Case study

Innovations in new product development at Universal Pipe and Fittings

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Abstract

Purpose – To describe an innovative practice that has implication for new product developers.
Design/methodology/approach – The case describes an approach to building creativity used in an actual company. The name of the organization has been changed at its request. Interviews with company representatives, organizational concept papers and publicly available data were used to write the case study.
Findings – Provides information and action approaches to new product developers that may increase the success and accuracy of resulting new products. The subject company applied the mind mapping technique, previously used in project management, to new product development. Their results offer encouraging implications for new product development teams.
Research limitations/implications – As in all case studies, the specific conditions found in one organization may not be found more generally in others. Readers are cautioned that the conclusions drawn in the case may have limited applicability.
Practical implications – The case depicts an innovative application of the mind mapping technique to the new product development process. Other organizations may find the technique of value in their own efforts.
Originality/value – The case is the first to describe a successful application of the mind mapping technique to the new product development process. It offers the potential of improving the success of new products in the marketplace, increasing company success.

Keywords Product development, Innovation, Energy industry

Paper type Case study

Universal Pipe and Fittings is a global energy services company. It started its operations in the 1930s in Oshawa, Ontario as a specialty pipe coater. Today, it specializes in products and services for the pipeline and pipe services, and petrochemical and industrial segments of the oil and gas industry. Universal Pipe and Fittings operates through six wholly owned business units serving its target audiences. It operates manufacturing, service facilities and sales offices in over 20 countries around the world. It is a large organization but if one word captures the essence of Universal Pipe and Fittings it is innovation. Over time its innovation burden has grown rapidly. The level of customer sophistication and technological complexity seems to grow daily. As a result, the company has sought tools and techniques to increase its innovation efficiency and effectiveness. The company concentrates on two main innovation areas, R&D for new product technical characteristics and traditional new product development processes to satisfy customer preferences.

Company description

Universal Pipe and Fittings’ businesses are segregated into two segments. The pipeline and pipe services segment and the petrochemical and industrial segment. The pipeline and pipe services segment includes businesses that provide sophisticated coatings, linings and insulation for pipeline corrosion protection, weight coating and temperature maintenance applications, including products and services designed specifically for deepwater installations; ultrasonic and radiographic line pipe and pipeline girth weld inspection services; heat shrinkable sleeves, adhesives, sealants and liquid coatings used for pipeline corrosion protection; inventory management, inspection, testing and refurbishment services for oilfield elements including drill pipe, production tubing and casing used in the exploration for and production of oil and gas.

Universal Pipe and Fittings represents a real company in the petroleum industry. It has pioneered mind mapping in R&D and new product development. The company’s experience may be valuable to marketers concerned with developing new products.
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The petrochemical and industrial businesses supply wire and cable for use in robotics, process instrumentation and control systems; and heat shrink tubing, sleeves and kits utilized in automotive, electrical, electronic, telecommunications and mechanical insulation applications. All of Universal Pipe and Fittings' (UFS) businesses involve highly technical product design and manufacturing. In addition, each business unit is part of a well-connected group of core businesses. Each product is the result of a careful design process involving multiple factors that relate to user and manufacturing issues. UFS's average new product design activities involve a level of complexity far in excess of those needed for the average consumer product. Not only do the products require a complex balance of features and benefits; they have benefits that require a deep understanding of user needs.

History of innovation at Universal Pipe and Fittings

Management at UFS is mindful that growth relies on a stream of products with strategic advantages over other alternatives. Much of the company's success can be attributed to a focus on the development and application of innovative technologies. The company stresses that advances in material formulations, manufacturing processes and product designs have been vital. Company engineers and new product development team members have been very active in keeping current with new technologies. The objective has been to create new or improved products and services to serve customer needs better. For most of its history the company has concentrated on what it calls “the engineering solution.” That solution relies on a clearly articulated set of specifications that define the product. Most often customers define those specifications in requests for proposals. It is the R&D department that translates those detailed specifications into products and services.

UFS's public relations department is quick to stress that the company's on-going advances have helped it to maintain a prime position in its served markets. The company's corporate culture created a structure that supports creativity and imaginative problem solving. One consequence of the innovative corporate culture was the emergence of a standard of achievement. One engineer used an Old West analogy and called it, “the notches on the gun butt syndrome.” The analogy referred to the notches cut by gunmen on the butt of their six shooters to keep score of their successes. By that he meant that engineers concentrated on developing a series of new product technological solutions. They and the company measured their success and status by counting the number of each engineer’s successes: the notches on the gun butt.

The most serious consequence of that development model was a comprehensive focus on internal resources. Since definitions of customer needs originated outside of the company, engineers concentrated on meeting the specifications. The development process took place internally within the various R&D teams. When a product was fully developed it emerged from manufacturing and was introduced into the marketplace. Most of the time company products were quite acceptable.

Corporate R&D facilities

Another element necessary for innovation is structural support. One example of the structural support for innovation is the Meb Turner Research Laboratory. It is a well-designed facility that conducts experimental research and development. True to the company's origins, the center concentrates on the technical aspects of products. Consequently, there have been breakthroughs in technologies and product components that improve the performance of specific company products.

The center is named in honor of Meb Turner; a former Vice President of Engineering at Universal Pipe and Fittings. Turner is credited with developing both Universal Pipe and Fittings’ technology base and its innovative culture. The center is solely the province of engineers. Currently, Dr Ron Stiffler is the chief of R&D at the center.

Technology areas

One of the key technology platforms that has been instrumental in the success of Universal Pipe and Fittings is anti-corrosion coatings. This technology used to develop new corrosion protection solutions for the pipeline industry worldwide.

Pipe coating

Pipe coating was the technology platform on which Universal Pipe and Fittings was originally founded. Today, the company services customers' mainline pipe-coating needs. Universal Pipe and Fittings offers a variety of pipe coatings that have specialized functions or are used for specialized applications including: external corrosion coatings; internal pipe coatings; concrete weight coatings; insulation coatings; coatings for deep water applications.

Universal Pipe and Fittings personnel have experience with a wide range of materials that are used to formulate anti-corrosion coatings for both, factory applied mainline pipe coatings, as well as field applied coatings for joint protection including: liquid epoxies; urethane based materials; bituminous sealants; materials for thermal insulation including fillers and resins used to make syntactic foams. It is remarkable that other key technology platforms such as adhesives and polymer cross-linking are directly applicable not only to specific related products but also to the core pipe-coating mission.

The pressure to innovate

One of Dr Ron Stiffler's tasks as an R&D manager for Universal Pipe and Fittings is to develop new generations of coatings with totally new properties. They must be capable of withstanding the increased stresses encountered on modern pipelines due to higher operating temperatures.

Stiffler, a PhD, and his team begin most coating development projects by holding brainstorming sessions to discuss potential coating formulations. In the past, the team would typically use white boards and flip charts to gather ideas, and then create a spreadsheet with five or six initial approaches down the side and perhaps 100 possible components across the top. The first problem, they concentrated on was the difficulty of making order out of the chaos of dozens of possibilities. Once they created the
formulation matrix, the team could not see all the compositional approaches at once. Stiffler and his team would have to jump back and forth between different formulations trying to compare them.

It became apparent that some method of simplifying the organization, display and retrieval of information was missing. The company searched the industry, the business and computer literature and discovered the process of project mapping.

Project mapping provided a method of streamlining the process of brainstorming and doing preliminary testing on new materials.

In essence a formulation is nothing more than a recipe. To create a new formulation, engineers start with basic ingredients and combine them on paper to get something that might provide a desired result. For example, consider a prototype nuclear power plant requires pipe coatings of high strength and temperature resistance combined with resistance to the effects of nuclear radiation. In such a case the engineers might start with a material that provides high strength. They might then add another material known for its temperature resistance and finish with other materials that might reduce hydrogen embrittlement, the process that weakens metal over time. Typically, numerous alternatives exist.

Since combinations of ingredients may result in unwanted side effects, engineers formulate numerous alternative recipes that promise to provide the proper characteristics. Keeping track of them takes some doing.

**Building formulation “maps”**

One of Stiffler’s team, Joe Brusca, was an amateur artist. He decided that a graphical representation of the formulation process might be helpful in organizing the complex set of information. That “picture” became a map of the formulation tree. As an example, if the department planned to formulate a new coating based on acrylics, it would add a main branch and label it methacrylic polymers. That branch would be a starting point for one line of possible formulation approaches.

On that branch, it might have sub branches for the different types of methacrylic polymers that seem to have potential to offer the right properties. Other formulation components become sub branches to those branches, representing things that are being added such as acrylic resin, epoxy resin, or other ingredients. If another formulation based on a non-methacrylic polymer is used, the department adds another main branch for that formulation. The next step would be to add the same or different sub branches to that main branch as well. The idea would be to deliberate all of the base formulations and across the component list. Brusca’s hand drawn map was instructive but too time consuming to produce and update. The department turned to traditional office tools like spreadsheets, but they were limited and not very useful in mapping.

Fortunately, there was an off-the-shelf program with mapping capabilities. Mindjet’s MindManager project-mapping software allowed Universal Pipe and Fittings to conduct the often complex and lengthy projects a lot faster, easier, and smarter.

Using the software, the team could create a formulation map, which could serve as a management focus. For example, a team leader could assign individual formulation branches to team members. Each person would do preliminary research on that formulation branch, and add what he or she had learned to the project map. As research is added to the map, the team could review goes through the formulation tree periodically, looking at the data on different branches of the tree. It would be possible to evolve a project plan focused on those branches that look the most promising. That simple visualization tool adds dramatically to managerial control as well as fostering effective creativity. Using mapping it is less likely that a solution is overlooked.

The company found that maps have proven to be extremely useful for formulation trees. One of the big issues facing Universal Pipe and Fittings R&D is how to represent a great deal of complex data so that a viewer can see it all at once. In addition, the mapping software clarified communication. For example, the company’s chemists use numbers as names which might look like: formulation A-1, A-2, B-1, B-2, and so on. The problem is that these names tell you nothing about what is in a formulation.

Before the R&D group started using project mapping, they would construct spreadsheets or tables filled with these kinds of notations, and would have to continually flip back and forth to see what “Formulation A-1” meant. Figure 1 shows a typical generic formulation map and its elements.

**Seeing the forest for the trees**

Project maps give the R&D team a way to view data in layers. On the first layer of branches they record their main formulation bases. Go down one layer, and all the components they have tried for that base are revealed. Open another layer, and the team has access to test results that indicate how close to the target each formulation has come, based on certain qualitative indicators. Maps can help distinguish among a number of alternatives to highlight similarities and differences. One can view the most to least effective possibilities on a given set of criteria. Moreover, the patterns can give clues to potential new alternatives that have not yet been considered.

The R&D team offered an example. It was looking for particular set of properties in a coating formulation. The team created a series of symbols to demonstrate how close a formulation came to meeting a target. The team actually created 30 customized symbols for ten unique properties. The symbols can be created easily and they are extremely useful. The advantage of symbols is that they provide a visual representation of the alternatives. Team members can see all the coating formulations at once, with each one’s compatibility and coating performance laid out. This means that one can see how composition is affecting the coating properties – at a glance.

Universal Pipe and Fittings has found that the use of project mapping has brought a real productivity gain to R&D because it enables a team to “wrap their minds” around what they are doing – especially with large mixing matrices. The maps work better because they make it easier to see all the data at once – which is not just a matter of convenience. When everything is laid out in front of an individual, the brain can start to make connections that would not otherwise be made. Mapping software provides both decision making speed and quality.
Bringing teams together, moving faster

R&D teams typical use dedicated project management software to chart projects. In addition, they can use project mapping to keep projects on target as they move forward. Members have reported that mapping saves an amazing amount of time in terms of figuring out which material is affecting which properties, and in which way.

Operationally, each staff member can add data to a project map, which the team as a whole can evaluate. The resulting new information will allow modification of the project to push strong formulation candidates to the front. Then once it has arrived at a clear sense of what the most promising formulations might be, it can design a series of experiments to thoroughly test each candidate.

It must be stressed that project maps are very good communications tools. With many applications, viewers can instantly see a team’s approach to a problem. This can be helpful when the team needs to communicate its work to upper management. By looking at just one single map, management can understand the development process quickly. There isn’t any shorthand to figure out, and no flipping back and forth between reference materials. The maps just provide a nice visual layout that quickly and clearly communicates a lot of information.

As with any new technology, Universal Pipe and Fittings’ Dr Stiffler recalled that there was considerable resistance at first to using this kind of mapping – particularly for creating formulation trees. Team members questioned the need to learn use of the maps when they had reliable old spreadsheets. This resistance disappeared when the ease of building project maps was shown. Moreover, what the maps could do in terms of communication and provoking new alternatives sped acceptance. Now the team tends to use project maps almost exclusively for these kinds of projects.

After seeing its value in R&D, Stiffler made strong efforts to integrate the technique across the UFS enterprise. He used maps to transmit product ideas to his CEO and COO who found them valuable and endorsed their widespread use. The company acknowledges that MindManager has helped it speed up and improve its research activities. Already Universal Pipe and Fittings has adapted the tool to other uses. It keeps track of customer suggestions, helps brainstorm market opportunities, and track intelligence on competitors, markets, and emerging technologies. These applications lead directly into the new product development process.

Applying mapping to new product development

For Universal Pipe and Fittings formulating a technical solution to a problem is admittedly a complex task. There are numerous factors and effects to consider. However, the data involved are usually precise. For example, factors such as temperature, pressure, solubility, resistance to corrosion, hardness, and cost are precisely quantifiable. That level of precision means that the R&D team has a conceptually simpler task than the new product development team. Nevertheless, Stiffler arranged a demonstration of a MindManager exercise to the marketing executives active in the new product development process (NPD).

Chris Miller, the marketing director for one of Universal Pipe and Fittings’ businesses attended the demonstration. His major responsibilities included developing new products for industry and consumer segments. He had a fundamentally different problem than Ron Stiffler. His division’s customers were not engineers; they were purchasing managers and end consumers. As a result he lacked the detailed specifications that his engineering colleagues enjoyed. Miller was stuck in the same position as new product developers in the consumer products industry. He was burdened by the need to collect, analyze and interpret the volumes of consumer preference data. The process had to be completed before ideas could be generated.

He had concerns about how useful mapping would be since it had worked with precise engineering information. There was no evidence that it could really help NPD.
referred to his new product development process as handicapped by the “fuzzy front end.” The fuzzy front end described the difficult and even scary work of tracking the wants, needs and problems of current and potential customers. Miller stated:

It's difficult work because at this stage, so little is known. NPD teams don't really know what questions to ask. Further downstream in the NPD process, it is easier to identify the questions that will verify that we're on the right track or those that will result in improvements to concepts that are already defined. The “how do you like it?” and “how would you make it better?” questions easily roll off the researcher's tongue and we are quite comfortable with how to deal with the answers.

He went on to say:

The fuzzy front end tends to be much more ambiguous and messy. Here we are often searching for good problems to solve. We are searching for new hunting grounds, new areas of business opportunity. The questions are not, “How do you like it?” but more “Will you tell me about yourself?” and, “May I spend a day simply watching what you do?”

He went on to say:

… this mapping process seems like a good tool that would help with idea generation, screening and the higher level stages in the NPD process. That benefit is enough reason to try it. But, I don’t know whether that tool applies to the most vital work: understanding the consumer to set the stage for the rest of the process.

Stiffler acknowledged that he did not know whether mapping would work with such ill defined and ambiguous data. He offered to demonstrate mapping's capabilities and hoped that the NPD team would see applications that he might miss. The group decided to watch, listen and learn and see if they could find something of value. He started MindManager and using a projection system, proceeded to conduct an interactive NPD process. He deliberately concentrated on the stages beyond the fuzzy front end. He went to Brainstorm Mode and began to capture ideas that were relevant to work the team was doing. He solicited input and ideas and asked about connections and what resources the team thought were important. Within the space of 45 minutes, the team had created a comprehensive map of each stage of the NPD process with connections, prioritized tasks, clearly defined processes and workflows. There were branches representing:

- idea generation;
- screening;
- economic analysis;
- development;
- test marketing; and
- commercialization.

Each branch contained links to required resources and approaches to information. The team leader, Chris Miller was even able to consider how and where to assign members to complete critical tasks.

When the demonstration was over, Stiffler asked about other areas that mapping might help. Immediately, the fuzzy front end came up. Now that the team had experience with the process, each member had some ideas that might be applicable. Stiffler provided another demonstration. He knew the process even if he did not know the content of the consumer research problem. Over the course of an hour, the team and Stiffler identified a set of generic issues and their relationships that encapsulated the challenge of plumbing consumer preferences.

Stiffler coaxed Chris Miller into helping develop a map of the foundation to the NPD process. Miller decided that it would be helpful to have the team devote a free Saturday to a brainstorming session focusing on how to gather consumer information. Mapping provided some insight into the obstacles to approaching gaining knowledge of the customer. As the team considered how to divine customer preferences some members stated, “We already know the answers.” The mapping process allowed someone to ask, “How do we know?” The team could be asking the same questions in the same way almost guaranteeing that they would get the same answers. Miller decided that they should assume that everything they knew was wrong. The solution was to change the way the team asked questions. The division traditionally used focus groups. That led to new branches with research techniques like surveys, phone interviews or “day in the life” research.

Another obstacle arose in the form of a comment that the team gets end user input from the division’s sales people and distributors. One worry was that while the information from the field could be valuable, it was often anecdotal and sometimes caused knee jerk reactions that were not the best response. Mapping allowed the team to prepare to track themes that emerged. The process allowed the team to take control of an important research process.

Surprisingly, the team voiced one last issue. Some felt that their customers really did not know what they would need in the near future. Perhaps this might be true. However, much could be gained by observing the ways in which they dealt with whatever activity the team was interested in. In this case, how they dealt with the division’s product lines and the problems they solve. That realization also prompted a series of branches and connections.

The experience taught the NPD team that MindManager was valuable in each stage of the new product development process. However, its most valuable application was in researching customer needs and wants. Conventional wisdom acknowledged that most new product ideas do not make it in the consumer marketplace. Moreover, the failure rate of new products in the market is much too high. The cause seems to be consumer research that is faulty. Many companies try to collect consumer information by repeatedly using the same set of techniques. The mapping exercise brought out the importance of deploying additional research techniques for increased reliability.

After the session, Stiffler felt that he had planted a new tool in another Universal Pipe and Fittings division. In fact, he helped apply it in a new field. MindManager's project management functions were valuable. In this application, they help improve not only the new product development process, but also the research foundation that underlies it. It was a first step, but a large step forward.