CASE STUDY:

Bose Rapid Prototyping Development Center:

Enabling Fast and Innovative Product and Concept Development

BY KATRINA APPELL, PhD | APRIL 2017

When Kiichiro Toyoda was starting Toyota Motor Corporation he emphasized the importance of learning rapidly to provide value to customers:

> ***"We are going to build cars. Let's all learn as much as we can, and work together to create something our customers will buy. My job is the same as yours: to learn as fast as I can."*** *– Kiichiro Toyoda* [i]

The fact that learning is what creates new value is one of the core principles of lean product and process development (LPPD).[ii] When making decisions and solving problems in product and process development it is critical to understand the knowledge gap between what you know and what you need to know. This knowledge gap should be closed through learning in the most effective and efficient means possible, often achieved through rapid cycles of learning, such as building low-fidelity prototypes. Quickly creating prototypes with just enough fidelity to test assumptions or concepts enables rapid learning to occur. Rapid prototyping also lets you get your product in front of customers, both internal and external, to learn and improve the design.

CREATING A COMPETITIVE ADVANTAGE THROUGH RAPID PROTOTYPING

Bose Corporation was founded to discover new and better solutions than anything that's come before.[iii] With this spirit, Bose became one of the initial partner companies in the Lean Enterprise Institute (LEI)'s LPPD Learning Group with the aim of learning with LEI and other partner companies to transform their product development system.[iv] In August 2015, Bose began the process of creating a Rapid Prototyping Development Center (RPDC) to create a competitive advantage through the ability to learn rapidly.

The charter for the Rapid Prototype Development Center (RPDC) is to:

Enable **fast and innovative product and concept development,** such that rapid prototyping is a true competitive advantage for Bose.

- Engage and empower employees.
- Creative, simple, low cost solutions when possible. Demonstrable value proposition when not.
- Customer service.

The intent was to build on existing groups within R&D to quickly prototype product concepts to support early market studies and exploration and enable set-based design. There were rapid prototyping capabilities within the electronics and machine shop departments, but these were not well-known within the rest of the organization. There was also no place for capabilities that were not part of the electronics or machine shop departments. By merging these departments into the RPDC it both provided one place to go for rapid prototyping needs and enabled additional capabilities to be added.

Both the machine shop and electronics departments had embraced lean thinking and made significant improvements prior to the formation of the RPDC. The machine shop led by Craig Miller, Rapid Prototype Manager, had used lean to become more cost-competitive. The department was very effective and comfortable with the progress they had made. Joining the RPDC focused the department on where they needed to continue to improve, which was on reducing turnaround time.

CREATING THE ENVIRONMENT FOR RAPID PROTOTYPING GUIDED BY THE RPDC CHARTER

Bose created a new position, Engineering and Operations Manager of the Rapid Prototyping Center, to create and manage the RPDC. Jon Grovesteen stepped into this role and was excited about the value a RPDC could provide. He knew that to be successful he would need to get other people throughout the organization engaged and excited about how the RPDC could provide a competitive advantage.

The first thing that Jon did when creating the RPDC was to learn what the RPDC should be to best serve internal Bose customers. This followed the LPPD core principle of deeply understanding what your product must be.[v] Jon spent two months interviewing internal product development groups to understand the customer needs. In these conversations he used a technology matrix to understand the technical capabilities required based on existing products. This approach focuses the RPDC on improving capabilities to support Bose's product roadmap. The interviews also served the purpose of creating awareness of the capabilities the RPDC could have and build excitement for the RPDC throughout the organization.

When creating the RPDC the focus was on creating a fun and inviting environment, knowing that the business results would come as developers were supported to do their best work. This aligns with the LPPD core principle that LPPD is all about people and enabling them to bring their energy, imagination, and creative potential to product and process development.[vi]

The RPDC leadership and team sit in an open space in the middle of the RPDC and no longer use their offices or cubes. This has increased their teamwork and customer service as they are more readily available to help when people come to the RPDC.

Figure 1: Rapid Prototyping Development Center

DESIGNING SPACE TO FACILITATE COLLABORATION

The area was designed to be open and accessible for all Bose employees to use (Figure 1). This approach was different than how prototyping has historically been done at Bose. Prototyping is typically done with a specific technology in an area covered with black tarps, so that what is being worked on can be kept confidential (Figure 2).

The engineers enjoyed working in the prototyping spaces that they owned. They were able to focus and do great work. However, it was easy to let things slide because other people couldn't see in. Now that the walls are down and the work is transparent, people from different technologies are supporting each other and collaborating with design engineers. This collaboration enables engineers to work together to make better products.

> ***"The positive 'can-do' attitude of the technicians and engineers makes collaboration effortless and greatly improves the quality of my designs."***
> *– Nate, Research Engineer*

The RPDC includes an open conference area that is unscheduled, so that it is always available for impromptu meetings (Figure 3). The participants in this meeting space noted that without this area they would not have been able to collaborate and share ideas as effectively. They said that:

Figure 2: Prototyping Space

Figure 3: Open Conference Area

"It would not be a good time. But now it is fun. There are resources, help available, and the ability to focus."

CREATING A MAKERSPACE TO ACCELERATE INNOVATION

Jon learned about First Build[vii] at GE Appliances during the LEI LPPD Learning Partner Event[viii] hosted by GE Appliances in May 2016. A key takeaway was that it takes about four years from when someone has an idea until that idea is developed. Of that four years, the idea is just in someone's head for the first two and a half; only in the final year and a half will it be actively developed. Within the RPDC, a "makerspace" being developed will focus on shortening the time an idea sits in someone's head. The makerspace will enable people to bring their ideas to life.

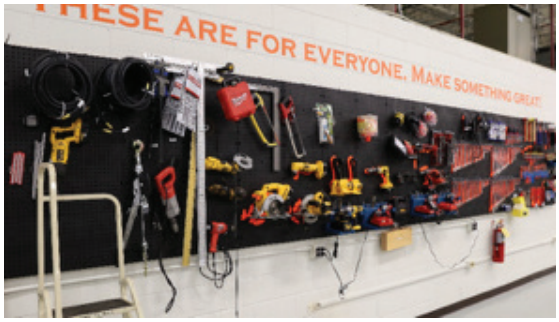

Figure 4: Visible Tools

Also influenced by the Learning Partner Event was the creation of a wall where tools are visible, accessible, and available for everyone to use (Figure 4). This is another supporting feature of the open, transparent and collaborative environment the RPDC is creating. Groups throughout Bose donated their underutilized equipment to the RPDC, so that it can be of a greater benefit to the overall organization.

INCREASING CAPABILITIES WITH LOW COST SOLUTIONS

The RPDC operates with a "start-up mentality" to get the equipment needed to provide value to internal customers. They always have their eyes and ears open for a good deal on equipment. One example was the purchase of a used electronics oven for $30,000. The old one was sold for $20,000. For a net cost of $10,000 the RPDC was able to get a machine valued at $110,000. Before opening a check-book they look for ways to repurpose materials that might otherwise go in the trash. For example, Figure 5 shows the repurposing of a display shelf in the 3D printing area. Finding creative low-cost opportunities enables the RPDC to provide more capabilities.

Figure 5: Repurposed Display Shelf

SUPPORTING ENGINEERS TO FOCUS ON DESIGNING

After the RPDC built a molding room, other groups donated their molding equipment to be used in it. People are learning from each other now that this equipment is co-located and they are working in the same space. Engineers can focus on designing parts rather than on iterating molds as they have the support needed to make molds. The molding experts, 3D printing experts, and product designers are able to collaborate much more effectively than they previously did, resulting in parts being made in less than a week.

For molding and other technologies there are supplies available that have been donated by vendors (Figure 6). This gives engineers easy access to materials along with business cards to be able to contact suppliers. By donating the material the suppliers have a higher likelihood of their material being used in the product. In other areas such as the model shop, materials are not donated but there is a standard library of materials available in stock, which are preferred and approved materials. The engineers can still custom-order anything they need, but knowing what materials are immediately available usually drives the designers to design within that standard library. This ease of access to materials also increases creativity amongst the engineers.

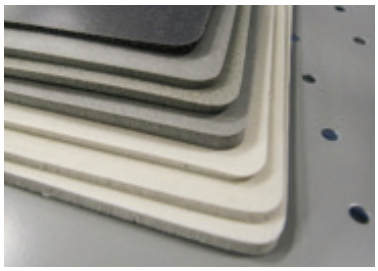

Figure 6: Gasket Materials

"Being able to touch the materials leads to greater creativity and innovation. It helps you think about what is possible." *- Brock, Advanced Development Engineer*

CONCLUSION

Bose created a Rapid Prototyping Development Center to test ideas quickly.

> ***"You are able to try a bunch of things and have them fail. The one that doesn't fail could be huge for the company."*** *– Binu, Development Engineer*

Examples of the rapid learning enabled by the additional capabilities in the RPDC include:

- Laser cutting - A packaging engineer was able to learn in twenty minutes that the material and design he was considering would not work as intended. If not available in the RPDC, it would have taken at least two weeks to obtain this knowledge by outsourcing the learning.
- Acrylic bonding – An engineer was able to laser-cut, bend, and test in a couple of hours. It would have taken months to obtain this knowledge through modeling.
- Fixturing – An engineer was able to do six iterations in the time it would typically take to do two. These iterations enabled design changes to improve fit, ergonomics, and strength.
- Composite Material – An engineer was able to get proof of concept and evaluate rigidity, strain of failure, and fit. Without this capability available the design would not have been considered.

The ability to learn quickly has had many benefits for the development of products:

- A week before a product was scheduled to be reviewed by stakeholders, a newly specified performance target was set. This required a redesign that was only achieved in that timeframe because of the ability to rapidly prototype.
- Having shorter turn-around time for conceptual prototypes enables more development iterations to be completed, which enables better performance characteristics.

In addition to the tangible benefits noted above, there are many intangible benefits of the RPDC. It supports higher levels of creativity, greater collaboration, and increases employee engagement.

> ***"This space is one of the strongest things that impacts engagement."***
> *- Brock, Advanced Development Engineer*

The creation of an environment to enable and support people to do their best work while learning quickly can result in improved product performance.

References

[i]Ward, A. C. and D. K. Sobek II (2014). Lean Product and Process Development. Cambridge, MA, The Lean Enterprise Institute.
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