for contributing innovation. Market-driven organizations cater to a number of customers. Thus the development organization needs to have a deeper and more diversified domain understanding 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 probably has cumulated experiences from many customers and domains. This makes the development organization, which includes developers, marketing, sales, installers, and support very suited to not only interpret incoming needs, but also proactively suggest innovative features and even new products.

From a technical product management perspective, an important goal is to enable the generation and selection of new product ideas that aim at strategic growth markets [2], and funnel them into development. For this to be possible, ideas for long-term innovations need not only be caught/generated to begin with, but in order for them to survive in the constant bombardment of requirements from external sources, proper decision making processes and business justification materials need to be created that support their realization. Value propositions and business cases are a key factor in such decision making processes. They help balancing the overall level of considered long-term innovations to the 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 actual process for eliciting, screening and selecting innovation candidates needs to be cost-effective to compete with short-term product development activities. The decision support material produced in the process needs to be good-enough for supporting product management decisions as well as being the basis for estimating a software development effort.

Industry Partners

Asea Brown Boveri (ABB) is a leader in power and automation technologies and the development of software intensive systems within the domain to enable utility and industry customers to improve their performance while lowering environmental impact. The ABB group of companies operates in around 100 countries and employs more than 110,000 people. The transfer of new methods for requirements engineering involved ABB development centers in Sweden, Switzerland, Finland, India, and USA.

Danaher Motion Särö AB (DHR) develops and sells software and hardware equipment for navigation, control, fleet management, and service of automated-guided-vehicle systems. More than 50 AGV system suppliers worldwide use DHR technologies and expertise in their own products. The headquarters and R&D center are located in Särö, Sweden, with 85 employees.

We present *Star Search*, a light-weight process that can be used by any company looking to maximize the continuous utilization of scarce resources for innovation. Star Search goes beyond a “new idea workshop” once in a while, making innovation a part of the normal day-to-day business. Star Search was developed in close collaboration with, and subsequently piloted at two companies, ABB and DanaherMotion (DHR).

Background – Short Term vs. Long Term

In Star Search we don't really differentiate between Product Innovation and Process Innovation [3]. For a software company's survival, the key success factor is to select the new product ideas from a broad range of potential innovation candidates that support the business strategy and have the greatest financial impact. The same can be said for catching and implementing suggestions for improving the development process itself. Using Star Search for process innovation can be seen as an equivalent to the “Toyota string”, i.e. a possibility for anyone to suggest better ways of working. For the purpose of this article the focus is on product innovation however, although Star Search is and can be used for both.

The new product ideas can be of many types: a new software feature extending a present product offering, a completely new product, or even a new marketing or segmentation angle, which might enable the expansion towards a previously untapped customer base using present-day products. Other innovation candidates support internal innovation: improved development processes, reduced complexity of software design, or reduced cost related to a software product, for example a candidate could make a case for a software refactoring effort

Prior to the development of Star Search at ABB and DHR several other innovation activities were present at the companies, each evaluated on-site and described below.

A. Workshops or events for idea generation and planning: These activities are generally arranged once or a couple of times a year, involving key personnel like technical management, senior department representatives, and so on. The format is a workshop where new ideas are brought and/or created during the event. The potential drawback is that not everyone can contribute directly, i.e. the invited participants decide what is to be discussed, even if the idea is that e.g. a department head should convey good ideas from the department in question. A one or two day meeting has to accommodate all new ideas, as well as compete with reactive issues such as requirements from key-customers.

B. The idea database: Most companies probably have one, or several. In general it's a "suggestion box" where anyone can deposit good ideas and suggestions for innovation. The idea is that these suggestions are screened regularly by for example product managers and the best candidates are singled out for further investigation. In theory this seems fine, but in reality several problems were identified. Handling present day reactive development, and taking care of today's incoming requirements takes precedence over the perceived luxury of parsing a new source like the idea database. This potential source of innovation hence turns into a "black hole" that is not prioritized in reality. As a consequence the people contributing to the database get no feedback on their ideas, and stop contributing.

Assuming that the database was screened regularly the contents is often sparse in comparison to competing reactive ideas. For example, a key-customer requirement is backed by the immediate promise of sales and revenue (or the threat of loss of the same). Often it is very easy and straightforward for e.g. product management 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 is not backed by anyone. This leads to an uneven playing field even if the idea database is screened.

Also, identifying high-impact ideas requires an innovative combination of strategic, market based, and technological aspects. This can be achieved with people negotiating these aspects with each other by entering in a problem-solving mode [4]. The use of idea databases hinders effective cross-functional communication towards the resolution of such conflicts.

C. Dedicated research department: Many companies have dedicated resources for research and development of new ideas and technologies. There is no question that companies with the resources for corporate research have an advantage as their focus is not on solving today's problem but more forward looking into technology enablers and predicted problems. It is however important to realize that corporate research does not utilize the practitioners of the operative parts of a company, e.g. developers, sales, installers, support and so on. The majority of corporate research employees are bright scholars that often have not been truly exposed to the company's products, product development, markets and customer issues and demands. Hence, disconnects occur between the research and key business drivers.

D. Informal communication: Any practitioner will tell you that the informal way of getting things done is often the dominant one. This isn't necessarily a bad thing. It can even compensate for a lack of scalable and realistic innovation processes in some cases. The problems are evident however.

People in power will get their ideas through. The one “screaming the loudest” will be heard first. This problem is especially important for global companies: distance hinders or even breaks such communication. Hence, the best ideas might not be captured at all and the associated champion to support the idea is never found, not to mention that the vast majority of practitioners will not be able to compete, and therefore is not motivated to raise the idea for consideration.

Related Work – Innovation Management and Product Development

Research into innovation management recognizes that even if innovation is coveted, 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 well established companies with well aligned processes and strategies [5, 6]. Van Den Ven [7] 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 every-day product development activities*. This innovation imperative [8] was recognized at ABB and DHR and is the basis for the development of Star Search [9]. Star Search is based on, and inspired by, several innovation models and best-practices (see Figure 2). The purpose of the Star Search initiative was not to reinvent innovation management, but rather build upon the established, and concretely realize the sometimes abstract recommendations offered by innovation management models. It should be observed that many innovation management models are either 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 and practical process for eliciting innovation candidates, refining them, and making sure that the candidates are championed to stand a chance in competing for the development resources that is often earmarked for short-term market-pull development[10, 11].

General management and quality frameworks like TQM do embody the principles of innovation with their motto of “delight the customer” and the utilization of ideation events where new ideas are put forward. This is also true for SPI/SPA models like CMMI that includes innovation enablers. The main issue with models supporting the management of new product development is that they are aimed at repeatability, predictability, and controllability, all targeted at increasing efficiency and shorter development cycles [12]. In addition, the focus is on enabling innovation in or close to projects is to some extent self defeating as good ideas are often shelved as they may negatively influence project schedule [12]. For this reason an innovation management model, focused on the elicitation of innovation candidates, like Star Search, has to be independent and a part of the continuous innovation effort with a longevity superseding any one project or batch effort like ideation[7, 10, 11, 13].

Star Search

Star Search consists of four steps depicted in Figure 1. Each step is detailed below together with lessons learned. The lessons-learned are a result of running Star Search over a period of more than one year. Observations made (by the researchers and Star Search participants) were collected, as well

as interviews conducted with members of the audition groups and senior managers in charge of the innovation initiatives. In addition, each lesson learned is connected to 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 co-workers in the company that a Star Search audition has been scheduled at a certain time and place. People sign up for participating in the audition. If few people sign up the meeting audition is short. If many sign up, the audition can be as long as necessary, even spanning multiple sessions.

Information about the process and the goals of the audition are important and should be made available and communicated in the call. An audition form is made available that enables potential “contenders” to reflect on their idea and to formulate it for the audition. It is important, however, to realize that the idea can be presented in many forms, depending on the preference of the contender. He or she could prepare a slide presentation, and actively sell the idea, or just sit down in front of the AG and go through the idea without any or little preparation except using the form as inspiration.

To angle a call, the call text can be formulated to premiere certain aspects. For example, a specific line of products or a specific development process can be the main focus of the call. This serves two purposes. First, the number of innovation candidates coming in can be limited. Second, efforts can be focused on a specific area of interest to the organization. Thus goals related to company strategy can be used to angle calls.

The Audition Form (bases for a Value Case)

Source: The source of the idea

Title: a short title of the proposal/idea/innovation

Description: a general description of the idea

Present Products Affected: As some ideas will be based on previous products/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, i.e. does the new idea compete or cannibalize on present products?

Why/Benefit: whom does the idea benefit/why is it relevant?

Potential Customer/Market: It is important that the candidate not have the technical perspective but also a market/sales perspective

How can this be sold: A slogan or idea for marketing/sales

Estimated Cost: A cost estimation (including a separate field describing what the estimate is based on, e.g. previous experience?)

Technical Risk: A short description of potential technical risks

Infrastructure Risk: What is the risk to the infrastructure of the company, e.g. can present sales and marketing handle the new idea/product?

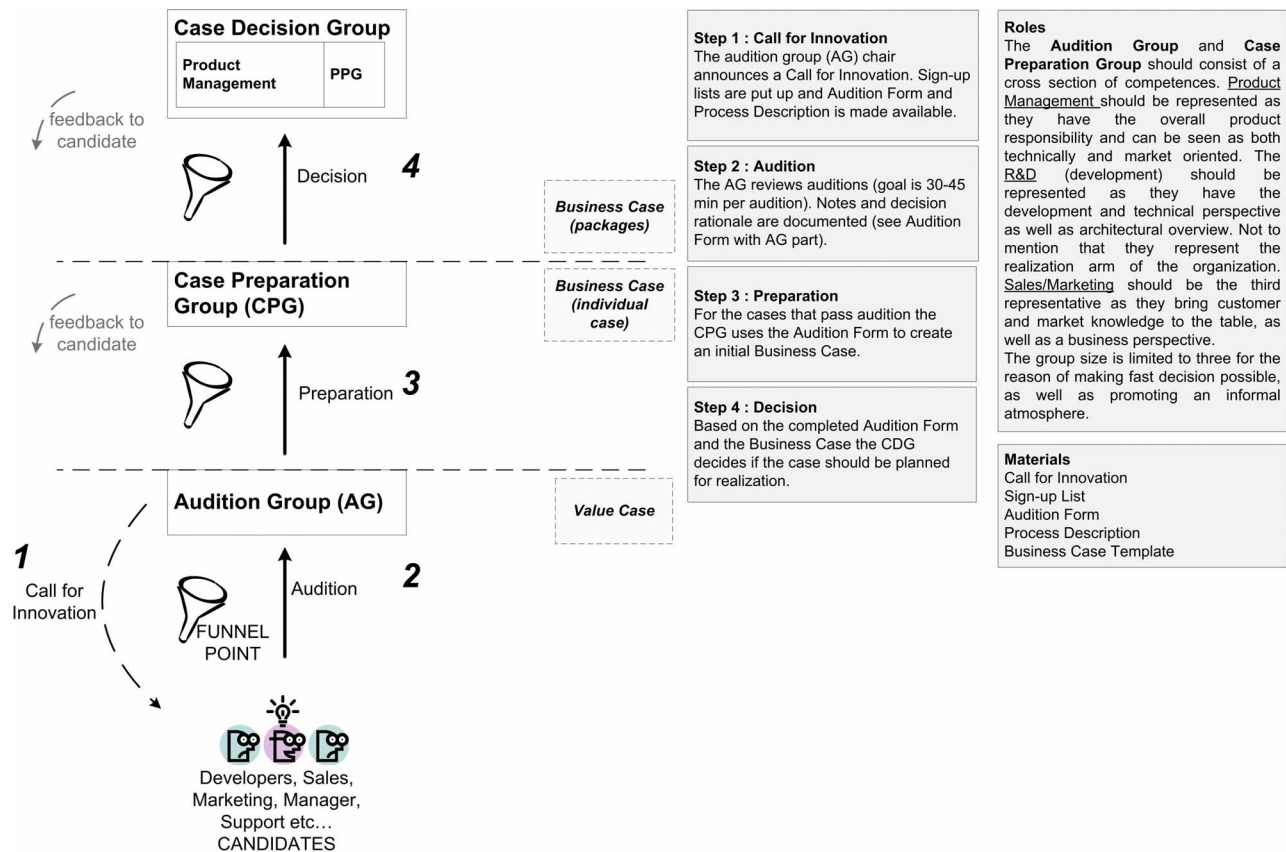


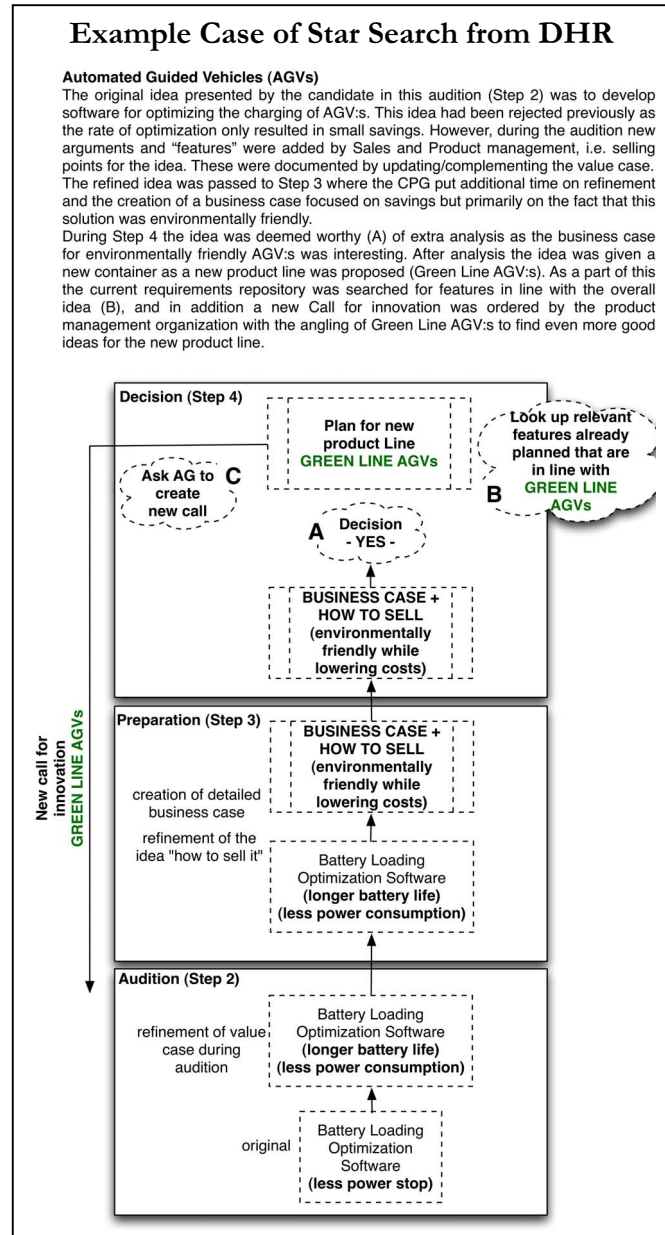
Figure 1. Star Search Overview

Step 2. Audition. The actual audition takes place in an informal setting with AG members and the contender. Each case is presented and discussed for a predetermined time. For example, ten minutes presentation/introduction by the contender, and then fifteen minutes of questions and answers. The most important parts of the audition are the initial refinements and elaboration of the case and the AG members' assessment of the potential business value. It is the job of the AG members to help the candidate refine and improve the case. A distant second objective is to dismiss ideas, i.e. screening. Finally, the AG ensures that all the fields in 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 is not prepared at this stage for reasons of scalability.

If a case is dismissed, a proper reason for this decision should be offered to the contender. The reasons should also be documented with the case to enable decision traceability. In addition, dismissed cases should be made available within the company to avoid repeated submission of the same ideas without refinement that takes the original decision motivation into account.

Lessons Learned – Step 1 & 2

- **Lesson 1:** Trust is an issue the first time Star Search is presented to an organization. Practitioners are used to learning new processes and models, many of which initially don't lead to any real change, thus leave them disillusioned. This can lead to only few people participating in the first calls. The management team must be committed and demonstrate that the process will be repeated regularly - depending on people's interest in submitting new ideas.
- **Lesson 2:** Real gee-whiz ideas are very thinly spread. For this reason, involving as many idea contributors as possible in Star Search is crucial for high-impact idea generation.
- **Lesson 3:** A reward system can improve motivation and show that the elicitation of ideas is prioritized by the organization. To be blunt, one might argue that if salesmen get commission on sales, why shouldn't engineers get a reward for innovation? Besides monetary bonuses any symbolic reward will be a motivating factor. Simple recognition, respect from peers, or funding for a pre-study are rewards that work in practice.
- **Lesson 4:** The audition group should be fair (democratic) in the processing and evaluation of the ideas. Good ideas should not be dismissed, and a good atmosphere should be fostered for the contenders. It has been observed that some audition group members have difficulties in helping and refining the case instead of critiquing. One reason for this is that many requirements compete for limited resources. One way of helping (and essentially training) the AG to focus on refinement of innovation candidates is to have an external party available with the focus of being a moderator



of sorts. This role was managed by the researchers in our case. It only took a couple of auditions until the moderator was not needed.

- **Lesson 5:** The dismissal of ideas should be communicated by the leader of the AG in a manner that encourages future idea submissions.

Step 3. Case Preparation and Screening. The cases passing the auditions are conveyed to the case preparation group (CPG). The CPG has two major functions in Star Search: further refinement of the case and triage if appropriate. As a part of the case refinement an in depth business case is prepared. The originator of the case (the contender) can be called to answer questions and help in this activity. As the business case is prepared, additional experts should be called to review and provide their judgments and case improvements e.g. estimates, feasibility, risk analysis, and software architects gauging the technical long-term impact.

As more analysis is performed, it is only natural that some re-prioritization is performed. For dismissal, the same rules apply as during the initial audition: the decisions needs to be motivated and the rationale recorded.

The CPG should have the same background as the AG, but doesn't necessarily need to have the same members. The cases can give indications to the needed group competence in the CPG. However, changing the group members from AG to CPG carries risks. First, people from the AG can be seen as champions of the cases they audition and don't dismiss. This effect can be lost when group members are changed. Second, new people need to read up on the case and might lose tacit knowledge.

Lessons learned – Step 3

- **Lesson 6:** If the contender has to assist the CPG with the review process this should not be done in addition to the normal every day workload. It is important that a successful audition not be seen as additional work; rather time has to be budgeted to avoid the feeling of penalization. To support such budgeting, line managers could be given goals stating the expected number of successful cases to be contributed by their local organization within a year.
- **Lesson 7:** The level of refinement (e.g. how detailed the business case is) should be good-enough for assessing its potential benefit, reward, and risks. An indicator that was used was the level of refinement performed under normal circumstances (outside of Star Search) when a new software product or feature is considered.
- **Lesson 8:** The main goal of Step 3 is to make sure that the cases prepared are at least as well understood and documented as all other requirements coming in from customers and other stakeholders. The key is that the best ideas should be selected, and lack of information or analysis due to bad preparation should not be a major determinant for dismissal later in the process. In addition, during Step 3 a champion for the innovation candidate should be

established. If this can not be done (can't be found in the AG/CPG or by the AG/CPG), then chances are there is no one believing in the idea in any case.

Step 4. Case Decision. The now refined cases are passed to the case decision group (CDG). This group already exists in every software development organization. It is the group that prioritizes and performs the selection of requirements to be implemented. It can be product management and/or a product-planning group. Star Search should reuse this infrastructure. The only difference is that the decision makers (termed CDG in Star Search) have new cases coming from Star Search as input to their release planning and prioritization work.

Lessons learned – Step 4

- **Lesson 9:** One potential problem of cases coming from within the organization is that they lack the backing of a champion. This can become a threat during the last phase when selection for implementation is performed. This threat can be alleviated, however. One, the level of refinement and analysis of Star Search cases is often better than the one performed on the “normal” requirements. This improves accuracy of estimates and risk analysis. Two, the professionals working in the Star Search audition and case preparation steps already support the case. Otherwise it would probably have been dismissed. This gives backing to the case, which would be lacking if e.g. a developer just submitted an idea directly to product management.
- **Lesson 10:** Transparency of the overall Star Search process is paramount. Transparency motivates participation in the process. Idea contributors should be informed about where their idea is in the process and should have insight in the reviews and the rationales for the decisions that are taken.

General Results and Conclusions

As many process improvement initiatives it is hard to quantify the value and effects, this is also true the realization of many innovation initiatives, as the success of innovation is hard to measure[14]. However, some indications can be observed. Due to reasons of anonymity however details and exact mapping to company (site) can not be stated.

- One of the sites has increased the number of innovation candidates that have been auditioned, refined, and selected for realization (put on the product road-map) by over 25% since the start of Star Search. No innovation candidate has gone through the development process due 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% are based on innovation candidates from Star Search.

- One of the sites report that the submission rate of innovation candidates is about 10% every year, that is, one innovation candidate per every 10 employees. Out of these about 25% were selected and underwent pre-study. And, out of these elaborated innovation candidates about 20% ultimately succeed to be introduced to the market after development. Hence, a total of about 5% of the innovation candidates make it through the entire innovation process to the market place while competing with short-term customer needs.
- One of the sites reported that the theme of the submitted innovation candidates influenced the rate of success of the candidate. A theme in line with the company's product strategy significantly increased the success rate of the innovation candidate.
- One of the sites reported 30-60 minutes audition time (initial screening, Step 2) per innovation candidate. Whether this is lightweight, hence scalable, or not is dependent 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 (e.g. budgeting, development cycles), but also on domain. Domains that have very low level of innovation (mature markets with very long product life cycles) have very few calls, maybe two to four per year, while other cases showed about six to eight per year.
- Several contenders commented on the positive effects of face-to-face meetings. They preferred a bespoke innovation process over submitting ideas to a database or a passive manager. Fast feedback and immediate discussion of the innovation candidates was weighted as more important than thorough evaluation.
- Finally, several of the contenders participating that got their ideas past the screening phase, did so even if the basic same idea had been sitting in idea databases (submitted!) for a long time. The general perception among the practitioners is that the face-to-face refinement performed in the audition (and made possible by the AG) increased the competitiveness of the innovation candidates in competition with short-term customer needs.

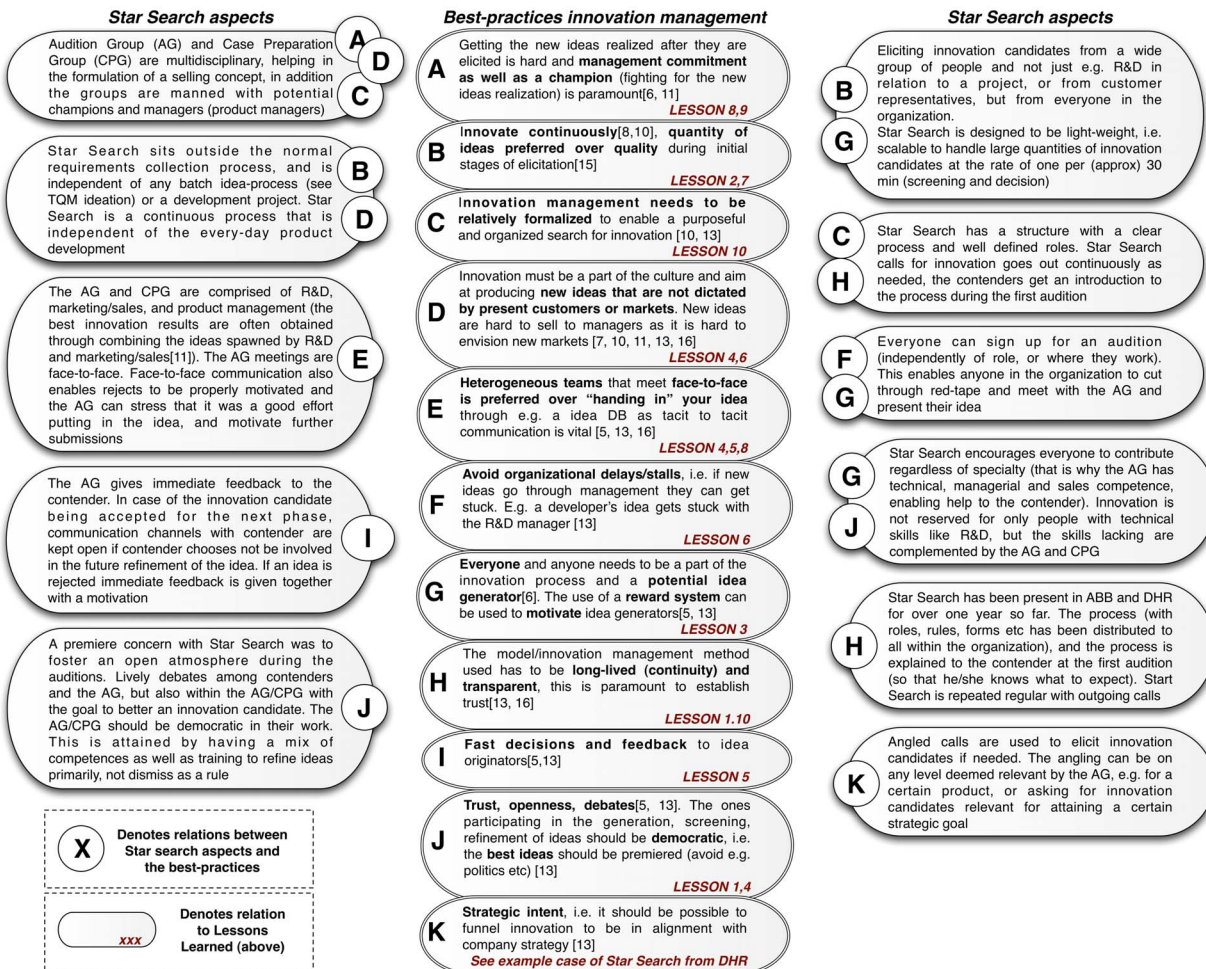


Figure 2. Overview of best practices in innovation management and relation to Star Search.

Listening to market demands and customers is important, and the survival of any software company is dependent on this. However, true innovation comes not only from solving problems or satisfying customers in a new or better way, but also from enabling change. For example, 3M had a hundred scientists working in their fluoro chemical program for eight years without any application being discovered, ultimately giving rise to several ground breaking innovations [16]. These innovations were not a result of customer demands, rather, the innovation was one of technology-push, not market-pull. The point is that the passion for innovation and technology-push has to be renewed and become a part of a software company's day-to-day work. Innovation through dedicated research is one approach that works well in some cases. But the luxury of a dedicated research organization is often left to larger companies. For small and medium sized enterprises, innovation in day-to-day operations is a necessity for survival. This implies utilizing every bit of creativity of the employees, whether they are engineers or line support personnel. For larger companies this prospect is also very

appealing as getting ideas from many employees could mean a lot of innovation if utilized correctly. This is especially relevant due to the increasing demands on time-to-market and due to the 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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