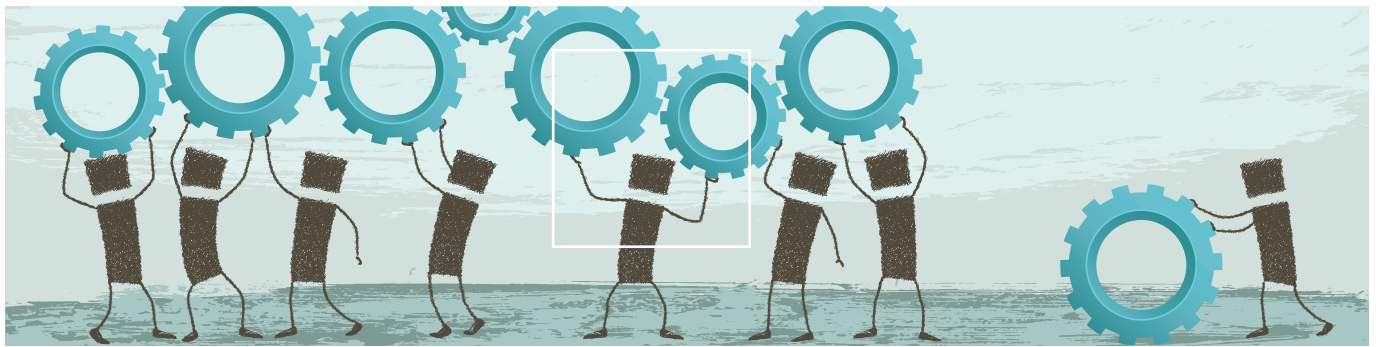


How to create breakthroughs in nine months

Build fast and effective capabilities to deliver breakthroughs with The Breakthrough Factory™



The challenge of creating “breakthrough innovations” is one that many large corporations struggle with. It is especially difficult for mature companies with technically complex and long-lifecycle products, for which conventional R&D programs often fail to meet “breakthrough” expectations. However, there are ways to break out of the deadlock. In this Viewpoint we explore key success factors and examples in which companies have solved grand industry challenges and produced industry breakthroughs fast and cost efficiently using the Breakthrough Factory™ concept.

Challenges in achieving breakthrough innovation

Most large corporations in the non-digital sectors struggle to find the best way to achieve “breakthrough innovation.” The challenge is especially daunting for mature companies whose products are technically complex and have long lifecycles requiring significant investment to develop further. In such situations companies often set up small internal teams with the aim of focusing on longer-term or “step-out” innovation. However, these teams often fail to deliver the expected benefits. Either they become disconnected from the core business, or they spend too long pursuing unattractive concepts. Or else, in order to demonstrate business value, they give up on being truly “breakthrough,” and instead move towards short-term, incremental innovation.

One of the key challenges is that technologically intensive businesses usually need to conduct research into basic science in order to find the breakthroughs in both their own and other industries. This is not easy: how do you identify game-changing future technologies and science that can significantly impact your industry? How do you engage with the high-caliber specialists required to deliver these projects for you? How do you ensure that your company benefits from its investment in terms of being able to systematically produce game-changing technologies and products with at least a degree of continuity? And most importantly, how do you do all this quickly to outpace the competition?

The Breakthrough Factory™ is a new concept that addresses all these challenges. It sets out clear approaches and methods for defining breakthrough innovation strategies, identifying breakthrough innovation challenges, running breakthrough creation projects, setting up the appropriate organization and processes to continuously deliver breakthroughs, and implementing and commercializing the breakthroughs.

From challenge to industry breakthrough in less than nine months

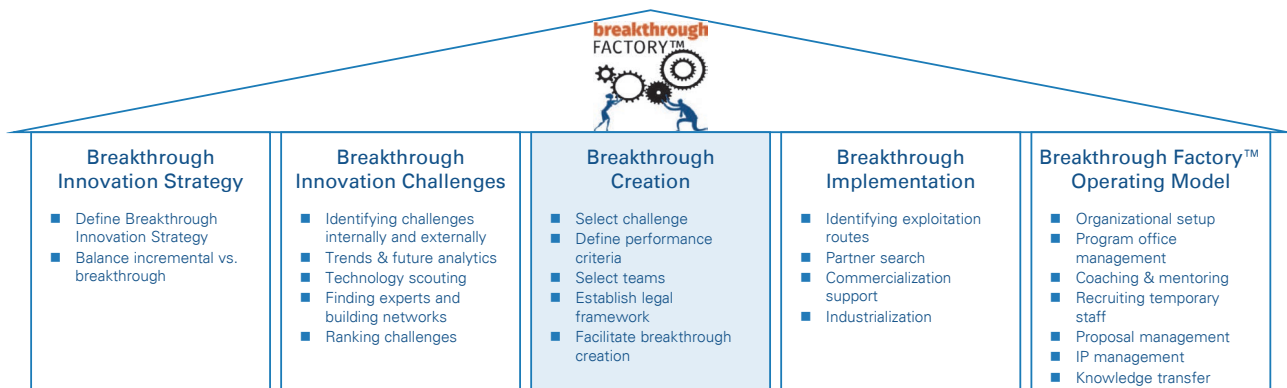
Collaborative competition between externally resourced teams

In the Breakthrough Factory™ model, multiple teams with mainly external resourcing compete collaboratively to solve a grand challenge within a fixed time period – typically less than nine months. Each team uses a fundamentally different approach to solve the same challenge. This allows for hedging against failure, but also enables the organization to build knowledge on approaches that may be completely new for the internal team of experts.

“External resourcing allows leveraging of world-leading expertise and laboratories not available internally, as well as providing fresh input and new perspectives”

The key reasons for primarily relying on external resourcing are to leverage world-leading expertise not available internally, to

Figure 1: The five elements of the Breakthrough Factory™



Source: Arthur D. Little

get fresh input and new perspectives, and to avoid getting stuck in internal politics and the “we have already tried and it didn’t work” mentality.

The breakthrough creation process

The key steps in the breakthrough creation process are:

1. Select a challenge
2. Define performance criteria
3. Select external teams
4. Establish the legal framework

To facilitate and secure a fast and cost-efficient breakthrough creation process, it is important to “front-load” the project. This means devoting significant effort upfront to selecting the challenge and defining its breakthrough potential and performance criteria thoroughly. These two steps are critical in order to succeed and get results swiftly.

Select an isolated and clearly articulated challenge

Critical challenges generally arise from one of two situations. Your internal engineers and/or scientists may have been struggling to reach a specific target imposed on them (e.g. significant cost cutting or performance enhancement) and are in need of fundamentally different approaches to reach the target. Or alternatively, you have observed a fast-growing scientific field or technology that you fear could disrupt your existing products or solutions.

“Understanding, isolating and clearly articulating the challenge is one of the fundamentals of being able to define clear and measurable performance criteria”

No matter which situation you face, it is important that your team of experts starts isolating the problem to such an extent that very clear performance criteria can be defined. Take the example of the carbon fiber composite beams that showed

catastrophic failure when subjected to impact loading (such as bird strike on an aircraft wing). Here, the problem was isolated to the composite laminate’s low delamination toughness, and the challenge was, hence, to find ways of creating delamination-resistant composite materials. Understanding, isolating and clearly articulating the challenge is one of the fundamentals of being able to define clear and measurable performance criteria.

Define specific and quantified performance criteria

Defining the performance criteria of your challenge is the way to build a solid contract with the external teams that will take on the challenge. At the final reporting of your breakthrough creation project, the teams will show their prototype solutions and aim to demonstrate that they have met the performance criteria you set out at the start of the project. The performance criteria should be specific, so that the precise breakthrough improvement can be clearly understood. They should be quantified and possible to measure as an indicator of progress. They should also have specific time lines attached to them.

“...all factors that did not directly relate to reaching the performance criterion were removed from consideration, thereby allowing for completely new approaches to meeting the objectives”

Although performance criteria should be defined with great detail, it is critical not to set criteria for the approach to reach a breakthrough performance. Take the example of the breakthrough of replacing the costly scintillator (a specific material property) rare-earth materials in positron emission tomographs (equipment used in medical diagnostics). Here, the required breakthrough was to find a solution that significantly reduced the cost of the scintillator material, while keeping or improving the same overall performance. Traditionally, it was believed that the scintillator properties scaled with the density of the material, and hence, only high-density materials were in focus (constraining the approaches to reach the performance criteria). However, in the Breakthrough Factory™ project, all factors that did

not directly relate to reducing the cost (the chosen performance criterion) were removed from consideration, thereby allowing for completely new approaches to meeting the objectives. (See also the further description below.)

Select external teams

When driving a breakthrough creation project, multiple teams are employed to create an environment in which teams can co-create while simultaneously competing. The selection of teams can be made via a traditional request for proposal (RFP) process in which each team has to specify clearly their intended approach to reaching the predefined performance criteria. The teams are also required to specify potential knowledge gaps and how these will be closed. The RFP should be complemented with deep interviews with the team leader and team members. In the case of university teams, it is critical to understand the resources the professor has at hand in terms of students and post-docs, as well as laboratory equipment. Moreover, deep interviews should be held with key team members such as PhD students to understand the fit between the PhD student's thesis and the proposed project. If the fit is not clear and synergies seem unlikely, then the students may not put in the required effort to deliver the project.

"...it is critical to understand the resources the professor has at hand in terms of students and post-docs, as well as laboratory equipment, and how they can contribute to solving the challenge"

The number of teams that participate in solving a challenge has great impact on the knowledge creation and probability of success. In our experience, at least three teams should be employed, and each team should use a different approach to solving the challenge.

Establish the legal framework

When the teams have been selected, a formal agreement has to be reached to manage the intellectual property rights that are produced during the breakthrough creation project.

In university collaborations, the company should make sure it owns the resulting intellectual property – e.g. patents – yet the professor and students could be listed as co-authors of the patent to build their resumes/CVs.

In collaborations with start-ups, the start-up could be allowed to own the patent, but the company could hold exclusivity for licensing the patent in selected industries. This will be desirable for the start-up as a means of building its value.

Regardless of the form of collaboration, incentive schemes can be set up in which academics and start-ups get an agreed reimbursement when the patents are used.

Facilitate collaboration and breakthrough creation

Breakthrough creation typically starts with a three-day build-up kick-off in which the company explains the challenge and everything that has been done to date, and the teams together penetrate the challenge in detail. Each team also explains its specific approach to the other teams, and the teams challenge each other constructively to further refine the different approaches. An important aspect of these dialogues is that each team should understand the competences and strengths of the other teams.

Once in execution mode, the company needs to establish a continuous follow-up of the teams without micro-managing the way of working. This should focus on progress and removing obstacles to try to speed up the process as much as possible. Funding is typically linked to progress and the achievement of agreed milestones.

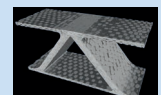
"...establish a continuous follow-up of the teams without micro-managing...focus on progress and removing obstacles to try to speed up the process as much as possible"

The teams should also get together on a regular basis where progress is reviewed against defined targets. Critical obstacles and challenges are discussed, as well as specific resource needs, e.g. competence, lab equipment, etc.

The breakthrough creation process ends with a shared wrap-up meeting – the grand finale – where the teams present their evidence to demonstrate that the performance criteria have been met, including any relevant boundary conditions. This evidence could be a film clip of an experiment, a physical prototype, or similar. In the final meeting the results are compared, learnings discussed, and the winner is announced, including recognition of the knowledge sharing from any other teams that has enabled the results.

Breakthrough creation case examples

Defense organization: Delamination-resistant composites



CHALLENGE: Creating carbon fiber composite structures tough enough to withstand extreme conditions has been a long standing problem in the fiber reinforced composite industry. Arthur D. Little staff was engaged by a defense organization to explore ways of creating carbon fiber composite structures without adhesive joints and thus creating delamination resistant composites with improve toughness. The breakthrough creation project involved three Universities with know-how in composite materials and structures, one Start-up Company specialized in textile technologies and a composite material component manufacturer.

“The project delivered a first prototype with breakthrough properties in less than nine months”

RESULTS: The project resulted in usage of a new textile-manufacturing method that allowed the possibility of assembling individual carbon fiber yarns into complex 3D shapes and fiber micro-architectures without any seams or adhesive joints. The tested 3D-assembled structure showed 300% higher energy absorption and strength than a state of the art equal-weight aluminum structure used in aerospace. Moreover, it had 50% higher strength than traditional carbon fiber composite sandwich structures and no signs of delamination damage could be observed. From initiation, the project took only nine months to deliver the first prototype results.

Philips: Finding a replacement for rare-earth materials



CHALLENGE: A great number of industries struggle with the scarcity of rare-earth elements, which has made prices high and volatile, and supplies uncertain in a market where demand has generally been increasing. To tackle this challenge at Philips, a multi-university challenge was initiated by iKnow-Who, involving 10 master’s students, five PhD students, five post-docs and five professors from three different universities.

“The winning team discovered a material with strong potential to replace all the rare-earth material”

RESULTS: Apart from carrying out an invaluable amount of research in the area, the winning team discovered a material with strong potential to replace all the rare-earth material by, instead, using a low-density nano-polymer that both lowered cost and increased performance. Upon final review, three invention disclosures were submitted with full patent applications in progress and one patent already awarded.

In conclusion

The Breakthrough Factory™ model provides organizations with a highly effective means of creating breakthrough innovations rapidly. Of the five components that compose the factory, breakthrough creation is specifically challenging. Examples across several organizations and industries have shown that a collaborative competition approach can generate breakthrough innovations in short time and with low costs. By launching pilot breakthrough creation projects as outlined above, organizations can test the concept without huge expense and risk exposure, and use the results to further enhance their breakthrough innovation capabilities going forward.

If you would like to learn more about how Arthur D. Little and iKnow-Who work with companies in this area, please contact one of our experts.

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iKnow-Who



iknow-who.com was established by Sigvald Harryson in 1999 and has since then solved more than 20 extreme innovation challenges. iKnow-Who is the partner of choice for breakthrough creation in Arthur D. Little’s Breakthrough Factory offering.

Please visit www.iknow-who.com for further information on extreme innovation through collaborative university competitions.

Arthur D. Little

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