

# DFMA Culture Shock at Kohler

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**“When a great adventure is offered, you don't refuse it.”**

Amelia Earhart



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### **KOHLER CO.**

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## INTRODUCTION

Culture Shock! That was the initial observation made as Kohler successfully implemented DFMA (Design for Manufacture and Assembly) within its Global Faucets organization. The following paper will discuss the progression Kohler made recognizing the need to adopt DFMA, the steps taken during its implementation, and how the shock and pain points were overcome along the way. Some critical success factors, including management support and development of internal DFMA expertise, will be highlighted, resulting in the use of DFMA expanding beyond the initial plans and reaching into other functions and organizations within the company. Examples of Kohler projects that effectively utilized DFMA will also be discussed.

## EARLY INVESTIGATIONS

Kohler Company was first introduced to the Boothroyd Dewhurst DFMA software and methodology when it was seeking a tool to help with cost reduction in response to the global business downturn of 2008. An initial group of associates were sent to a training session in Providence, RI. However, without a DFMA champion to communicate the benefits and encourage adoption, the subsequent cost reduction effort failed to gain traction. There was no purchase of the software tool, and the effort eventually disappeared. At the time it seemed that Kohler would not be pursuing a DFMA strategy.

Years later, in 2013, when memory of the limited DFMA activity had faded, another group of intrepid pioneers at Kohler began to investigate the potential of DFMA. At the corporate level within Kohler there is a continuous improvement group known as KOS (Kohler Operating System), which focuses on driving uniform change throughout the various Kohler businesses. Members of this group began investigating the DFMA tool and its possibilities.

Simultaneously, a new organization within the Global Faucets business unit of Kohler was being created. This organization, NPI (New Product Integration), was coming together at the hands of Ben Marotz, who wanted to enable collaboration between engineering, manufacturing and purchasing within the new product development process. Fortuitously, these groups met during a benchmarking trip to a Kohler subsidiary, Mira, in the UK, where an aging stand-alone

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version of the Boothroyd Dewhurst DFMA tool was already in use, primarily to conduct DFA assessments to simplify design and reduce assembly time. The visit made a positive impression of the DFMA method on the group.

Subsequently, the NPI team coordinated a session of a DFMA webinar sponsored by SME. Several teams took part in the webinar, which included in-depth paper analysis using the DFA method and the teardown of a computer.

The seminar was informative but failed to create engagement. The paper method was not intuitive and required large amounts of time. It did, however, reconnect the two groups and

intrigue Ben with the idea that DFMA could help the fledgling NPI group facilitate a collaborative environment for new product development, so he wanted to know more.

Subsequently, Ben reenergized the discussion concerning DFMA with the KOS group, whose effort was now led by Adam Guenther. An agreement was reached in which Adam would identify the best practice tool for the DFMA process. His investigations into various DFMA tools identified competing approaches and providers. Two tools were identified, including aPriori and DFMA by BDI (Boothroyd-Dewhurst, Inc.). The aPriori tool focused on part cost modeling, but lacked the ability to analyze and improve assemblies. The DFMA tool from BDI had the ability to simplify product designs and understand the cost drivers of the resultant parts.

Kohler wanted to implement a mechanism that positively injected process engineering and operations influence into product design. The intention was to support more rapid downstream product launch activities such as part production, quality approval and improved delivery. Ben and Adam also sought to target more involvement in rapid upstream activities such as supply chain design, process development and quoting. They wanted their decision making to be rapid, early, and based on accurate data. With determination they set out to further investigate DFMA and discover how to implement the methodology. Ben wanted the NPI team to have a tool that provided an analytical approach to evaluating design concepts.

Adam wanted a tool that could be used universally across the disparate business units of Kohler.

Deployment of DFMA would require an efficient tool, otherwise they feared that all parties involved would quickly lose interest and go back to “guesses” and “gut calls based on experience”.

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Another objective that Kohler sought to accomplish through DFMA adoption was early manufacturing engagement. They wanted to enhance performance in the manufacturing environment by improving the product design as well as adequately preparing to execute manufacturing processes. Additionally, Ben and Adam wanted to capture cost savings through early “Should Cost” estimating. This objective was identified during their investigation into companies who were fully utilizing DFMA.

Further research into the BDI DFMA tool, resulting from a meeting with the BDI team at an Assembly Show pre-show seminar, revealed that it helped drive collaborative work behaviors during product development. The resulting analysis data was more comprehensive and enabled the evaluation of alternative design approaches. It was an ideal fit for the type of work environment and goals within Kohler.

## **EARLY DFMA EFFORTS**

Once the decision to move forward with the DFMA software was made, Ben and Adam, in concert with their leadership in Global Faucets Manufacturing and KOS, moved quickly to begin

the growth of DFMA within the Global Faucets organization. Adam would serve as the initial subject matter leader, with Ben serving as the change leader and manager. The initial thought behind this effort consisted of 6 steps:

- **Step 1** – KOS (corporate) and NPI (business unit) would collaborate more closely in the implementation of DFMA and provide financial and cultural justification for adopting the DFMA tool.
- **Step 2** - Socialize the benefits of DFMA with other functional leaders in the New Product Development (NPD) environment. Drive awareness and create a desire to give it a try, then utilize some experts for immediate benefits during the pilot program. It was critical to link the previous recurring project delays and product cost overages to the important decisions being made in the early phases of the projects. Once this link was believed by the group, there would be enough support to move forward with DFMA.
- **Step 3** - Pilot the DFMA tool on a project that has clear reason for application and high potential for success. Invite a BDI external expert to facilitate the first workshop. Continue to drive the DFMA efforts with both KOS and NPI, documenting and reporting results and benefits as the project continues.
- **Step 4** - Schedule a two-day DFMA Workshop at Kohler headquarters for the end of 2014. The workshop would focus on a new product that was in the early concept design phase, and it would be attended by representatives from engineering, manufacturing, program management, and the new NPI group. The results of the workshop needed to demonstrate that this initial small investment in the first workshop for Global Faucets could provide the targeted proof of concept regarding DFMA, along with adequate financial and project benefit to justify the initial capital expenditure of the DFMA tool.
- **Step 5** - Train the NPI personnel in use of the DFMA tools, along with facilitation skills, to establish clear responsibilities for deployment. Since the NPI team reports to operations, it provided a nice mix of desire, credibility and justification to question the design work coming from the NPD community. It was absolutely critical that Kohler have a trained group with the desire and motivation to implement the DFMA change. Without that group of initial change agents, the effort would fail immediately, just like earlier attempts.
- **Step 6** – Drive change through an initial series of workshops and the creation of a DFMA dashboard. During the first year of the deployment, the goal was to conduct these workshops in each of the major design centers globally, reporting on the results via a dashboard to senior management.

The initial 'sell' to senior management for employing the DFMA tool was not easy. The business had limited knowledge about the DFMA process and potential benefits. The general belief was that a typical DFMA activity consisted of manufacturing personnel reviewing a set of drawings for an hour or two after the design was completed. A few were skeptical that DFMA could do anything else, therefore it would be a waste of time and money. Oftentimes, there was confusion between DFMA and DFMEA, where it was thought that the two activities were the same, which required a brief explanation about the differences. DFMA was also considered a 'technical expertise' best suited for the corporate (KOS) team.

Adam and Ben set out to grow the DFMA deployment by socializing the effort within Kohler leadership, gaining buy-in and increasing a sense of urgency by highlighting the areas of required change which would be addressed by DFMA. This led to support for the third and fourth steps, which took place in December, 2014. The initial, BDI-led Kohler workshop, which was attended by 24 multi-functional individuals, produced excellent results for the pilot project, leading to increased demand and the capital purchase of the software in early 2015.

In January 2015, a small group of associates from KOS and NPI were sent to Providence, RI for DFMA training. During the subsequent months, multiple workshops were completed, largely

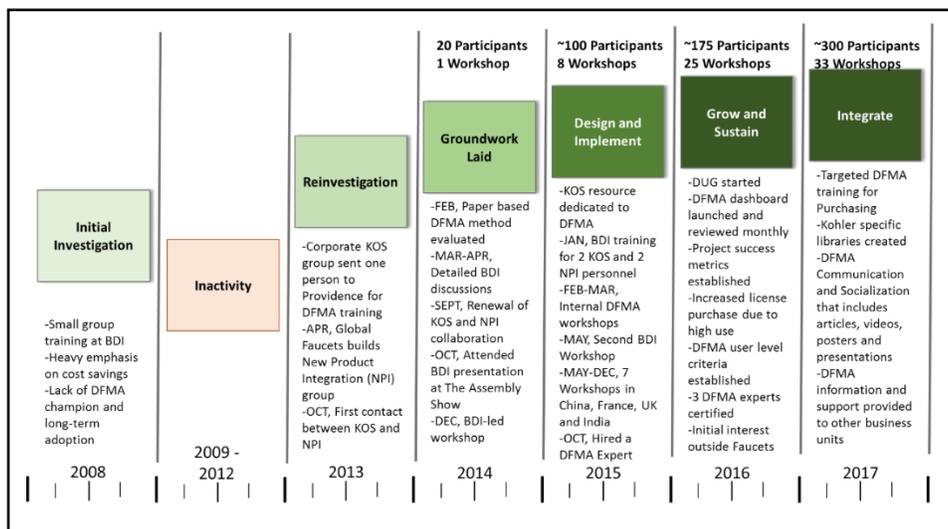
domestically but also at the other developmental centers throughout Kohler’s global footprint. They were led by Adam from KOS and representatives from BDI. The cost savings and design improvements from these workshops led to increased support from senior management.

Kohler had a thirst for DFMA knowledge after realizing some of the values that DFMA activities could provide and achieving initial improvements. However, change is hard. It became clear during the pilot work that changing the opinions of senior technical skeptics would take established credibility, repetition and results. This led Ben to the conclusion that in order for DFMA to be fully sustained, Kohler would need to hire a full time DFMA expert to institutionalize the benefits of the DFMA tool and its new way of operating. An immediate ‘Trainer of Trainers’ would provide the ability to rapidly and effectively deploy DFMA. Toward the latter part of 2015 an external DFMA expert, by the name of Bill Devenish, was hired into the Global Faucets organization of Kohler. Bill brought more than a decade of experience at implementing DFMA within other companies.

The addition of Bill significantly reinforced the early results. The external credibility brought by his hire, his experience in driving DFMA results, and the additional support provided through his full-time dedication to the method, took the Kohler results to the next level. This led to the addition of another step in the strategy:

- **Step 7** - Create and manage a DFMA Strategy. Kohler would create a 3 year vision with 1 year tactical goals to drive the DFMA deployment measurement and management of key performance indicators, DFMA training across multiple functions globally, and continuous improvement. Kohler then would need to communicate the strategy, ensuring functional buy-in and commitment. The plan was based on the idea that DFMA could only be as successful as the broad group of innovators that came together to find solutions to the difficult problems.

Three months after Bill was hired, the key metrics were updated and presented to the business president and his staff. The immediate results in cost avoidance identified and proof of product simplification in design was the tipping point. Upper management was more than supportive and demanded DFMA activities on all major projects and strategic initiatives.



Global Faucets was also working to build a Lean culture, and it was observed that DFMA pairs extremely well with this type of improvement initiative. The DFMA methodology, with its emphasis on part count reduction and manufacturability, focuses on some specific forms of waste and helps the project teams eliminate them before they ever come into being. Therefore, the Lean New Product Development effort blends very nicely with DFMA through the use of the Design Production Process Preparation (Design 3P) event. This event, which is focused upon selecting the best design alternatives for all customer and business requirements, is an ideal event for the use of the DFMA tool in conjunction with other tools such as the Pugh Selection matrix.

## EXAMPLES OF INITIAL DFMA PROJECTS

The first Kohler pilot project to experiment with DFMA was Real Rain. The objective for this product was to provide the customer with a realistic sensation of falling drops of gentle rain within a shower. The DFMA workshop was conducted prior to final drawings being made, demonstrating the benefit of utilizing DFMA to foster early engagement. The Design Engineering team had a preliminary CAD concept ready and were looking for cost savings to bring them into their target range. This initial workshop, conducted by a BDI contractor was done on a large scale with 24 people divided among 4 groups.

This very large group served a couple of purposes. First, it exposed many people to the DFMA training in preparation for improving the design concept. Second, it allowed for a wide breadth of alternate solutions to the many challenges. It is interesting to note, that while a few groups came up with some unique items, there were many duplicate ideas. This helped reinforce that the group size didn't need to be large in order to identify savings potential. Through the use of the training material, and having teams work through the software, good conversations took place to foster ideas.



Real Rain

After the workshop the team took the most promising ideas and updated their design. The savings identified and implemented as a result of the workshop essentially paid for Kohler's initial purchase of 3 DFMA software licenses.

The next project targeted for DFMA piloting was known as Artifacts Bridge. This is the final faucet in a family of 11 other kitchen faucet varieties. Its design is unique from all of the other faucets in the Artifacts Kitchens Suite because it has a two-handled assembly. Design of this faucet started just as DFMA was being introduced to the NPD community. The initial baseline design concept for this faucet was completed without DFMA analysis and had progressed as far



as the Print Process Reviews with suppliers before it was determined that there would be a very high plating scrap rate due to its complex shape. The high scrap rate on this component drove the cost of the assembled product outside the acceptable range and included too much risk.

NPI utilized the leverage of the emerging DFMA process to halt the project efforts and bring the team together for their first DFMA Workshop. Since the baseline design concept was considered unmanufacturable the team attempted a different design approach.

The workshop generated different concepts for engineering to consider as a part of the redesign. The next design resulting from the concepts identified in the workshop ended in a complete redesign of the internal waterway. While the next design concept provided more confidence in component manufacturing there were many added complexities with the assembly that NPI felt was unnecessary. The design was moving in the wrong direction as shown by the revised DFMA analysis results.

Baseline Design Concept (Unmanufacturable)	Next Design Concept (Complicated Assembly)	Final Design Concept (Simplified Assembly)
<ul style="list-style-type: none"> <li>• DFA Index: 11.2</li> <li>• Number of Parts: 37</li> <li>• Assembly Time (min.): 8.6</li> </ul>	<ul style="list-style-type: none"> <li>• DFA Index: 8.4</li> <li>• Number of Parts: 61</li> <li>• Assembly Time (min.): 12.8</li> </ul>	<ul style="list-style-type: none"> <li>• DFA Index: 15.1</li> <li>• Number of Parts: 60</li> <li>• Assembly Time (min.): 8.2</li> </ul>

The team needed something drastic. NPI called together an emergency team meeting that included additional representatives from Industrial Design and Manufacturing to identify new design alternatives. Industrial Design removed some of their initial aesthetic constraints and the team was able to come up with a new and unique concept for the design that was manufacturing friendly, assembly friendly, and still had acceptable design aesthetic. The Artifacts Bridge product launched in 2016 and has come within 4% of the DFM estimated cost and within 8% of the DFA estimated assembly time. The final DFMA analysis results show a significant improvement in assembly time and efficiency.

This was the breakthrough project for DFMA. It unlocked the potential for early collaboration and set the stage for other projects to insist on the use of DFMA. The purchase of the initial three software licenses had been validated. The next steps were to socialize and integrate the use of DFMA within the business.

## IMPLEMENTING DFMA

Kohler, including Global Faucets, operates globally and so a global perspective has been applied to the coordination of the DFMA tool. Challenges include cultural differences and multiple time zones as the DFMA tool is being used in France, China, India, the U.S., and the UK. One of the first steps after the arrival of Bill in late 2015 to overcome these challenges was the establishment of a DFMA User Group (a.k.a. DUG) that consists of representatives from each location. The representatives were identified as people who regularly used the DFMA tool and were enthusiastic advocates for using the DFMA methodology within projects. A charter for the group was created at the beginning, and managers of the participants had committed to supporting their efforts. The group developed a guiding vision statement that reads, “Our DFMA objective is to reduce development time, improve cost position, and foster early collaboration through rapid data driven design decisions.” The DUG shares DFMA user tips, develops Kohler specific library items, and looks for ways to share DFMA successes. The DFMA User Group meets bi-weekly for an hour using standard global conferencing tools. The difference in time zones results in meetings that are early in the morning for the U.S. and late in the evening for Asia, therefore, members of the group are highly committed to the successful use of DFMA.

Developing DFMA proficiency within each of the regional areas has been accomplished through the establishment of internal Kohler DFMA Experts. Having an expert at each location provides DFMA knowledge and competency to the local design projects. A person is declared a Kohler DFMA Expert when they can pass an expert assessment, and the assessment identifies proficiency in both DFA and DFM tool use. It evaluates technical competency that is closely associated with DFMA usage, such as knowledge of basic fabrication processes, proficiency with manipulating CAD models, reading drawings and understanding part tolerance impacts. Another area that is evaluated concerns facilitation skills, where the person is expected to demonstrate adequate training capabilities and the ability to satisfactorily resolve conflicts. Finally, the assessment reviews the level of DFMA enthusiasm and advocacy that the candidate displays. The assessment team consists of existing Kohler DFMA Experts. The assessors watch the candidates in action and then spend hours asking questions and observing candidate responses to various DFA and DFM scenarios, similar to defending a master’s thesis. When the candidate passes the assessment, announcements are made throughout the organization and the new DFMA Expert is presented with a customized DFMA desk clock, along with shirts that have the Kohler and DFMA logos embroidered. They are then expected to support local DFMA needs and mentor less experienced DFMA users. The achievement also looks good on their personnel record.

**Our DFMA objective is to reduce development time, improve cost position, and foster early collaboration through rapid data driven design decisions.**

## KOHLER DFMA EXPERT ASSESSMENT



CANDIDATE NAME:	DATE:
ASSESSMENT TEAM:	OVERALL ASSESSMENT RANKING AVERAGE:
	<b>0.0</b>
	<b>RANK</b>
	<b>COMMENTS</b>
<b>DFMA EXPERTISE</b>	<b>0.0</b>
Perform many DFA Analyses for a variety of assemblies	0
Calculate & explain the DFA Index	0
List & define the Minimum Part Criteria categories	0
Describe the various Handling & Insertion Difficulties	0
Explain the different Securing Processes	0
Import a Parts List/BOM	0
Generate Results & Reports	0
Compare DFA analysis results between design options	0
Create & test Kohler specific library Operations	0
<b>DFM EXPERTISE</b>	<b>0.0</b>
Perform many DFM analyses for a variety of parts	0
Demonstrate awareness of Automated Assembly	0
Use the Geometry Calculator to estimate Part Volume	0
Explain & estimate Surface Patches	0
Import a CAD model	0
Generate Graphs and Reports	0
Compare DFM analysis results for materials & processes	0
Create & test Kohler specific DFM library items	0
<b>TECHNICAL KNOWLEDGE</b>	<b>0.0</b>
Basic familiarity with part fabrication processes: Injection Molding, Casting, Machining, Forging, Hydroforming, Stamping & Forming	0
Competency with drawings, tolerances & CAD models	0
Proficient user of SAP & WindChill	0
Use DFMA to support competitor product analysis	0
<b>FACILITATION SKILLS</b>	<b>0</b>
Demonstrate competent training skills	0
Manage conflict resolution	0
Organize multiple DFMA workshops/events	0
Competently present training modules for DFMA Overview, DFA, Piston Exercise & DFM	0
Identify and resolve common DFMA beginner mistakes	0
<b>DFMA ADVOCACY</b>	<b>0.0</b>
Active involvement in the Kohler DFMA User Group	0
Attend & share BDI sponsored DFMA Webinars	0
Collaboration with BDI, & DFMA Forum contributions	0
Provide DFMA information to others	0

**IMPROVEMENT PLAN**

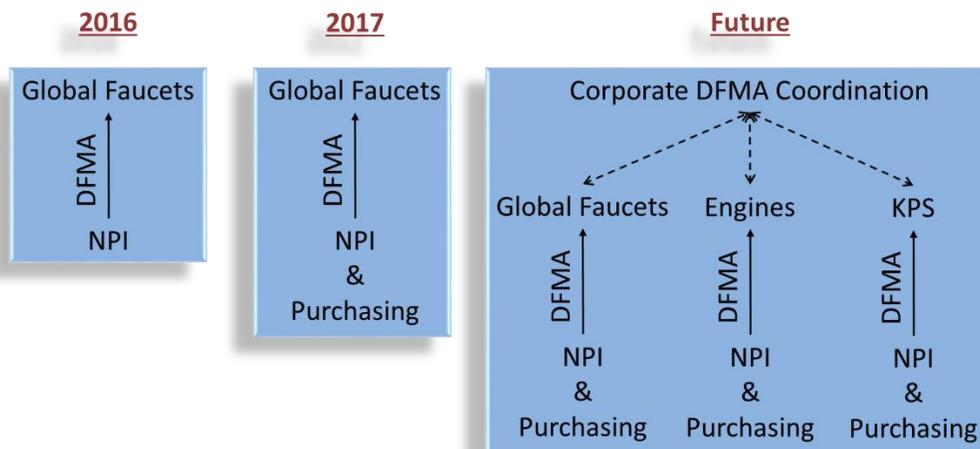
**Developing DFMA proficiency within each of the regional areas is accomplished through the establishment of internal Kohler DFMA Experts.**

Kohler has identified an organizational structure that allows it to provide a nurturing and supportive environment for DFMA to succeed and become institutionalized. Past history has demonstrated that some companies place responsibility for leading DFMA activities either in the engineering organization or within manufacturing.

When DFMA responsibility is placed within design engineering there are a number of circumstances that come together and overwhelm the effort. It is typical that the responsible engineers have little or no manufacturing experience, and often don't know where to find the necessary information to conduct DFMA analysis with a reasonable level of confidence. Tight development schedules also place pressure on resource availability, which sometimes can result in personnel who were originally targeted to be DFMA leaders becoming full-time project resources who end up designing the product. Usually the DFMA effort slowly fades away through non-use and atrophy of skills.

Other companies push to have DFMA efforts directed by the manufacturing organization. Knowledgeable and successful manufacturing engineers are selected to lead the DFMA activities, and they are generally excited to participate in the early engagement of projects. However, they soon find that their primary responsibilities to keep manufacturing operating through hands-on firefighting and problem solving prevent them from finding the time necessary to get involved early. It becomes a vicious cycle as they spend all of their time resolving issues that could have been prevented if they had been involved early in the development process. They end up with no time for DFMA, and so interest eventually wanes.

Kohler took a different approach to their administration of DFMA. They allowed the newly formed NPI group to be responsible for managing the DFMA implementation. This group resides within operations and essentially functions as a liaison between engineering and manufacturing, and so their primary responsibility is facilitating communication between the affected organizations. DFMA is one of the key tools that the NPI group uses to help provide a structured framework for cross-functional collaboration. They are an independent group that has listed DFMA as one of their primary responsibilities.



Based on interest and feedback, DFMA is becoming a tool that can be applied across multiple Kohler business units. To prepare for this future eventuality, the plan is to continue managing the use of DFMA locally, within each business unit. This will allow for adaptable tailoring to fit the different needs of each business unit. However, to foster collaboration and continuous improvement, as well as avoid “wheel reinvention syndrome”, there will be an element of coordination at the corporate level. This happens through an expansion of the DFMA User Group where communication can take place across the company without enforcing a corporately managed, one-size-fits-all, approach.

**As word spread about the benefits derived from DFMA, other Kohler organizations started to make inquiries.**

The DFMA Experts within Global Faucets are resources dedicated to the business unit and so they are not a commonly shared resource with other Kohler organizations. As word spread about the benefits derived from DFMA, other Kohler organizations started to make inquiries. To avoid resource conflicts, management and

the DFMA Experts within Global Faucets agreed to share information and provide training to DFMA champions identified within the other business units. For instance, representatives from Kohler Power Systems viewed a DFMA presentation given by Bill at a global corporate event and afterward asked to know more about the methodology. DFMA presentations were given to their management and then a DFMA workshop was conducted to demonstrate the process. The success of the workshop has now led to Kohler Power Systems identifying people within their organization to become DFMA champions and experts. There is currently no active management of DFMA at the KOS corporate management level, as management of the method has transitioned into informal coordination between the business units. This allows it to be managed closer to the actual users where they can take responsibility for its use and tailor it for the varying needs of their different organizations.

## **CULTURE SHOCK**

The implementation of DFMA at Kohler has evolved during the past few years. Once the decision was made to have DFMA be part of the development process, efforts were made to raise awareness. Not only were people unsure about what DFMA was, but they didn't know when or how it should take place. Awareness began with the targeting of high profile projects that were just starting their concept phase, and arranging to conduct 3-day DFMA workshops with the teams. The workshops included some initial training at the beginning to help participants understand the DFMA methodology and language. A baseline DFMA analysis was conducted and then ideas generated for improving the original design. The ideas were modeled, selected and then presented to key stakeholders at the conclusion of the workshop. Some of the results were unexpected and created an avalanche of positive buzz within the organization. Additional awareness efforts included Lunch-and-Learn presentations, status updates in group meetings, articles on the company intranet site, creation of informational videos, and targeting of critical upcoming projects.

As more projects began to utilize DFMA there was a cultural shock to the existing development system. Previous efforts to facilitate early engagement with various functions in product development had lacked a standard approach. In the past, if a collaborative effort was attempted it usually resulted in a group of people sitting in a conference room for an hour talking about the project. The team would then leave the meeting thinking they had completed their prescribed collaboration. The projects that implemented DFMA into their plans saw periods of time where there was a concerted effort, equaling many days, to evaluate the design concepts, generate new ideas and model the ideas for comparison. The team then had some early data to drive their decision making process and optimize the design. The cultural shock came about when the team realized that they were participating in a collaboration effort that followed a structured DFMA approach and provided significant results. Something they had rarely done before.

Another aspect of DFMA culture shock was the introduction of some new metrics to be tracked during product development. The concept of the DFA Index was new to the group, however it was rapidly realized that the index could be used to evaluate multiple design concepts, encourage alternative design approaches, and eventually focus efforts toward an optimized design. Using DFMA to provide early “Should Cost” estimates was also new. Previous cost estimating efforts revolved around historical cost data combined with best guesses. The ability to identify key cost drivers for parts led to more robust decision making during the early concept design phase.

**The culture shock came about when the teams realized that they were participating in a collaboration effort that followed a structured DFMA approach and provided significant results.**

One pain point along the path of DFMA adoption was acceptance of the results by a small number of people in the organization. In most cases it was found to be a misunderstanding of the DFMA terminology, which was quickly identified and corrected. The few remaining issues were resolved by additional investigation and detailed DFMA analysis, which confirmed earlier results. This confirmation led to greater acceptance of the DFMA methodology.

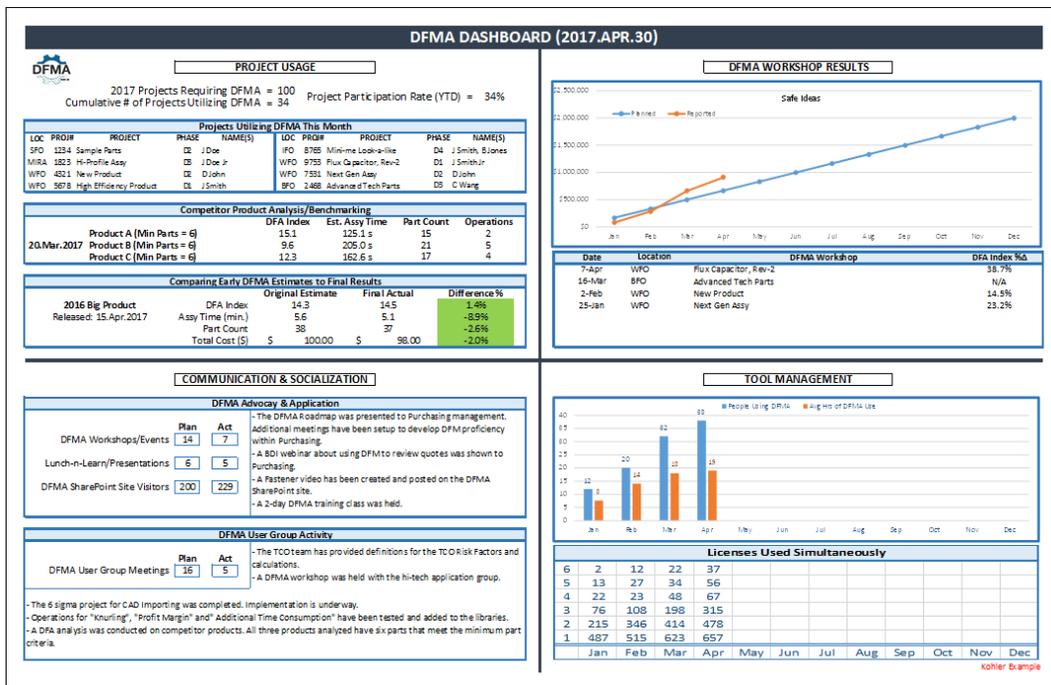


The initial DFMA successes encouraged additional use throughout the organization. Project planning efforts began to include DFMA as part of their early activities. Management also expected the development teams to present DFMA results throughout the project lifecycle. By 2017, DFMA was becoming “Institutionalized”. As DFMA institutionalization was underway its use started to expand into other areas. The Purchasing organization started to see the potential for early “Should Cost” estimating with the DFM part of the tool. The response to this new interest helped pivot some of the DFMA training focus. Instead of providing only 3-day DFMA Workshops, there was a new effort to offer 2-day DFMA training targeted at personnel within the Purchasing organizations. New employees throughout the organization were also invited to attend the training sessions. The organization is now speaking the DFMA language and understanding its methodology.

The ultimate objective is that DFMA becomes standard practice throughout Kohler Global Faucets. It is expected that DFMA activities will be deeply engrained into the product development process. Knowledge of the DFMA tool and methodology is anticipated to be a ubiquitous practice. If someone within the organization were asked about DFMA, their response would be, “It’s just what we do!”

## DFMA COMMUNICATION AND SOCIALIZATION

One part of a successful DFMA implementation is communicating the achievements resulting from its use. A monthly DFMA Dashboard was developed to highlight DFMA progress. At the beginning of each month the dashboard is updated and posted on the internal DFMA SharePoint site, and then an email is broadcast to the organization with a link to the dashboard. The dashboard is divided into quadrants that communicate various metrics.



The upper-left quadrant, **PROJECT USAGE**, tracks the amount of DFMA involvement within existing and upcoming projects. The projects requiring DFMA are identified with program management coordination and then each month the DFMA users are queried about the projects they supported. The goal is to achieve 100% DFMA usage on all identified projects. Additionally, this area of the dashboard is used to report the results of DFMA analysis on competitor products.

The upper-right quadrant, **DFMA WORKSHOP RESULTS**, illustrates the potential savings identified as a result of DFMA workshops and analysis events. Since much of the savings are attributed to cost avoidance, and difficult to actually measure, a metric showing the change in DFA Index from the original design concept is also presented. The displayed results are based on Safe and Reach ideas that the development team confidently believes can be executed.

The lower-left quadrant, **COMMUNICATION & SOCIALIZATION**, captures metrics associated with training and informing the organization about DFMA. The number of DFMA workshops and analysis events are tracked, along with the number of presentations made to various groups. The number of visitors to the DFMA SharePoint site is also monitored. Additionally, an area is provided in this quadrant to list brief DFMA accomplishments and share highlights about the DFMA User Group activity.

The lower-right quadrant, **TOOL MANAGEMENT**, tracks the usage of the DFMA tool. It lists the number of users during the month and the average hours of use per user each month. The number of licenses used simultaneously are also monitored to provide an indicator for the need to purchase additional licenses.

Through the use of an internal Kohler SharePoint site, DFMA information can be posted and accessed globally. This space is used to broadcast items specific to the DFMA efforts throughout the company. One example of this is the monthly DFMA Dashboard that was described earlier. Also shown on the DFMA Home page of the SharePoint site are quick links to various DFMA related websites both internal and external, the DFMA User Group Mission Statement, a list of all current DFMA Experts so those in search of a resource can find contact information easily, and general announcements.

The screenshot shows the DFMA SharePoint site home page. At the top, there is a navigation bar with 'K&BA ENGINEERING' and 'SITES' tabs, and a search bar. The main content area is divided into several sections:

- Description/Purpose:** Features the DFMA logo and the text: "Our DFMA objective is to reduce development time, improve cost position, and foster early collaboration through rapid data driven design decisions."
- Introduction to DFMA Video:** A video player showing a video titled "Introduction to DFMA Video" with the DFMA logo and "KOHLER" text.
- DFMA Experts:** A table listing four experts with their names, titles, locations, and email addresses.
- Quick Links:** A list of links including "Boothroyd Dewhurst, Inc.", "Boothroyd Dewhurst Online Tutorials", "DFMA Information", "DFMA Monthly Dashboards", "DFMA Tips", "DFMA User Group (DUG)", "DFMA Videos", and "DFMA Workshops & Projects".
- Announcements:** A section titled "DFMA Dashboard for April" dated 5/8/2017 8:04 AM, mentioning a monthly dashboard for April and providing a link to the dashboard.

An additional method for attracting DFMA attention was through a poster. The idea for using a poster to advertise DFMA Workshops came during an advocacy brainstorming session. The concept of a poster generated many ideas for messaging content. However, there were too many ideas to fit on one poster, so the principle of simplification was used. It was decided to go with a brief, eye catching, message. The poster was coordinated through the internal Kohler Communications Group who continued to provide ideas for message simplification. The poster has an aesthetic and tag line that draws people’s interest, with the reference to DFMA ensconced within the text. The posters were distributed and displayed throughout the global locations. Multiple queries about DFMA were received from a broad cross-section of business units and functions within Kohler as a result of the poster. One specific inquiry came from a representative of the Kohler Learning System who wanted to incorporate DFMA training into the curricula and allow employees companywide to receive training or organize a workshop.

**SAVE  
TIME,  
MONEY,  
& EFFORT**

OPTIMIZE YOUR PROJECT WITH AN EFFICIENT DESIGN APPROACH

Your team can reduce development time and cost, optimize product design and foster early collaboration through a Design for Manufacture and Assembly (DFMA) workshop. Engineering, Industrial Design, Supply Chain, Manufacturing and Quality participate in the workshop, which facilitates rapid data-driven design decisions that lead to measurable reductions.

PRODUCT SIMPLIFICATION  
PRODUCT COSTING  
SUPPLIER COSTING

SCHEDULE A THREE-DAY, HANDS-ON DFMA TRAINING WORKSHOP TO KICK-START YOUR PROJECT. FOR ADDITIONAL INFORMATION, GO TO THE DFMA SHAREPOINT SITE, OR CONTACT SOMEONE FROM NPI.

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**Multiple queries about DFMA were received as a result of the poster.**

## Devenish Honored for His Work in Design for Manufacture and Assembly



2016-07-14

Kohler Co.'s Bill Devenish, Principal Engineer – Global DFx, was named Supporter of the Year at the 2016 International Forum on Design for Manufacture and Assembly (DFMA), in part by spreading a new way of thinking through Kohler Co.

Commercialized by two professors of mechanical engineering, DFMA is a methodology and software tool that makes it possible to evaluate, estimate and reduce the manufacturing cost of a product while still in the design phase.

"It's an honor to be recognized for something I'm so passionate about," Devenish said. "I have been witness to many companies experiencing great success after helping them implement DFMA."

Kohler's commitment to employing DFMA throughout the organization is what drew Devenish to the company last October. His role is to institutionalize DFMA within Global Faucets through training and hands-on workshops that ultimately lead to creating inter-

"Kohler is one of the few companies supporting the adoption of DFMA and the user level," Devenish explained. "Management is providing the users are eager to provide their expertise. My role is to help the organization awareness and competency of the tool and methodology."

Devenish, who spoke about "Understanding Engineers" at the 2016 International Forum on DFMA held June 7 – 8 in Rio de Janeiro, was recognized for his long history of finding innovative solutions that lead to milestone cost reductions and market excellence.

when he was recognized by Boothroyd Dewhurst as the DFMA Supporter of the Year at the 2016 International DFMA Forum. A second article highlighted the success of the Artifacts Bridge faucet project which also included basic information about DFMA.

A weekly corporate newsletter that highlights stories of Kohler personnel around the world is broadcast on the internal Kohler intranet. This has also been used to highlight DFMA successes. The first article in reference to DFMA was about Bill, the newly hired DFMA Expert,

## Design for Manufacture and Assembly Streamlines New Product Development



Let's look at a simple DFMA example:  
Original and Updated Designs

2017-01-10

This is the third article in a series about Kohler's New Product Development Process.

In our third installment of New Product Development (NPD) articles, we focus on manufacturing and assembly.

We talked about Design for Manufacture and Assembly (DFMA) in mid-2016 [here](#). Let's start with a quick refresher.

### What is DFMA?

Commercialized by two professors of mechanical engineering, DFMA is a methodology and software tool that makes it possible to evaluate, estimate and reduce the manufacturing cost of a product while still in the design phase.

The two basic principles of DFMA are almost too simple:

Reduce the number of assembly steps by reducing the number of parts

Optimize part manufacturing processes and materials

It may seem simple today but this concept was a radical move from the design guidelines popular during the early 1970s when DFMA was developed. During that time, designers focused on simplifying individual parts to cost less and be easier to manufacture. Research leading to the development of DFMA exposed the fact that this actually led to substantially higher product costs relative to the use of fewer, multi-functional parts.

Hosting regular DFMA Lunch-and-Learn sessions is another venue for socializing the benefits of DFMA. Every two or three months one of the DFMA Experts will host a Lunch-and-Learn. The purpose of these lunch meetings is to give a basic overview of DFMA and explain how it can help projects be more successful. This aids in communicating the successes that teams have had through use of the methodology. These Lunch-n-Learn sessions are open to all Kohler personnel, and with lunch provided, helps draw in more people from various functions and business units.

The Webinars offered by BDI provided another avenue for the dissemination of DFMA information. Some of the Lunch-n-Learn sessions were combined with showings of pre-recorded webinars that targeted key audiences such as purchasing and engineering. The webinars also reinforced basic DFMA concepts learned by new DFMA users.

Once a year Kohler hosts a two-day event, known as the Makers Meeting, where best practices within the company are shared across all business units. This is a great opportunity for those who attend to see what is happening throughout the company. It sparks ideas for others to follow and continue to make positive changes within Kohler. Last year, 2016, Bill presented an overview of DFMA to the

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**2017  
MAKERS MEETING**  
THE POWER OF NETWORKING

Network with global innovators, thought leaders and colleagues to learn about cutting-edge technology, exchange ideas and develop connections that will enhance your career. This dynamic event will feature small-group dialog, hands-on demonstrations, presentations and open discussions and tours. It will allow you to enhance your business unit with solutions, ideas and up-to-date information to share and apply.

DISCOVER THE LATEST

- Materials and innovations
- Automation, robotics and technology
- Manufacturing business processes
- Continuous improvement projects
- Software solutions

audience, which led to curiosity from other business units. This year, the NPI Team will be presenting about the successes of implementing DFMA into the Global Faucets NPD community. Break-out sessions where the DFMA tool will be demonstrated are also planned.

One fun way to advocate for the use of DFMA is through the creation of short, informational videos. Numerous videos have been made that are about 2 minutes in length and stored on the DFMA SharePoint site for all to access. These include:



- **Introduction to DFMA**, provides a brief overview of DFMA benefits
- **DFMA Workshops**, explains what a DFMA workshop is and how to schedule one
- **DFA Index**, is a simplified explanation of the DFA Index, how it's calculated, and how it is used
- **Minimum Part Criteria**, shows how to apply the Minimum Part Criteria
- **Fasteners**, highlights the different types of fasteners and how they are equated to a zombie apocalypse and should be avoided in assemblies
- **Global Faucets Manufacturing**, depicts some of Kohler's manufacturing processes to the beat of music

Kohler also hosts quarterly updates for the different business units, which offers an opportunity to present the DFMA Successes within Global Faucets and maintain positive reinforcement from management.

## CONCLUSION

The initial introduction of DFMA was met with some hesitation among the project teams. The teams assumed they would need to stop a project and take an additional few days to review a design concept that the engineers had worked hard to develop. That seemingly large time commitment made it challenging to rally the team around the idea that taking the extra time early would really save them more time later. Without having seen any results that would be

applicable to faucets there was little buy-in within the teams. Once the teams attended a DFMA workshop there were a few more hurdles to overcome. It was challenging for some design engineers to objectively review their design in order to identify the minimum parts required in an assembly. This is similar to the “Ugly Baby” syndrome. It seemed hard to click on the little radio button in the software that states “No Fundamental Reason Exists,” because the engineers had worked hard on a solution that they thought was the best, and every component had a purpose. Kohler overcame this by referring to the button simply as, “Doesn’t meet Minimum Part Criteria”, which seemed to reduce the anxiety. Through the guidance of talented facilitators, the engineers accepted the concept of components they had designed not being theoretically necessary. Once this happened they began to open their minds to the thought of thoroughly reviewing a design before it was solidified and found the value of early manufacturing involvement. As teams began seeing the potential savings in their designs and exploring ideas that they never would have thought of on their own, they began to see the value DFMA brings to projects. One pivotal moment in the introduction of DFMA was when the Industrial Design manager made a commitment to no longer allow any project to go to Design Review without having a DFMA assessment completed.

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Once the project teams started to see the value that DFMA brought to projects which were already designed, they understood the potential for greater success if DFMA was to start much earlier in the design process. The move toward the beginning of the project timeline was incremental. Since so many designs are years in the making, it was difficult to bring DFMA into the concept phase when Industrial Design hadn’t finished ideating. Previously, the Industrial Designer would work in a vacuum and the engineering team wouldn’t see the design for evaluation until the concept was approved. Breaking into this cycle and getting the whole cross-functional team in alignment was a challenge. Through the implementation of Lean NPD Kohler created an avenue for alignment of the entire team. The exploration of design ideas starts as they are being created and DFMA workshops are being conducted earlier than before. The teams now seek out NPI and DFMA Experts in order to assist in the generation of concepts and ideas as well as quickly determining cost position.

Another contributor to the effective execution of DFMA was the support provided by Boothroyd Dewhurst. Questions were quickly answered with sufficient background information provided to help understand and retain the explanation. Sometimes, the solution required

**The “Should Cost” component of DFMA has led to expanding the vision of what can be accomplished.**

customization to a library item, and the assistance from BDI was instrumental in its successful implementation. They helped Kohler fill-in the DFMA knowledge gaps.

Kohler is finding out that the application of DFMA offers more than just evaluating and simplifying product assemblies. The “Should Cost” component has led to expanding the vision of what can be accomplished. Instead of having just one group,

such as NPI, become the experts in DFMA use, the purchasing organization is also developing DFMA user skills and expertise. Both of these organizations are using DFMA to directly support product development within the Global Faucets business unit.

DFMA is now well integrated into the Global Faucets NPD process and is included in the standard work for the project teams. This is particularly true when creating products for internal manufacture. However, there is still room to grow. Increased use of DFMA on products that are purchased complete from suppliers could help prevent excessive costs to the company from those vendors, while simultaneously helping to reduce quality problems associated with unnecessary parts. Should costing is starting to be used and is helping to partner with suppliers on a very early basis to reduce lead times and increase product and process capability. The culture shock is over, and DFMA is becoming institutionalized within the Kohler Global Faucets business unit.



**“All adventures, especially into new territory, are scary.”**

Sally Ride