Innovation and IBM

Dr. Seshadri Subbanna
Director, Innovation and Technology, IBM Corporate Strategy, Yorktown Heights, NY, USA.
and
Dr. Sanjay K Prasad
Chief Data Scientist, Global Industrial Products Center of Competence, IBM Global Business Services
Bengaluru, Karnataka, India.

Introduction

"Dedication to every clients' success" and "Innovation that matters, for our company and for the world" are key principles of IBM. How is IBM one of the few companies to survive and thrive for 120+ years through the exponential changes in Information Technology. With many patents, national awards, and Nobel Prizes? Chalk it up to our "Culture of Innovation", whether it is 26 years of patent leadership, beating human contestants on the "Jeopardy" game show or speeding up knowledge search and analysis for cancer treatments. We will review essential requirements for innovation and differentiating methodologies we use. The emphasis is on not getting in the way of people but directing them towards value, both business and societal.

Essentials of Innovation

There are four primary elements in an Innovation management program as shown in the Figure 1

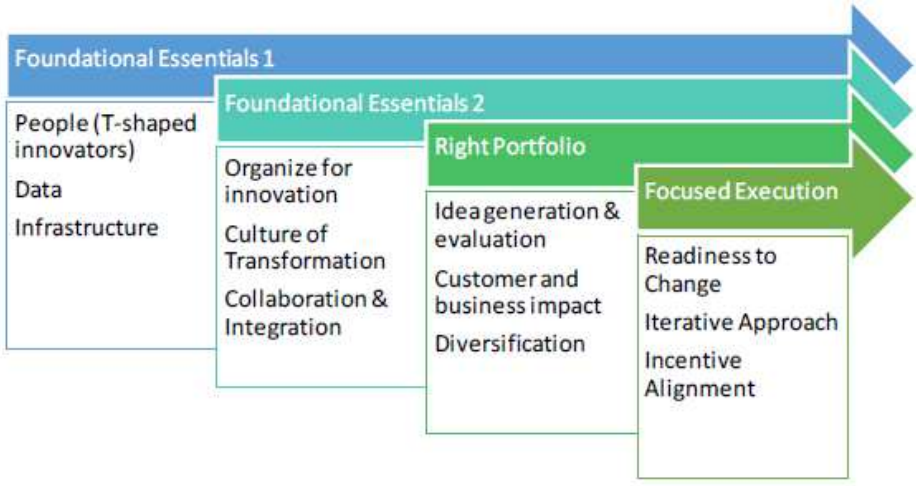

Figure 1: Elements for digital innovation management

First two elements are about preparing the organization for the seeds of innovation.

The first element is more around tangible things like creative people, data preparedness and investment in the right infrastructure.

- Innovative people are at the heart of it, and good news is that everyone can be innovative – it just needs a mix of expertise. When IBM invested in creating the field of Services Research in 2000, we introduced the concept of the "T-shaped" individual - breadth and some experience in many areas and depth in (at least) a few areas, both on business and technical sides. There is also a need for leadership, motivation and creative thinking skills. Nowadays we talk about STEAM rather than STEM - Science, Technology, Engineering, Arts, and Mathematics, because the design of the human interface to efficiently transfer information has become an essential part of designing an application.
- Data preparedness – More often than not, this is the area where we see lot of ideas tripping, especially as most of cognitive technologies need a good history of quality data as the starting point. In many analytics projects, 30-50% of the time may be spent in collecting and curating the data to be uniform, clean, and filtered enough to be able to depend on the results for business-critical decisions. Many companies are proactively investing into data management platform, even when the use case is not completely clear, to enable them to leverage opportunities which will arise in future.

- Infrastructure – People and good quality data will need access to right compute platform to test out the ideas quickly and do the initial prototype. This is where companies need to think about a target platform, which take care of their data needs and computing needs (machine learning/AI/blockchain etc.). "Right" platform is not just about the features, it is also about the scalability – horizontal and vertical. Can we start small with a pilot ("Proof of Concept" or PoC) and quickly productize and scale the platform without much additional work as user base increases (horizontal) or as more components are needed (vertical)? Can the developers collaborate easily? How mature is DevOps capability? etc. Here a standardized development platform and operating environment like IBM Cloud helps reduce the time and resource needed to get to a Minimum Viable Product (MVP).

  The three items above greatly reduce time and resource requirements, and improve success rates and value, of any pilot projects that are undertaken.

The Second element is more around the intangible essentials.

- Does the organization structure support innovation? While there is a merit for operational people getting involved in generating innovation ideas and helping them implement it. This normally works well only for small incremental innovation. For the bigger ideas, there need to be a more formal way of supporting innovation.
- Another key element is culture of transformation. Have we banned the phrase "We always did this way" or "Nobody does it that way" from our meetings? Have we created a safe environment for people to share ideas from the science lab to the manufacturing floor? Have we made people comfortable with failure? etc. etc.
- Last but not the least is collaboration. Research has proven that highly successful teams collaborate more. In IBM, we have taken focused efforts to create cross-brand forum like The IBM Academy of Technology, representing IBM's 200,000-strong technical community, where people from various business units can collaborate on an initiative. Some of the external facing programs give a higher weightage to programs with customer collaboration, thus encouraging teams to find sponsors and champions in the customer organization. Another key investment in our talent is ability to move between different kinds of jobs and re-train for new skills – We have an education and learning unit with a key focus on our own employees.

The Third element is about building a right portfolio of ideas. This requires fostering idea generation, idea management programs to ensure right ideas are taken forward, there is a healthy mix of idea on various dimensions –

- Product/ process/ service,
- Incremental-low hanging/ Radical – world changing
- Solution themes (visibility/ analytics/ cognitive)

These ideas are the seeds – some of which will grow to be big trees in due course of time. We crawl first, then walk and run.

So, now we have the right portfolio of ideas, and the right garden bed for these ideas. What is needed next is an eagle-eyed focus on execution. Some of our major lessons learnt in running innovation programs are:

- Readiness to change: Operations/Business need to be ready to change, and readiness to change cannot be just wished or mandated. We have tackled this challenge by using a 3-in-a-box leadership concept, where all initiatives were led by a business leader, a change management leader and a technical leader. Without active participation by the business unit that will take over the project, the pilot will not grow into a robust plant but instead will die away. One issue here is that for futuristic ideas originating in research teams, existing business units sometimes do not have the skills to run these new programs. In such cases, we transfer an entire team of researchers, designers, programmers, etc., along with the newly developed products, to ensure the success of the new program These employees can then be "recycled" back into research and development in a few years, coming back with invaluable experience in productizing and working with customers to build business value, (Building their "T-shaped" capability)
- Iterative deployment: It is ok to start small and build in phases. There is no shame in failing early, failing fast, learning, extracting the valuable bits, and moving on. Failure is nothing but an opportunity to decide how to refine the initial idea.
- Incentive alignment: For any significant idea, there will be multiple stakeholders. One of the leadership challenges is to ensure that incentives of all these stakeholders are aligned. We have seen in our experience that we start many innovation programs, where the responsibility of innovation success lies only on the innovation leader (chief innovation officer/chief digital officer etc.). These programs invariably move very slow, as the business has not much skin in it, and they are swamped with their daily operational issues. Further, we have also seen how some of these programs move very fast, when the business leader's goals are tweaked to add the innovation/digital roadmap success.

Innovation culture and Transformation

Every organization has perhaps tried several versions of Innovation Programs, either internally or suggested by third parties. It does not matter where the program comes from – without emphasis on cheap, quick, "fail-and-learn", and matching to the culture of the corporation it is highly likely that the program will not be able to demonstrate value to the business in terms of improved performance and speed of product development, deployment, or improvement.

From IBM's own wrenching experience with Transformation in the early 1990's, we have learned the importance of culture transformation, starting at the executive level, executed by the middle management, and being clearly communicated and propagated down to every working individual. The demonstration of a path to "re-skilling" or "new-skilling" though internal education is key because many of the new roles are best filled by loyal employees. This is also discussed above under "Readiness to Change".

A key issue related to projects we undertake is what NOT to do. With the advent of AI and the potential to outstrip human capability to control it, IBM has focused on both ethics and the individual's data privacy in reviewing all ideas with an AI Board that considers all these aspects in addition to business value before deciding to proceed.

Discontinuous versus Continuous Innovation

Looking back on IBM's century of technical invention and discovery, there are two major types of innovation. The first type is "Discontinuous Innovation", where a lab discovery leads to a new, significantly different, technology and useful product. In the context of inventions related to IT, we have example such as RISC, magnetic memory (Hard-drive storage), silicon-germanium chip technology, and many more. Other inventions of this kind lead to new product areas, such as high-temperature superconductivity (Utilized in the power industry), laser-ablation (Utilized for eye surgery), fractals geometry (Utilized in visual imagery), etc. This is where it is very important to allow "wild duck" scientists to keep tinkering in the lab to come up with these unexpected discoveries.

Cross-collaboration is a key factor here to generate unexpected results. One method we used in IBM Research was to send a coffee cart around the building with free coffee. People would congregate around the cart, talk to each other and exchange ideas, and new concepts would be "invented"! Even the architecture of the IBM T. J. Watson Research Center was designed to encourage scientists to come out of their labs and offices for the outside view and thus meet each other and collaborate.

The second type is "Continuous Innovation". Scientists and engineers continue to make incremental improvement on a day-to-day basis in an existing product, and over time this results in significant advancements. One of the best examples is Moore's Law in semiconductor technology. It is actually an observation ("Doubling of density transistor every 2-3 years)" that is a result of mostly continuous innovation (with some discontinuous innovation thrown in), which has resulted in many orders of magnitude improvement in logic/ microprocessor chip transistor density, storage chip, and storage hard-drive bit density and power over the past 6-7 *decades* (This resulted in a modern-day cell phone containing much more memory and processing power than the IBM computers that put Apollo 11 on the moon !).

Grand Challenges

IBM has focused its Innovation around "Grand Challenges". They help focus the organization around a large visible goal that makes the employees feel good, as well as solving real-world problems which are quickly translated to business value for clients.

This started in the 1960s with IBM computers being part of the Apollo program that put humans on the moon. Another big bet in the 1960s was the IBM360 mainframe, which continues 50 years later to be a huge mainstay of IBM's (and the world's) business.

In 2000s, through an IT "Innovation Jam" involving more than 50% of employees, we came up with a new set of grand challenges that became the basis of our "Smarter Planet" program. Examples are reducing wastage in the food supply chain, reducing energy consumption worldwide, improving health outcomes.

One can consider that IBM's Watson, the competition and Win in "Jeopardy" Game Show on television, its extension into improving analysis for cancer cures ("Watson for Oncology"), and the recent news around IBM Watson "Debater" debating humans, are other examples of such Grand Challenges.

Some Examples of Cross Pollination

Cross-pollination is a method whereby inventions in one area of science turn out to be useful in a completely different and unexpected area. It is the very essence of Innovation!

When IBM Research obtained one of the early excimer lasers for experimentation, scientists from different disciplines got together. They started playing around using it on leftover meat from the cafeteria! They found they could remove layers of tissue without damaging the underlying tissue. This resulted in a technology and patent that became the underlying basis for laser ablation eye surgery! For this work, IBMers James Wynne, Rangaswamy Srinivasan and Samuel Blum received the USA National Medal of Technology in 2013.

As a second example, the techniques of statistical analysis and prediction we had used in our semiconductor manufacturing fab line to improve chip yield were utilized to monitor and help predict premature infant health, to the point that the computers could predict health declines many hours in advance of even expert nurses.

As another example, the chemistry expertise (People, technology, and equipment) that was used to develop photo-sensitive polymers for use in the manufacture of chips was utilized as the basis for creating the first "green" recyclable thermosetting plastics.

As another example, the question-answering inference system that was used by IBM Watson to win "Jeopardy" game show versus humans was used to develop a product (Watson for Oncology) to speed up analysis of patient genomic and drug test data to determine what was likely to be the optimum personalized treatment for patients. While of course the reason for doing the original "Jeopardy" was because of the offshoots of the technology bring developed into product, the actual specific results are sometimes a surprise.

Conclusion

To sum up, Innovation, by its nature, cannot be fully structured; it needs chaos. It's very difficult to manage chaos, because virtually anything may develop, and the existing organization is only able to recognize and develop a limited set of areas (or markets, etc.). That's why we need multiple programs and initiatives, each addressing specific elements or sub-elements of the innovation space.

An Innovation leader's job is to put a loose structure on this seemingly chaotic state and ensure that end to end lifecycle of problem identification, idea generation, incubation, prototyping and operationalizing is maintained.

It's also critical to BOTH (a) NOT to kill any ideas coming from unexpected places or heading in unexpected directions, and (b) Kill ideas that have been evaluated prioritized as not beneficial to a business, while convincing the employees to learn from the failure and continue develop other better ideas.

References

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About the authors\

Dr. Subbanna is currently Director of Innovation and Technology Evaluation, IBM Corporate Strategy. He is involved in working on developing innovative solutions with and for clients, especially financial and industrial clients. Focus areas are Industry 4.0, Cognitive, and innovation culture. He also works on IBM strategy for future technology development and evaluation, using innovation in technology and business models. His focus is in the area of analytics solutions, client experience, reconfigurable computing systems and IT future workload acceleration. He has talked about Innovation at various international events. Prior to this, Dr. Subbanna was Director of Systems Hardware Intellectual Property Licensing and Partnerships. In 2005, he was Director of Early Technology Development at IBM Albany Nano-Technology Center (ANT), driving the early setup of a global multi-billion-dollar collaborative Research program with the State of New York at the University at Albany. During his 20+ year career in IBM, he has worked on strategy, culture of change, customer satisfaction, intellectual property evaluation and licensing, advanced CMOS process technology and memory development, very high-speed Silicon-Germanium mixed-signal technology, and server technology. He has over 50 publications and 50 patents to his credit, including many invited talks. Dr. Subbanna received his B. Tech in Elec. Eng. from IIT Bombay, and M.S and Ph. D. in Elec. Engg. and Materials Science from the University of California at Santa Barbara.

Dr. Sanjay Prasad is currently employed with IBM India as a Chief Data Scientist and is responsible for AI/Machine Learning applications in industrial sector. Sanjay has rich industry experience and has worked for large organizations like Coal India Ltd, Steel Authority of India Ltd, i2 Technologies etc. He is actively involved in the academic circles and has delivered lectures in institutes like IISc Bangalore and RIMS Bangalore. He also received Emerald Literati Award for Outstanding Reviewer in May 2013. He has developed a strong interest and expertise in Supply Chain Management, Services Engineering, Data Mining, Machine Learning, Game-theoretic modelling and Optimization Modelling. Sanjay received his B.Tech. degree in Mining Engineering from IIT(ISM) Dhanbad in 1993. Following that, he completed PGDM from IIM Ahmedabad and Ph. D. from IIT Delhi.