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DMADV: An Approach for Developing New Initiatives

This Innovation Insight provides an overview of the DMADV (Define, Measure, Analyze, Design, Verify) approach for design and implementation of new services, products, or processes. Because of its thorough analysis, basis in data, and early identification of measures of success, DMADV can be a useful approach in implementing new initiatives or strategies to accomplish planning goals.

As technology has advanced over the past 20 years, and made greater data collection and analysis possible, there has been increasing emphasis on basing decisions on data, and on more detailed data. DMADV is one aspect of Design for Six Sigma (DFSS), which has evolved from the earlier approaches of continuous quality improvement (CQI) and Motorola's 'Six Sigma'¹ approach to reduce variation. DFSS emphasizes more structure and metrics than earlier CQI, with a greater focus on the bottom line, but uses many of the improvement tools. As the case study referenced below shows, using DMADV to design a new residence hall at the University of Miami (Johnson 2006), DMADV can be applied to academic environments.

The intent of **Design for Six Sigma (DFSS)** is to

- minimize future problems
- minimize variability
- maximize satisfaction
- deliver what is desired in a timely fashion
- include suppliers in the design process

Within DFSS, there are two approaches to plan change and reduce variation: DMAIC (Define, Measure, Analyze, Improve, Control) to improve *existing* situations or processes; and DMADV (Define, Measure,

Analyze, Design, Verify) to design a *new* service, product, or process. Both DMAIC and DMADV are similar to Penn State's IMPROVE model for improvement, but focus more on data and analysis. The DMADV approach was designed to develop a service, product, or process that will successfully address identified issues and maintain it through normal operations. A top level decision is needed to drive and support the DMADV project, and this can be one basis for its link to strategy implementation. From another perspective, implementing strategies identified in a long-range or strategic plan often involves introducing new services, products, or processes and procedures. Because of its focus on success through thorough analysis, DMADV may be a useful approach to strategy implementation.

There are five major steps to the **DMADV** approach, and component steps to each of those five. A key component of the DMADV approach is an active 'toll gate' check sheet review of the outcomes of each of the five steps before proceeding onto the next one.

Define: identify purpose, identify and set measurable goals from the perspective of both the organization and stakeholder, develop schedule and guidelines for review, identify and assess risks

¹'Six Sigma' is a registered trademark of the Motorola Corporation. It is based on standard deviation, a measure of variation, and refers to control of variation that results in only 3.4 defects or errors out of a million items produced.

Measure: define requirements, define market segments, identify critical parameters for design, design scorecards to evaluate design components that are critical to quality (CTQ), reassess risks, assess production process capability and product capability

Analyze: develop design alternatives, identify the best combination of requirements to provide value within constraints, develop conceptual designs, evaluate, select the best components and develop the best available design

Design: develop a high level design, develop exact specifications, develop detailed component designs, develop related processes, optimize design

Verify: validate that the design is acceptable to all stakeholders, complete pilot test, confirm expectations, expand deployment, document lessons learned

These steps use many of the same tools used in improvement initiatives and project management, and described in Innovation Insight 12, *Tools for Organizational IMPROVEment*. The references listed below can provide information on more complex tools.

As noted earlier, a top level decision is needed to drive and support the DMADV project. At the University of Miami, the president wanted a more residential campus. There was also growth in enrollment and a requirement for first year students to live on campus, resulting in a housing shortage. Analysis indicated that new housing would have greater impact on the president's objectives than renovating existing housing, so the strategic decision was made to design and build new housing for the business school.

Define

The function of the Define step is to establish a clear definition of the project. This includes the product or

process that will be improved or the needs that will be met, and the scope of the project, with a schedule, resources, and deliverables, much like a project management plan. It includes a change plan, to identify and document who or what components of the organization will be impacted by the change, to what extent, and how receptive or resistant they may be to the change. It also includes a risk management plan, identifying the known and foreseeable risks in the project, for example: technical (complex design); human (stakeholder resistance); team (low commitment by team members); planning (inadequate design research); business (cost increase); organizational and political (too many decision makers, inadequate sponsorship). Once risks are identified, an analysis is done of the degree of seriousness of each risk and the means to address or minimize each risk.

In the Define phase at the University of Miami, the team reviewed the background that led to the decision to build housing and completed an analysis of the risks involved with the project, identifying as the major risks that the building would become obsolete and there would be difficulties in the interaction of design team members. They also analyzed the benefits of the project. They then developed a plan for the project that addressed the opportunity that the project would take advantage of (the opportunity to advance in school rankings), the objectives of the project (high-class living facilities for executive, graduate, and upper-class undergraduate business students), the scope of the project (timelines and location), and the measures of success for the project (increase in on-campus residents).

Measure

Measure focuses on customer (or student, client, or stakeholder) requirements. Who are the different groups of clients or stakeholders who may have different interests? What exactly are these people looking for in the new product or service? What is the relative importance or value of the different components they would like to see in the new product or service? Data is used to identify the 'must haves' in

the product or service, those things that are critical to quality (CTQ) from the client's point of view. There is also an attempt to determine individual return on investment (ROI) for each of these components, and prioritize them. As more data is gathered, risks can be reassessed.

At the University of Miami, the team divided their prospective residents into different segments (executive, graduate, and upper-class undergraduate business students) and gathered data on their expectations for a new living facility. For example, would they be surprised and delighted by, expect and like, or not like items such as a queen sized bed, a large corner desk, a microwave, or laundry service? How much (in terms of percentage increase in total cost) would they be willing to pay for each of these amenities?

Analyze

The analysis focuses on identification of the different approaches that could be used to meet customer or stakeholder requirements. Key functions within the requirements are prioritized. Alternative methods and processes are developed based on prioritization of these functions. Finally, several alternatives are evaluated, and the most effective alternative, based on the best parts of the best concepts, is selected for Design. During the Analyze stage, an estimate of the total life cycle cost of the design is made, including costs for development of the concept, creation of the production system or process, ongoing production, use of the product or service, disposal of the product or service and final retirement of the process or production system.

At the University of Miami, five different designs were generated, based on inputs from undergraduate and graduate populations and combinations of their preferences. Designs were then analyzed based on data indicating willingness to pay more, repair frequency, ease of repair, ease to clean, replacement frequency, and cost/benefit ratio. A risk analysis was conducted for the risks of personal injury or fire. As a result of the analysis, a final design was selected.

Design

The Design stage includes both a high level and detailed design for the selected alternative. Design elements are prioritized and a high level design is developed. Following that, a more detailed model is prototyped. There is also an effort to identify where errors may occur and address them through modifications.

At the University of Miami, this involved developing detailed floor plans for the residence facility.

Verify

The final step involves piloting the new product or service, gathering data and evaluating performance, satisfaction, or results. Based on the data, any final adjustments are made. A plan is developed and implemented to transition the product or service to a routine operation for the organization and ensure that the change is maintained. Finally, lessons learned in the DMADV process are documented.

In the University of Miami case study, this included providing plans to University stakeholders to get buy-in for developing a transition plan to proceed with the project.

Implementing DMADV

At different levels of an organization or aspects of an initiative, there may be more emphasis on some components of the DMADV approach than others. There may be different teams assembled to address different parts of the initiative. Define, Measure, and Verify may be the focus at the system or administrative level. At the unit, subsystem, or module level, emphasis may be on Measure, Analyze and Design. In these cases, communication among the different groups, and documentation, supported by the DMADV toll gate check lists, will be critical.

The goal of the DMADV approach is to produce what is needed to address the identified issue, with the initially identified desired results, successfully, and maintain it through normal operations.

References

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