

CAN INNOVATION BE NURTURED?

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“I want you to stop working on EinsTuner – maybe you’ll start looking at process variations instead. As you know, that will be the next big challenge,” said my then-manager, Leon Stok, at the IBM Watson Research Center. I was just completing a couple of successful years working with the EinsTuner team on transferring innovative techniques for optimizing custom microprocessor circuits to IBM’s product divisions. In my mind, we were still in the thick of things and this request took me and the rest of the team by surprise!

As much as this was a shocking disruption to a successful project, in hindsight it was exactly the right thing to do, for me, for the team and for the company. Even after I wrapped my head around this concept, and agreed to step out of my comfort zone, dealing with the resulting fall-out was not easy. Since I was one of the developers of the original research prototype, we feared that I would get dragged into day-to-day issues and therefore would not have the bandwidth to undertake the new challenge. It is always difficult to maintain personal time boundaries between a production-oriented project and a more open-ended research project. When a product under development has a problem, it makes a giant sucking sound and anyone capable of helping is pulled in without regard to other priorities!

The solution was to pack me off on sabbatical to Eindhoven University in the Netherlands! As it turns out, at that time, we had Professor Jochen Jess of that University visiting IBM, and he had started some collaboration on process variations with me. It seemed a natural extension for me to return the favor and continue the research on his home turf. The rest of the story is the kind of fable that happens but once or twice in a researcher’s career: the sabbatical was both fun and successful, I returned to IBM energized to get this new area of research going, and as part of an extremely talented team, we developed two versions of statistical timing tools, obtained a number of patents, won ‘Best Paper’ awards and helped energize the company and industry to recognize the benefits of statistical timing.

The point of this story is that it took many elements for this innovation to be nurtured: a sanguine manager, a laboratory where a visiting Professor sparked interest in new fields, an employer who made a sabbatical possible, and superb teams who could handle the disruption to the production-oriented project and help bring the new research concepts to fruition. An important postscript: even in my absence, the EinsTuner team just kept right on innovating and keeping up with the rapid pace of change in microprocessor design requirements.

Innovation is elusive; it cannot be produced on-demand, nor can it be corralled or scheduled. Real innovation that matters and has a major impact in practice is extremely

difficult to achieve. At best, we can create an environment in which innovation is nurtured and rewarded. Innovation needs to be nurtured at every level of the organization, and most of all by each person deep within himself or herself. Meaningful innovation is like scoring a goal in soccer – it doesn't happen often, but is always a hallmark that differentiates the winning team.

As shown in Figure 1, most innovation goes through a cycle of four phases: have an "Aha!" moment, develop a prototype, productize and deploy. With each succeeding phase, ideas and implementations become more concrete, flexibility is reduced, and expectations and urgency quickly mount. An important aspect of successful innovation is maintaining the balance between the excitement and "hype" required for continued investment, and controlling the message and expectations to realistic proportions.

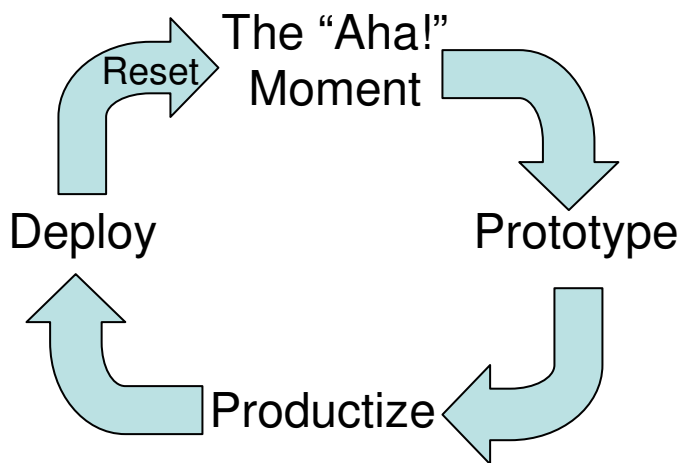


Figure 1: The innovation cycle

The "Aha!" Moment

The "Aha!" Moment (AM) happens at the strangest times and in the least likely places. Bathrooms, showers, cars, trains, jogging trails, doctor's office waiting rooms and bicycle rides lay claim to many of the best AMs. I was once working side-by-side on an optimization program with Andy Conn, a mathematician colleague at the IBM Watson Research Center, when some information that came up on the screen prompted us to exclaim, "Good step!" and "Bad step!" almost simultaneously. Further investigation revealed that it was indeed a good step from the point of view of the optimization problem that we had posed, but a bad step from the point of view of the underlying engineering problem we were trying to solve. Indeed this was an AM that led to a very neat solution to focus the mathematical optimizer better on the engineering problem!

Have you heard of the executive who called his assistant and said, "I've just had an 'Aha!' Moment, clear my calendar for the next two days?" Neither have I. AMs cannot be rushed. AMs require a gestation period for the murky idea to rattle around in the nether regions of one's brain until its implications start to become clear. If an AM may lead to a fundamental change of direction on a large project, it is surely worth the

disruption of canceling the next few routine status meetings. Ideally, a trusted colleague or team can help bounce ideas around and provide constructive criticism in this phase.

Without an AM, nothing gets off the ground. In this phase, take many shots at the goal, but try to make each one count in terms of what you might learn from the failed attempt. Long shots and Hail Mary's are useful attempts early in the process – they probably won't succeed, but they will frame the difficulty of the problem for you. Don't settle for less than the "real thing" unless you are first convinced that it is not achievable, and compromises or approximations are necessary.

Why do some people have more AMs than others? Fear is the single biggest inhibitor of innovation. Fear of failing. Fear of not showing sufficient progress. Fear of the unknown. Fear of looking like a fool. Fear of asking dumb questions. Fear of questioning what seems obvious to everyone else. By definition, an innovator is venturing into the unknown. If you are in a comfort zone, you are not innovating. Make a habit of forcing yourself out of comfort zones – it may seem gutsy and unnecessarily risky, but only the first few times.

Every now and then, in an organization, there is a chance to step into a new whirlwind of research activity. When there is such a storm, gladly step into it – for better or for worse, you will be changed as a result. To be better positioned to have AMs, read widely since worthwhile ideas have usually been applied previously in some other discipline. Interdisciplinary research is often fertile ground for innovations. Attending conferences in areas related to your own is a good idea.

Prototyping

The AM is just the beginning. As much as a good idea is a terrible thing to waste, innovation is more than just a good idea, and the truth is that the vast majority of good ideas don't go anywhere. Most inspiration must be combined with plenty of perspiration and attention to a million niggling details. The details are often what differentiate great ideas from merely good ones! Innovation suffers from being subject to a wide variety of time constants. This is where one needs experience to give the innovative idea plenty of time and loving care, while attacking the concomitant engineering details with an extreme sense of urgency. One must try to design a prototype to maximize the coverage of only those details that are likely to become show-stoppers in a subsequent phase.

While solving sub-problems, resist the temptation to apply a known technique to every problem you can get your hands on, instead of applying every technique you can get your hands on to solve the problem at hand! It is clear that one must continuously invest in the skills necessary to convert ideas into innovations, be they communication skills, organization skills, technical skills or marketing skills.

Productizing

The productizing phase is the most severe test of the innovator's communication and team skills, since he or she cannot achieve much alone. The soccer analogy is useful again. Unless you are somewhere near the goal, the chances of being successful are slim

– you must expend the effort to put yourself in a good position. Innovation is indeed a team sport. Surround yourself by innovative people and work in an innovative environment, and you are more likely to receive a pass that you can convert! Team sports are played by team rules – remember that in a successful team, there is infinite credit to go around, and that you should do your share of passing promising opportunities to your teammates.

It is in this phase that you will be most under pressure to “sell” your ideas. Be your own harshest critic in honing your message – when you have a good idea, be prepared for tough resistance and stubborn disbelief. If you can’t convince yourself of the value of the new idea, or you can’t crisply frame the value of the innovation, you will not fare well in your efforts to convince others. This is also the phase where things most often fall apart. Be prepared to fail and be disappointed – if this does not occur from time-to-time, you’re either a genius or not picking the hard problems. Learn to console yourself with the argument that if what you’re attempting were easy, someone else would have done it by now.

Innovators are often fantasized as being brash and brilliant – nothing could be farther from the truth! In real life, the most important characteristics of an innovator are patience, persistence, organization and thoughtfulness.

Deployment

The innovator’s job is not done until the full benefit of the innovation has accrued. The deployment phase is paved with dashed ambitions and disappointed researchers. The product is ready, and embodies many wonderful new ideas – but nobody wants it! This is where it is most useful to put yourself in the user’s shoes or even do the job that you think is the best application of your innovation. In the early 90s, I spent two full years developing a sensitivity analysis capability in a circuit simulator, thinking that design engineers would be delighted to understand how their circuit’s behavior would change as a function of design parameters. I was disappointed at the low level of interest, so I decided to take the next step, and optimize circuits myself based on the new sensitivity computation. Collaborating with Andy Conn, a mathematician, and Ruud Haring, a software-skilled circuit designer, I developed an automatic circuit optimizer called JiffyTune. JiffyTune evoked a moderate amount of interest since it required the designer to carefully set up simulations that sensitized the critical path of the circuit being optimized. I did this once myself, only to realize how tedious and onerous this task was. So the next step was to develop a circuit optimization program that did not require any critical path or input sensitization information from the user, which was ultimately successful.

The lesson from this story is to put yourself in the shoes of the user of your ideas and understand why they are skeptical of what you are offering! The other interesting reflection in my case was that if I had not gone through the stepping stones of the two multi-year failed attempts, I would not have been in a position to deliver the ultimate home run.

The reset or extrication phase

The part of the cycle that most often gets forgotten is the reset phase from deployment to the next innovation. It is also the most difficult phase. The natural tendency is to stay with the previous successful project for too long, or to lack the discipline to seriously begin a new research endeavor, or to be fearful of the transition. It often takes a traumatic event for this phase to occur, and I would suggest that research management needs to pay most attention to this phase of the cycle.

Conclusion

Innovation is arduous, difficult and tricky. Be prepared to score a game-winning hat-trick (or grand slam, depending on the sport to which you relate) once, maybe twice in your career. And enjoy the journey (the presentations, the conferences, the patents, the development, the endless meetings, the engineering details), for the fruits of the destination, as alluring as they may seem from a distance, are fleeting in their allure!

Innovation is fun. It can convert a drab day or week into an exciting event, or a ho-hum group of people into an energetic and passionate team. Believe me – the thrill of achieving something that no human has tried never wears off! Give it a try!