Chapter 2
Process and Methods

NOTES for the Instructor:

1. The study projects and the cases are posed as challenging assignments to students. This study guide elaborates all the material needed to teach those study guides and cases. The study projects can be assigned in two different ways:
    a. If you want to evaluate the ability of the students to form assumptions, research materials, and understand the study projects, you can ask the students to work on the study project without any additional information. In this case, the students should be encouraged to obtain necessary information using the Internet.
    b. If you want to provide all the information, you can provide the information shown in the following pages to solve the study projects.

Objectives

- Define project process and how organizations benefit from adopting those processes oriented toward customer satisfaction
- Understand PMBOK® project management processes and how project activities are mapped to these processes for successful project management
- Explain what Continuous Improvement Management (CIM) is and how CIM methodology can be used in projects
- Explain what Six Sigma is and how this process improvement approach is used to find defects and errors of a project
- Describe the five levels of Capability Maturity Model (CMM) in software projects, and understand how organizations can attain the highest software maturity level
- Describe traditional Software Development Life Cycle (SDLC), iterative SDLC, Unified Process, Spiral, Scrum, and Extreme Programming models; their inputs and their outputs; and how these software development models can be used effectively in software projects
- Understand new paradigms in software projects and how and when to use them in software projects

Cases

- Information technology Case: SAP Project at NIBCO, Inc.
- Healthcare IT Case: Memorial Hospital of South Bend: Computerized Physician Order Entry Project
- Financial Services IT Case: Syndicated Community Bank: Core Banking Systems Replacement Project
- General Construction Case: Craig Constructions, Inc.: A Home Improvement Project

Review Questions

1. A process is a specific ordering of structured activities with defined inputs and outputs. A project process is a collection of project-related structured activities.

2. Since a project lifespan consists of project activities that are structured to accomplish a project, the project lifespan can be considered a process.

3. The benefits of adopting process are consistency and maturity in their operations, better strategy, and effective and efficient projects.

4. The Process and Enterprise Maturity Model (PEMM™) is a roadmap for organizations who are striving to become process oriented. This concept was introduced by Dr. Michael Hammer in an article "The Process Audit" that appeared in the April 2007 issue of *Harvard Business Review*.

5. The benefits of process improvements are:
    - Improvements in project quality
    - Increase in internal and external customer satisfaction
    - Increase in project value
    - Better customer satisfaction
    - Improvement in productivity
    - Improved efficiency and effectiveness, and
    - Facilitating better communication among project stakeholders.

6. After identifying opportunities, a team can be formed. Using team resources, requirements from customers need to be analyzed to establish the scope of a project. Once the current process is analyzed, the new process can be formulated. If the project is to improve an existing process or even if a project is completely new, root causes of problems at hand can be determined. Using root causes, multiple solutions can be formed. The solutions can be prioritized and tested until a solution is identified. That solution can be implemented, the progress can be measured. Once the project is completed, the project can be closed and the results can be communicated to stakeholders.

7. Benefits:
    - Can be used in environments where customers demand quality
    - When used in conjunction with organizational strategy, produces competitive advantage through employees' knowledge of and experience with technology and engineering
    - Can be used to improve leadership, people management, customer focus, process improvement, strategy planning, and quality
    - To improve quality and improve work processes

8. Since CIM is totally focused only on serving customers, it is a great fit for project management.

9. Six Sigma is a process improvement approach that is used to find and eliminate errors and defects, reduce cycle times, reduce cost, improve productivity, and meet customer expectations. Since project management is to control potential causes of project failure, Six Sigma can be useful toward the solution of problems at the root level and the prevention of their recurrence.

10. Motorola chose a 1.5 standard deviation figure because it was the average shift of the company's processes. This has become the standard shift of an organizational process.

11. DMAIC stands for Define, Measure, Analyze, Improve, and Control. DMAIC incorporates statistical and other types of process improvement tools. DMAIC is used for projects aimed at improving an existing business process in a project.

12. CMM is a model for software to identify the software process maturity level of organizations.

13. Some of the benefits of software process improvement:
    - Provides guidance on how to gain control of their processes to develop and maintain software
    - Allows software organizations to strategize how to evolve toward a culture of software engineering and management excellence
    - Guides software organizations to select process improvement strategies by determining their process maturity, identify critical software quality and process improvement issues, and
    - Allows software organizations to focus on software process activities.

14. An organization at LEVEL 1 is a software department or a software company where software process is ad hoc and occasionally even chaotic.
    An organization at LEVEL 2 has basic project management processes in place.
    At LEVEL 3, software processes are documented, standardized, and integrated into standard "to-be-practiced" process for an organization.
    At LEVEL 4, detailed measures of software processes as well as product quality and performance measures are collected and controlled.
    At LEVEL 5, an organization focuses on continuous process improvement.

15. It is the total lifecycle of developing a system and is used in software projects.

16.

Phase	Inputs	Outputs
Systems Investigation	Thought process	Idea of the system
Systems Requirements	Idea of the system; Input from various stakeholders	Requirements of the system; Requirements Documents
Preliminary Design	Requirement documents, Design factors; Inputs from review	Preliminary design considerations
Analysis	Preliminary design considerations	Preliminary design requirements documents
Design	Preliminary design requirements documents; other design considerations	Final Design Specifications; Interface design specifications; Test plans
Coding	Design specifications; Inputs from review	A preliminary system
Testing	Preliminary system, test plans	Tested System
Launch	Tested system, Input from reviews; further coding and testing if necessary	A final system with all operating instructions and user manuals.

17. While XP and AM are iterative solutions, SDLC in a traditional sense is a series of activities depending on the outcome of previous activities.

18. SDLC can be used in any type of project. XP and AM are used typically in projects where customers can spend a lot of time with the software developers.

Teaching Points - Discussion Questions

1. Can CIM be used in any project? What are the pros and cons of CIM in any of these projects?

   As projects are aligned with corporate strategy, CIM can be used even in smaller firms. Moreover, smaller companies learn and grow by using CIM. Small and medium companies can use CIM in their projects and as and when CIM gets incorporated into the company and becomes part of the company culture, it will be relatively easy to use this process in all projects. CIM can demand more time for a project manager during planning of a project. This is one of the reasons that project managers as well as organizations do not get involved in many processes like CIM. However, if projects are implemented using processes such as CIM,

project time will be well spent as it helps a project and its project manager to complete the project successfully.

2. Can Six Sigma be used as a benchmark to measure quality in any project? How can Six Sigma be used in activities of an instructor in assigning grades?

   Six Sigma can be used as a benchmark since all projects must be processes-oriented. Evaluations of the project can be prepared using Six Sigma. For example, in the case of an instructor, to determine how long it takes to grade, time may be measured to check the variance of various exam times. Six Sigma not only measures the defects in a project but also paves a way to better the defect detecting mechanism in a project.

3. Is documentation in MIS projects needed? Why? Why not?

   Yes; the documentation is needed. The documentation makes it easier for a project team to avoid past mistakes and errors. If the developer is not present at the time of implementation, the project can be executed without any problem or worry. It can be helpful for other projects without re-creating the wheel. The documentation should be part of organizational process assets. Documentation is useful in the accumulation of organizational knowledge. It is a pity that many projects do not document projects as they should. In MIS projects, it becomes imperative and a necessity to document as future projects and maintenance depend upon that knowledge.

4. How do processes help organizations realize stakeholder satisfaction?

   Structured activities and standards will help project teams to achieve success. Processes such as testing and reviews will ensure project success and satisfaction. For the stakeholders of the organization, processes help to streamline their activities and work together as a team. As far as stockholders are concerned, processes help them to realize their financial goals. For example, continuous improvement processes like quality initiatives streamline existing processes in an organization. They improve customer satisfaction leading to customer loyalty which results in better profits thus realizing one of the coveted stockholder satisfactions.

5. Can all benefits of project management be realized?

   Yes; all the benefits of project management can be realized if the project management principles are followed and executed effectively. For example, if the scope of a project can be controlled and delivered, the benefits of the project can be realized. Of course, the other five success factors have to be controlled as well.

6. Compare SDLC to AM and discuss their pros and cons.

Process Model	Advantages	Disadvantages
Traditional SDLC	Easy to understand and implement Easy for project managers to control and manage projects Works well and is proven to work with large complex projects as well	Revisiting and revising any prior phase once it is complete is not possible If project is to be implemented in stages, it may become tough to integrate all aspects of project Increased development time and costs

	as small projects Works well with global and virtual teams Better control of projects Projects can be handled with changes in human resources	
Iterative SDLC	Revisiting and revising prior phases are easy to accomplish More flexible than traditional SDLC Changing scope is less costly than traditional SDLC Works well and proven to work with large complex projects as well as small projects Works well with global and virtual teams Projects can be handled with changes in human resources	Needs great effort to manage all integrations High-level design has to predict all integrations well in advance Project teams should be able to estimate well enough to plan all integrations Needs experienced team members
Scrum Model	Great when requirements are fluid Easy to manage small projects Customers see deployments in increments Customers able to see how the product works before final release	May not be suitable for large projects Needs experienced developers Needs customers to work with the project team
Extreme Programming Model	Requirements are provided when needed Project proceeds well when requirements are fluid Customers see deployments in increments Customers able to see how the product works before final release	May not be suitable for large projects Needs experienced developers Needs customers on site on an continuous basis to work with the project team

Answers to Chapter Problems

Problem 1:

All those processes can be used for continuous improvement. CIM is basically an improvement process using quality as its principle while Six Sigma is a process that is used to reduce defects. Both of these processes focus on analyzing the "as-is" process and defining the "to-be" process for improvement. Identifying the root causes is also a common method in both these processes. While CIM and Six Sigma are related in a way, the others such as SDLC and CMM are different. Both CMM and SDLC are related to software methodologies. Both these processes are used in creation, modification, and maintenance of software. CMM is a process improvement methodology for software projects while SDLC is a process of designing and implementing the software methodology. CIM and Six Sigma may be used in a software development process as well.

Problem 2:

Let us take a look at a software development project.

CIM: All the team members should be knowledgeable of the processes and be able to improve the project based on following structured activities:

- Identify opportunity: Define certain problems to be solved. We can assume that the team members sometimes take a long time in acquiring requirements. Another assumption is that the owner of the project has decided to add a new feature to the project during the course of the project execution.
- Form team and create scope: Selecting the best team members who are related to the problem and aware of the process. Those employees will determine the scope of the project based on customers' needs.
- Analyze "as-is" and determine "to-be" process: The team will initially analyze the current process of acquiring customers' requirements, and then set up a target performance based on customers' needs and project scope.
- Identify root-causes and proposed solutions: Determine whether the new process is technically and economically feasible, and if not, the team will have to repeat the analysis of "to-be" process till they understand the root cause.
- Prioritize, Plan, and Test proposed solutions: From the root cause come up with a number of solutions. Test these solutions on the various part of the ongoing project and come up with a solution.
- Implementation, progress and closure: Implement the solution, measure the performance, monitor the project and publish the results to management and employees.

Six Sigma: A process to reduce defects.

- Define: To reduce the number of bugs in the software.
- Measure: We need to understand why there are so many bugs in the programs. We need to establish a measure, for example, the number of bugs per module. The data should be collected using past software applications that have been developed in the organization.
- Analyze: The software development process needs to be analyzed in order to determine the root causes of the defects and whether the process can be

improved or redesigned. The collected data and observations are used to verify relationships between variables. Hypotheses need to be formulated to investigate and reach statistically supportable conclusions to find the root cause of the bug problem. This root cause analysis gives a stable and reasonable approach to find which factors are critical to quality and which ones have to be improved.

- Improve: Using the results of the analysis, improve the part of the process that was identified as the root cause.
- Control: Take continuous measurements of bugs to make sure that there is no deviation in performance.

SDLC: The software process

- The software process can be designed, analyzed, developed, tested, and implemented using the SDLC process.

CMM: The software process

- The software process can be improved using the capability maturity model. Depending on the level of the software organization, the organization can try to improve its internal processes to reach the next level.

Problem 3:

Let us look at a Six Sigma process in a neighborhood bank.

- Design: Why is the process taking so long for the bank to approve a loan?
- Measure: Interview the personnel involved in the process using some kind of measure on the process
- Analyze: Analyze how they work and the reason behind it by using a cause and effect analysis
- Improve: Test the process in each stage and see if the workflow can be improved
- Control: Control the variances that were found and ensure that the new process has the capability to prevent those defects.

Problem 4:

For a bank: Deposit Pricing Process

- Have a pricing meeting on Monday
- Modeler needs to update internal rates sheet before Tuesday for deposit operations
- Reviewer needs to make sure the rates are updated based on the discussion in the pricing meeting
- Rates are approved by an appropriate committee
- Update the rates on application and web site pages and to ensure that the rates and effective date are identical
- Reviewer needs to review the rates and send the results to approver
- Approvers review the rates again and then send the results to publisher
- Publisher publishes those interest rates pages.

Problem 5:

Let us take an example of a minor purchase like a printer:

- We need to define our needs for this new printer which will provide the specifications of the printer we want. We need to list the range of size and speed, whether it is color or not, all-in-one or stand-alone unit, length of time we have before we need to buy one, and a budget range that we can work with. We then need to locate and visit stores that sell printers and also check online stores to find and filter different printers and to find the best deals. After checking the local stores and online stores for the different printers with different specifications, we can pick the printers we like and research any quality issues they may or may not have. This may be researched online as well, as many printers are discussed and rated online. However, some newly released printers may not have ratings. If this is so, we need to check with the manufacturer of those printers and check company ratings if available. Using the list of specifications we created above we can choose a handful of suitable printers from which to choose, three to five printers.
- From the few selected printers we can compare the most important features relevant to our needs and also the quality and price of the product. After we have decided on the printer that best suits us, we can then make the purchase.
- As consumers, we expect the product to be easy to use, with instructions (if necessary), that are simple and concise. We expect that the product will do its job and serve us well. Poor quality products evoke a sense of betrayal. Many customers feel that they have used their hard earned money for a service/product and they should get what they expect for the money spent. If the product stops working, customers expect to get a replacement. They also expect that the product manufacturer or service provider should replace the bad product and re-service and that it shouldn't take weeks for the replacement or re-service and the warranty should hold.
- The customers would like the manufacturer to monitor and control the printer's printing quality and the speed that was advertised. The printing quality and speed should not vary too much from the listed specification and should not degrade within the first few years of ownership.

Problem 6:

Let us consider a simple project to furnish a new bedroom.

- Define the scope of the bedroom project:
  It is necessary to decide on a budget for the whole project, quality of the furniture, and the amount of time you want to finish this project before you design your bedroom. The determination of this scope can prevent you from over-budget and dissatisfied results
- Make a list of all necessary furniture you need to furnish the bedroom:
  To compile a list of the furniture you need, you should start with the rough design of your bedroom. For example, what color would you like and what kind of furniture would you like in your bedroom such as a bed, lamps, a dressing table, chairs, and cabinets to match the color you have decided. For example, by understanding the details, you may design the material of your bed frame, the size

of your bed set, the color of the dressing table and style, and the number of chairs in the room. Then you make a more detailed design by determining where all these furnishings should be placed in your bedroom. After you are satisfied with your design, you can make a list and be ready to make purchases.

- Wall coverings:
  You need to define the requirements of the wallpaper such as color or style, the wallpaper's material, the wallpaper's length for covering all walls, quality and a budget. Similar requirements may be defined for painting the walls as well instead of wallpaper. Then you can either go to wallpaper stores or browse online stores to gather more information on wallpapers such as price, quality, delivery, instruction of installation, or reviews from the customers purchasing that particular wallpaper. You may have many choices of wallpapers that you can select according to your requirements. By using those information and your requirements, you can narrow your choices and make a final decision on which wallpaper you would like to purchase. After you make the purchase, you bring the wallpaper home or use the store service to deliver it to your house.
- *Purchase furniture:*
  After you know what furniture you would like in your bedroom, you need to visit various furniture stores or browse online to make purchases. You may end up with many choices and may need to narrow down which furniture is reasonably suitable to your bedroom according to your taste, design, and budget. Then make the purchase and get them delivered to your house.
- *Install the wallpaper:*
  When you receive your wallpaper from the store either by delivering to your home or picking it up, you are ready to install it on your bedroom walls. You can choose either to install the wallpaper yourself or hire a professional. If you decide to do it yourself, you may start with measuring the wall size, cutting the wallpaper to the measurements, and then hanging the wallpaper on the wall. If you choose to hire professionals to help you, you may need to ask some information such as a service fee and their schedule to install the wallpaper, and, of course, you need to make an appointment with them.
- *Arrange the furniture in the bedroom:*
  After installation of your wallpaper, you can place the furniture you have purchased earlier by arranging it as per your design.

The total cycle time can be assumed to be between twelve days and two months. We can also identify the cycle time by activities as well.

- *Define the scope of the bedroom project:* one day to one week. It depends on a person and readiness of the plan. Each person needs a different amount of time to make a decision. Also, the readiness of the bedroom is one thing you may have to think about. For example, is the project budget enough? What is the condition of the bedroom? Does it need to be cleaned or repaired?
- *Make a list of all necessary furniture you need to furnish the bedroom:* one day to three weeks on a design before you can decide on the furniture list. You may take more time because you would like to do some research; for example, what kind of color is suitable for the bedroom and what kind of beds are suitable for you now

that you have a back problem, etc. It may take more time because you may want to re-design your bedroom several times before you are satisfied with a result.

- *Purchase the wallpaper:* three days to three weeks; you may take a lot of time to decide which wallpaper to select and the store where you would buy. You may need some time to ask the people you know about the style and material of wallpapers as well as reading reviews of particular wallpapers. After you decide, you may need to wait for the store to delivery your wallpaper to your house or wait until it is actually available.
- *Purchase the furniture:* one week to one month; you need time to decide which style and what furniture to buy, select the store you are going to buy all furniture, narrow your choices down, waiting the delivery to your house.
- *Hang wallpaper on the walls:* one to three days depending on who is going to install it. If you hired professionals to do it, it might take one day to finish an installation of the whole room. However, assume you have never installed the wallpaper and you decide to do it by yourself, it should take more time to complete.
- *Place the furniture in the bedroom:* Assume that the delivery men help you to carry all furniture to your bedroom including putting them in the right place according to your design. It may take one day or two weeks depending on the delivery date of your furniture. If you can ask all stores to deliver the furniture on the same day, it should take you one day to finish it. However, sometimes it might be hard to get a delivery on the same day because of some circumstances such as the product is not available or the store cannot deliver because of schedule.

When you plan to do this project the second time, you can improve the cycle time due to several reasons:

- You may not need to go to several stores or browse lots of online stores before you make a purchasing decision because you already know which stores you prefer and what kinds of products they sell. This can reduce the amount of time to spend on the project.
- You may take less time to hang the wallpaper on the wall. If you hung the wallpaper yourself, the next time you will already have the knowledge and experience to expedite the activity.
- You will know how to contract people especially workers or professionals to help you in the project. You do not need to search for the numbers or addresses to contact those people or to investigate their expertise; it can decrease the cycle time
- You have experienced how to scope a project and write initial plans. You can reduce cycle time because you know what you should do and follow each step with confidence and without hesitation. You also know how to solve problems that had occurred previously.

Problem 7:

CIM:

The plant manager can use CIM to improve any process in the plant. CIM can help the plant manager by sharing this responsibility of good quality for every

output of every process with the entire plant force by thinking like a plant manager when it comes to quality. CIM also advocates involving suppliers and customers within the measurements of the input and outputs of the plant to give a much better control and view of the processes in the plant. CIM helps to improve processes and the resulting products or services. The other important value of CIM is the improvement of corporate culture that develops from its implementation. The plant manager's main concern is to have the inputs and outputs as close to perfection as possible to lower the cost of mistakes and also the time factor that it takes to re-do certain processes.

Six Sigma:

The plant manager can use Six Sigma to reduce defects from any process in the plant. Six Sigma focuses more on the data gathered from the measurements of the outputs from the processes which can then be used to improve the process by minimizing the variance. The manager can implement a process review project which will help find the process bottlenecks in the plant. He/she can also implement projects to create customer quality expectation surveys to help understand if products are meeting customer expectations or not. Projects can be undertaken to focus on the processes that are causing unsatisfied customers and reconfigure it to satisfy their demand.

Problem 8:

HR managers need to make sure that their processes lead them to quality recruits and better trained employees. The HR manger can train new employees using the CIM methodology to get all employees on the same page and to train them to continuously improve projects. During orientation and training sessions, new employees can be introduced and/or trained with CIM techniques to initiate them into a corporate culture that believes the quality of their services/products must be improved in all phases according to customer demand. The HR manager can instill this idea to HR staff and in doing so create this culture for the entire company as new employees are hired and trained. Measuring processes, for example, hiring, employee turn-overs, employee performance, and training, can help to track the quality of service the HR department is providing to company employees. The managers can make sure that the variances of these processes are minimal as it will result in a more structured culture. They can improve communication within departments by utilizing CIM's approach. We can implement a project to reward and recognize employees who have worked to contribute to the improvement of products/services.

Problem 9:

An important aspect of a sales manager's job is to improve profits for the company. Utilizing CIM and Six Sigma as tools to improve sales will enhance consistent sales processes. When each employee is responsible for improving the process, comments and feedback may be encouraged from the employees and customers to help improve processes. This will create a culture of CIM and Six Sigma in the organization. Cross-functional training will also give the employees the feeling that they are improving and becoming more knowledgeable in the department. It also offers a better view of the entire sales process. Applying DMAIC, the sales department will be able to foresee the areas

that can be improved by understanding which processes are working and which are not. Measuring the variances of the inputs such as orders, total sales, and profits can provide indications of whether or not their processes are working. Measurements can also supply better tools and indicators for product sales forecasting.

Problem 10:

In a financial/accounting department, CIM or Six Sigma can be used in many ways. One way would be to increase the accuracy of financial transactions and decrease the errors in them. CIM may be used to decrease the time it takes to process a financial transaction. Data on the time necessary to complete the transactions can be gathered and the root cause of outliers or extra delays can be determined and eliminated. They may also want to assess the refund rates and values of product returns or examine the return on investment of equipment or assets. A related project could be to reduce the number of invoice entry errors to a six sigma level.

Problem 11:

An MIS manager could use either TQM or Six Sigma to evaluate the accuracy of project planning. An example could be a large software implementation project. This project will be planned with hundreds if not thousands of project activities. The theoretical versus actual duration of each of these tasks could be compared to a set acceptable deviation. The evaluation and correction of the tasks will lead to better and more accurate project planning in the future. We may also want to assess the defect rates of equipment and devices. For security aspect, it is preferable to examine the rates of intrusion and network attacks.

For business operations, the manager would like to measure database access time or processing time. The system and software requirements include obtaining scope/requirements, examining the "as-is" process, and defining specifications for "to-be" process. With the knowledge about the current process and objectives for the improvement, we can develop a preliminary design which addresses the root cause of the problem and the alternatives for improvement. To reach an optimal solution, the manager has to analyze, plan, and test all proposed solutions. Upon selection, he/she may want to apply a final refinement of the solution before executing the implementation. Finally, the implemented solution has to be tested by monitoring and measuring several performance indicators to verify adherence with defined scopes and requirements.

Problem 12:

A CIM process could be incorporated into a Six Sigma model at the "Define" phase of Six Sigma. The "Define" phase corresponds to the first four phases of CIM that include identification of opportunities, scope/requirements, analysis of "as-is" processes, and definitions of "to-be" processes. The analyze phase of Six Sigma fits into the root cause identification of the CIM model. The improve phase in Six Sigma includes the planning, testing, and refining of solution. The "measure progress" phase in the CIM model can be used to improve the process in the "improve" phase of the Six Sigma model.

Problem 13:

CIM could definitely be incorporated into the SDLC process. Using the team environment and the team members in a systematic structured environment, it would be easy to develop Information Systems projects. CIM's process implements the concept of continuous improvement in quality in projects. Hence, as the requirements change over time, the system can be re-designed. The need for all of the employees to be knowledgeable and practice this methodology is a key element to its success. CIM is customer-centric, meaning that customers, their requirements, and their satisfaction become the focus a project. Whether the customer is the organization itself or the client is from outside the organization, CIM can still work in the SDLC process. The need for the scope and/or requirements of a project to be adhered and monitored throughout the life span of the project would only enhance the SDLC process by constantly reviewing the needs of the company and revising the design for continuous improvement. CIM lets customers define the project requirements, provide budgets, determine schedules, determine levels of quality. CIM can assist in identifying opportunities often associated with a specific problem which needs improvement, as well as identifying existing problems or "to-be" created products or systems or services. CIM can be employed to identify and select projects from a number of projects.

Six Sigma would also help to serve as an aid to improve the SDLC process by incorporating it into the MIS department. Six Sigma is a process improvement approach that is used to find and eliminate errors and defects, reduce cycle times, reduce cost, improve productivity, and meet customer expectations. Because it is oriented toward the solution of problems at root cause and prevention of their recurrence, an MIS manager could incorporate Six Sigma to aid in controlling the potential causes of failure. Because project management is a process, Six Sigma is definitely a viable candidate applicable to the SDLC process improvement due to its structured data-driven methodology and the tools and techniques it possesses that help organizations to measure their performance. Six Sigma's metric-driven methodology would provide an MIS manager with measures to ascertain baseline performance of their projects, determine the root causes of variations in processes in those projects, and improve their processes to meet and exceed desired performance levels, hence improving quality performance of projects. Six Sigma can be used in the analysis phase of PIS projects.

Problem 14:

Unified Process (UP), along with integrating CIM's methodology can work very well. UP mitigates risks early in the project and changes can be managed very easily resulting in a better overall quality product. Also by incorporating CIM, the customer focused is maintained as well as continuously involving the global supply chain in the development process. Using this methodology would put emphasis on the involvement of the stakeholders which is central to the implementation of the product. Their requirements and their satisfaction become a focal point in the project since the results of the project affects them directly. The communication between the various stakeholders becomes a key factor to the success of the project. Even if one supplier cannot use the system, the project can fail. As other suppliers become involved over time, the need for continuous improvement as described in CIM would ensure that the scope and/or requirements of a

project to be adhered to or adjusted where needed, as well as continually monitoring the needs and the design throughout the life span of the project.

Problem 15:

Process	Period (month)	Labor costs ($)	Software costs ($)	Total costs ($)	Prob. of failure	Risk cost of project
SDLC	8	1,920,000	75,000	1,995,000	25%	$ 498,750
Spiral	10	2,400,000	75,000	2,475,000	45%	$ 1,113,750
Scrum	12	2,880,000	75,000	2,955,000	55%	$ 1,625,250
XP	12	2,880,000	75,000	2,955,000	55%	$ 1,625,250

Based on risk costs, SDLC is the best option. SDLC methodologies are easier to manage in large and complex projects. It has extensive documentation with checks and balances within the process. By implementing check points along the steps, SDLC could identify design problems before implementation. Although Spiral would seem to be a flexible and easily managed process, it does not work well with contracted software projects that do not have flexible commitments. Although Scrum is easy to manage, it is more conducive to smaller, less complex projects. XP works on small increments of project success which makes it unsuitable for large-scale projects.

Study Projects

Information Systems:

Evolutionary Development

This is a methodology in which initial outlines are specified then customers are involved to evolve a final system. In this approach, the process starts with well-understood requirements. Then, team members work with the customers to add new features to reach the final system. A throw-away prototyping is included with poorly understood systems in order to define the needed requirements. Unlike most MIS processes that start with clarifying and defining the system requirements before starting the implementation, this process starts with initial implementation to define the system requirements. This methodology has many problems. First of all, it lacks process visibility because the requirements are not clearly defined from the beginning. Second, the final system may be poorly structured as a result of a poor approach to defining the requirements. Finally, evolutionary development needs highly skilled programmers to be able to implement the system according to the customer's requirements. This methodology is applicable in small systems or in parts of large systems and is also applicable in small projects.

Incremental Development

This is a methodology in which the system development and the system delivery of the implemented systems are broken down into increments instead of one final delivery. Each increment delivers a specific requirement. Therefore, this methodology starts with a clear definition of the requirements. Then, prioritization of those requirements is essential so the requirement with the highest priority will be included in the first increment. This

is similar to Scrum and Spiral model in the way that it delivers the system in increments. However, it differs in attaching each increment to a specific requirement. This approach of prioritizing the requirements and attaching them to increments allow the requirements with high priority to receive more tests, which will result in low failure rate for the whole system. This methodology is applicable in systems with low complexity because it requires excessive planning to define and prioritize the requirements. It is also recommended for small projects when immediate results are needed. Delivered increments will help improve the whole system because they give feedback for the following increments.

V-Model

This software development process deals with defining the requirements for each development phase that provides the basis for the test cases used in system testing. The main focus of this process is the testability of the specifications. If the requirements are clearly specified, they can be tested, and if they are loosely defined, they cannot be tested. Therefore, in this methodology, proceeding to the next phase in development will not be allowed until the requirements for the proceeding phase are specified as well as the test cases. The main difference of this methodology from other methodologies is that it not only defines the requirements for the development phases, but it also specifies criteria for testing phases. Proceeding from one phase to another requires defining requirements and testing specifications simultaneously. This is good for complex projects where testing is crucial to avoid increasing costs of finding and fixing faults, i.e., cost of quality.

New Product Development

a. Six Sigma could be incorporated within each of the 6 stages of the Drug Development project lifespan (Stage Gate Process) assisting in the termination decision at the end of each stage by determining performance metrics for each stage that adhere to company quality assurance issues as well as governmental standards. Six Sigma provides a structured data-driven methodology with tools and techniques that would help the pharmaceutical company to measure the performance within each stage. Baseline metrics could be developed to enhance the termination decisions within each stage.
b. From the customers' perspective:
    - Quality of the drug
    - Side-effects of the drug
    - Cost of the drug
    - Availability of the drug
    - Potential health risks that are not perceived or discovered in any of the stages
    - Risks if the pharmaceutical company does not select the best compound project
    - Defects/errors that were not discovered before the entry to market
c. From the design perspective:
    - Adherence to company standards
    - Adherence to governmental regulations
    - Discovering defects or errors in the product
    - Rejection by the stakeholders

d. From the process perspective:
    - Continuous improvement of processes
    - Standards not followed
    - Performance metric not established
    - New processes may be overlooked
    - Continuous improvement of processes may become inhibited by adhering to preconceived standards and metrics

e. What problems do you envision from the product perspective?
    - The best compound may not be selected
    - Quality assurance not adhered to
    - Governmental Regulations not put into metrics process
    - Rejection by the consumer

f. Anticipated errors:
    - Errors and defects not controlled
    - Root causes of errors and defects not found
    - Failure to develop best product
    - Technical risks not identified
    - Scheduling Risks not identified
    - Budget not complied with (cost overruns, dumping a good compound because it ran over budget)
    - Market risks – getting late to market, losing share, revenues, product life…the competitive advantage

    Anticipated opportunities:
    Using Six Sigma could benefit the process by developing metrics within each stage of the drug development life span, thus having the assurance that the best possible drug is being marketed by putting the customer's needs first. Using the DMAIC problem solving methodology along with the metrics established could be used in every project, therefore enabling Six Sigma to reap the opportunities by:
    - Eliminating errors, defects, and waste
    - Discovering the root causes of errors, defects, and waste
    - Reducing cycle times
    - Improving productivity
    - Meeting customer expectations
    - Putting out an improved product
    - Lowering product costs
    - Increasing Revenues
    - Increasing profit levels, hence a better bottom line
    - Gaining the competitive advantage through Early-to-market product
    - Increase Shareholder happiness

Healthcare

a. Expected = 200 units
    Completed = 109 units
    No of deviations or defects = 91 units

DPMO = (91/200) x 1,000,000 = 455,000
(Using Excel) NORMSINV (1-(455,000/1,000,000)) + 1.5 = 1.61σ

b. Number of inspections = 35 x 60 = 2100
Number of non-conformances = 18
DPMO = (18/2100) x 1,000,000 = 8,571.43
(Using Excel) NORMSINV (1-(8,571.43/1,000,000)) + 1.5 = 3.88σ

c. Prescription:
- Wrong medication.
- Over dosage
- Medicine input
- Prescription transfer

Dispensing:
- Side effects
- Pharmacist collect the medicine
- Review before dispensing
- Late dispensing

Administration:
- Quality of service and patient care
- Information from doctor to pharmacist
- System to allocate the patients and their medicine
- Customer service

d. DPMO (Prescription) = (60/6,000) x 1,000,000 = 10,000
DPMO (Dispensing) = (50/330,000) x 1,000,000 = 151.5
DPMO (Administration) = (90/6,000) x 1,000,000 = 15,000

Prescription: NORMSINV (1-(2,000/1,000,000)) + 1.5 = 3.83σ
Dispensing: NORMSINV (1-(151.5/1,000,000)) + 1.5 = 5.11σ
Administration: NORMSINV (1-(15,000/1,000,000)) + 1.5 = 3.67σ

Financial Services

1a. Overall, the World Bank (WB) project cycle is very similar to the CIM process. Both processes start out to identify the opportunities and propose objectives. Next both processes develop project ideas and requirements. The next steps in CIM are to define current and new processes, identify root causes and solutions. These separate steps in CIM are lumped together in WB project cycle as part of the project investigation and planning. In the WB cycle, board approval is also included. In CIM, testing the solutions to choose a solution is followed. Both processes implement the proposed solution. After implementation, both processes measure and evaluate the progress. The final step in both is communicating the results. In the WB process these results are first communicated to the board and then to the Independent Evaluation Group.

1b. Six Sigma may be used to examine the defects in the financial system and financial instruments that are being used to provide loans. This may be

extended to the services that WB provides to its customers to understand and rectify defects.

2a. DPMO = 200,000; which results in 2.34 σ

2b. NORMSINV(1-(DPMO/1000000))+1.5=6
Solving for DPMO, we get DPMO=3.4
Now, DPMO=No of callbacks/No of customers*1000000
No of callbacks (complaining customers) = 7 or 0.00034%

Construction

a. For the projects in Chicago discussed in Chapter 1:
   - Identify opportunity: Define certain problems to be solved. We can assume that the team members sometimes take a long time in acquiring the requirements. Another assumption is that the owner of the project had decided to add a new feature to the project.
   - Form team and create scope: Selecting the best team members who understand the problem and are aware of the process. Those employees will determine the scope of the project based on customers' needs.
   - Analyze "as-is" and determine "to-be" process: The team will initially analyze the current process of acquiring customers' requirements, and then set up a target performance based on customers' needs and project scope.
   - Identify root-causes and proposed solutions: Determine whether the new process is technically and economically feasible, and if not, then the team will have to repeat the analysis of "to-be" process till they understand the root cause.
   - Prioritize, Plan, and Test proposed solutions: From the root cause come up with a number of solutions. Test these solutions on the various parts of the ongoing project and come up with a solution.
   - Implementation, progress and closure: Implement the solution, measure the performance, monitor the project, and publish the results to management and employees.

b. Maximizing both customer satisfaction and internal efficiency should be accomplished. One might be related to another; improvement of internal efficiency leads to a better product which improves customer satisfaction.

c. The most important factor is identifying the "as-is" process. The "as-is" process has to be improved and a significant effort should be exercised by the team to streamline the process. Another factor is to come up with multiple solutions. This list should be exhaustive and cover all possible solutions.

d. Usually, the CIM results in a change in the process. There might be some changes in the way some things are conducted, but the people who are impacted by the changes should be present in the CIM meetings and they should be contributing to the CIM process.

e. It depends on the change in the process. Some core processes are hard to change and might cost the organization a lot of money. But, these changes should improve efficiency and thus the payback should be substantial as well.

A financial analysis and a payback analysis should be conducted. Some other process changes may be very simple and may not cost much to implement.

f. Stakeholders and their commitments may vary depending on the process. For example, a simple process might impact a few stakeholders who use that process and may not be significant enough to influence others in the organization. Some other processes may need attention from stakeholders including the executive team, the board of directors, and stockholders.
g. Feedbacks are essential in any process. The knowledge of how the process change impacts its users and the organization is very important. Such knowledge may be used for future changes in the organization. Feedbacks should be initiated and delivered by users of the changed process. The receiver of these feedbacks may start at the supervisor level all the way to the executive level depending upon the impacts of the changed process. The feedback should result in a very positive way as to whether the changed process should be further modified or continuously improved.

Case Teaching Notes

Teaching Points – Use to open the case

- The processes used in the four case studies are different from each other due to the different project sizes and the different nature of the projects
- The benefits of each process explained in the case should be stressed, for instance, how the process in the SAP project increases productivity improvements, enhances governance, and reduces costs
- Reengineering business processes in the SAP project can be shown to understand the importance of streamlining processes in a project
- The six sigma activities in the MHSB project can be stressed to show how a process such as lean six sigma increases the value of projects
- Using the bank case study, it can be shown how software projects can use COTS type of software with effective and efficient in-house processes
- A simple CIM process can be illustrated in the construction project

NIBCO, INC.: SAP Project

1. An ERP system offers an integrated information system and provides:
    - Enterprise-wide data consistency
    - Accurate data
    - Availability for both daily business operations and decision making activities
    - Improved productivity
    - Increased insight
    - Enhanced governance
    - Improved flexibility
    - Reduced costs
    - Utilization of best practices built into the ERP software
2. BPR is related to ERP in that the business processes are often reviewed and changed when implementing a new ERP system. Reviewing current processes is

a necessity during the design phase of an ERP project. This is due to the fact that the ERP system must be configured to the current process or the business process may be changed to reflect the best practices of the ERP system. Other changes and efficiencies gained implementing an ERP open up the possibility to improve related business processes.

Processes, organization, structure and information & technology are the key components of the BPR. ERP combines business processes into integrated software. It automates business processes across the enterprise and provides an organization with a well-designed and managed information system. Many of the large companies in the U.S. started reengineering and integrated them with ERP. Companies like IBM, Texas Instruments, American Express, Johnson & Johnson, Chrysler, Ford, Shell Oil and many others have achieved major reengineering successes. Yet various research studies by leading management consulting companies, Forrester Inc. etc., have shown 60 – 70 % of BPR efforts have either failed or did not achieve the expected benefits.

Many organizations have successfully implemented ERP systems and reported huge benefits. Yet many research studies estimate that at least 90 % of ERP implementations end up late or over budget and several failure stories are cited. Failure of some of the ERP and BPR implementations are due to a variety of reasons like lack of strong executive leadership, focus on processes, poor planning, inadequate training, lack of employee involvement, etc.

Michael Hammer in his path breaking article, *Reengineering Work: Don't Automate, Obliterate,* published in Harvard Business Review, defined BPR as "using the power of modern information technology to radically redesign business processes in order to achieve dramatic improvements in their performance." For BPR to succeed or achieve the intended benefits, information technology has a critical role to play as the key enabler of business processes. Organizations have the following options:

- Reengineer business processes before implementing ERP.
- Directly implement ERP and avoid reengineering.

In the first option of reengineering business processes, before implementing ERP, the organization needs to analyze current processes, identify non-value-adding activities, redesign the process to create value for the customer and then develop in-house applications, or modify an ERP system package to suit the organizations requirements. In this option, employees will develop a good sense of process orientation and ownership. This would lead to a customized solution considering the organization structure, culture, existing IT resources, and employee needs, and promises relatively less disruption to routine work during the change program. It is likely to have a high probability of implementation, but the reengineered process may not be the best in the class, as organizations may not have access to world-class research and best practices. Moreover, this may be the only chance to radically improve in the near future and going for less than the best may be a costly mistake as developing an in-house application or implementing a modified ERP can take lot of time.

In the second option of implementing an ERP package with minimum deviation from the standard settings, i.e., "one size fits all," all the processes in a company should conform to the ERP model and the organization has to amend its current work practices and switch over to what the ERP system options offers. This option offers a world-class efficient and effective process with built in measures and controls and is likely to be quickly installed. But if the employees do not have clarity of existing processes and good understanding of their internal customer needs or current processes are not well defined and documented, it is quite possible that while selecting the standard process from the ERP package, employees may not be able to perceive the difficulties likely to be encountered during the implementation stage. Employees would lack process ownership and orientation. Other than issues like organization structure, culture, and lack of involvement of people can lead to major implementation difficulties and the full benefits of standard ERP package may not be achieved.

3. The best option for NIBCO is a combination of modifying the "vanilla" ERP system to current processes in some cases and changing current processes in others. If all current processes are kept, the required amount of modification and customization can create a number of issues such as increased cost, longer project duration and difficultly in applying updates and upgrades. If all business processes are conformed to that of the ERP, NIBCO may have issues with higher costs and long project duration due to increased training and testing. This may increase the chances of major issues at the launch of the new ERP system because of unfamiliar processes.
4. NIBCO's implementations phases were similar to the phases in a traditional SDLC with some modifications:
    - The first phase in both is a planning or preparation phase. For NIBCO, the project's plan, scope and budgets are determined in this phase. The SDLC differs slightly in that the scope is not determined until the next phase of design and analysis.
    - The analysis phase for NIBCO and design phases for SDLC are next. In this phase, the "as-is" and "to-be" processes are evaluated and analyzed.
    - The third phase for NIBCO is the design phase in which the results of the analysis phase are put into documentations and mapped to SAP's configurations. This phase for SDLC is similar in that the preliminary design for the project is generated, analyzed, and tested. The last phase for both is implementation and launching/go-live. The software is in production but also includes some post go-live support.
    - NIBCO should have added go-live testing and post project review in their last phase. Although the testing is mainly included in the implementation phase of NIBCO, a separate phase allows the design, configuration, and performance to be evaluated to meet the goals of the project and stakeholders.
    - A final review phase is to document good practices to learn from the project so that future projects' quality can be improved and acknowledged problems can be prevented.

5. BPR activities should be included in the preparation phase for "as-is" analysis of current business processes and information system and gathering internal-customer requirements. Here the current and future business processes are mapped out and analyzed. This includes evaluating what business processes that can be adapted to SAP. The design phase also could include some BPR. As the design comes together, it is possible that testing may prove that certain processes are not working and requires changes to the process.

Memorial Hospital of South Bend: Computerized Physician Order Entry

1. Business process re-engineering, also known as business process redesign, business transformation, or business process change management, is the analysis and design of workflows and processes within an organization. Many recent management information systems developments aim to integrate a wide number of business functions such as enterprise resource planning, supply chain management, knowledge management systems, human resource management systems, customer relationship management, and groupware aimed at collaborative systems.

   In the case of MHSB, their CPOE implementation goal is to be collaborative within the organization. The activities within BPR are:

   - To identify processes that need improvement or realignment
   - To bring cross-functional teams together from different facets of the company to identify the processes within each department that are to be affected by the re-engineering process
   - To review, update, and analyze the existing processes where current processes are reviewed and analyzed for improvement. The company must understand the current processes and how they work before they can be improved.
   - To perform the design "to-be" activities. The organization would design one or more alternative processes are designed to meet the strategic goals of the company.
   - To test and implement processes. After designing alternate processes, the organization would proceed to the next activity, test and implement "to-be" processes. These are the proposed processes that need to be tested and implemented in the organization.

   In the MHSB case, all four of the steps (Identify Processes; Review, Update, and Analyze As-Is; Design To-Be; and Test and Implement To-Be) would be an appropriate fit for the CPOE implementation process. The goals of the four BPR activities align well with the goals of the workflow design activity in the implementation process. These goals are improving and streamlining processes.

2, 3, and 4.

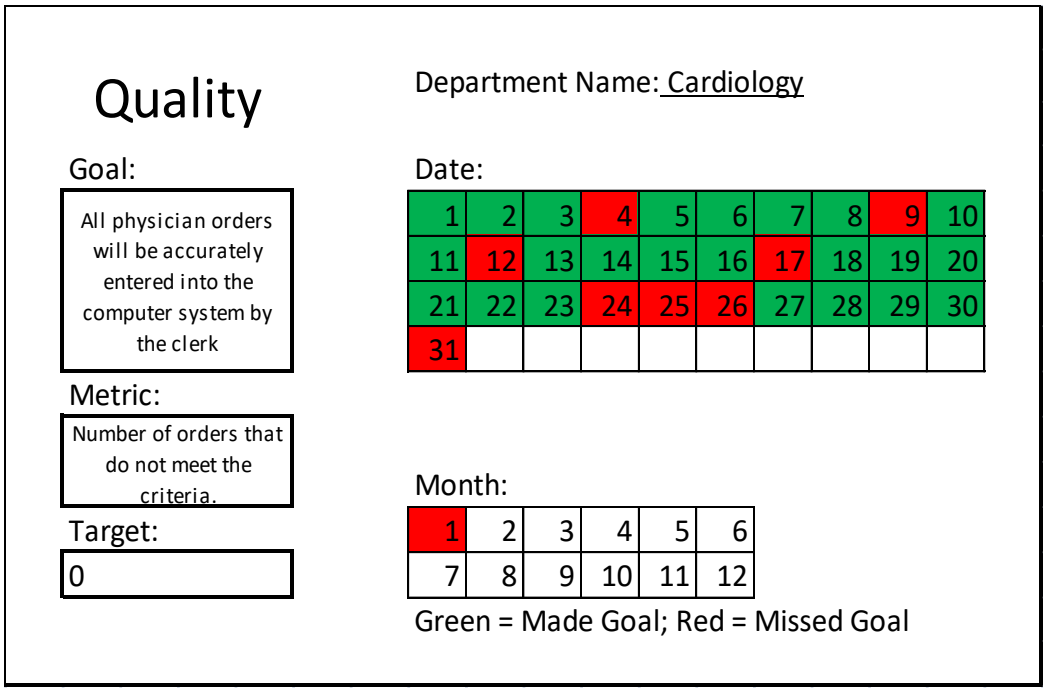
   The SDLC is a process of creating or modifying information systems, and the models and methodologies that people use to develop these systems.

   - The activities of the SDLC first require investigation and gathering requirements. In this activity, organizations gather the requirements of their systems and business. These requirements may include functionalities, business logic, data, and user interfaces.

- The next activity is preliminary design. In this activity, a working prototype is implemented to define functionalities and show the interface to the users.
- Next, the organization would perform the analysis activity. During this activity, the organization observes, measures, surveys, studies, tests, and researches the problem. The final result of the analysis should define the scope of the project.
- The following activities are then performed and designed providing the physical and logical design of the system: coding, having the programmers and developers develop the system; testing, determining the functionality of the process or project; and launch, implementing the system in the organization.
- The design, coding, testing, and launch activities would be an appropriate fit for the CPOE implementation process. The goals of these activities align well with the goals of the configuration, test, and implement stage of the CPOE Implementation Process.
- These final stages of both the SDLC and the CPOE deal with the development and launch of the system.
- The goal of workflow redesign can be achieved with the BPR process. The BPR activities align well with the workflow design activity in the implementation process. Both have the goal of streamlining and improving current processes to better align them with the organization's strategy.
- Also the goal of launching the system can be achieved with the final stages of the SDLC. These last four activities take the conceptual design of the system and turn it into something concrete.

5. Other than quality, the following categories can be used by Mary and Jane for lean reduction:
    - Cost
    - Productivity
    - Efficiency
    - Waste
6. Some other defects that could be used by Mary and Jane for lean reduction are:
    - Wrong orders by physicians
    - Inaccurate input of orders
    - Clarification errors by the nurses
    - Clarification errors by the laboratory technicians
    - Clarification errors by the radiologists
    - Long turn-around time
    - Accurate entries by clerk

    Kaizen event for the additional goal:



7. Mary and Jane can create a redesign which includes lean reduction. By reducing defects, MHSB should be able to accomplish more activities utilizing fewer resources. These resources include staff, assets, budget, and time. Certain management decisions regarding resources are now possible, including:
    - Time decisions – How much less time to spend on certain activities
    - Staffing – How many fewer employees to staff for certain activities
    - Budget – How much less money to spend on certain activities
    - Assets – How much less equipment to allocate for certain activities

    These decisions can be included in every stage of the SDLC process. Resources are consumed at every step during the SDLC process, and by reducing the defects and learning to operate "leaner". MHSB can complete the stages based on the reduced number of required resources.

Syndicated Community Bank: Core Banking Systems

1. Using COTS will be preferable over internally built software when certain conditions apply:
    - Capable of satisfying the needs
    - There is no conflict in the integrated system at any level
    - System has a sufficient capacity to maintain security, safety and real-time performance
    - Requirements and business processes are flexible enough to be accommodated in COTS
    - Able to explore, compare and analyze different alternatives of COTS in the marketplace
    - The current architecture can be evolved when needed
    - The current architecture can be scalable when needed

- Saving costs of acquiring additional expertise, technology, processes and information.
- Resources for COTS implementation will be less than those working for developing and maintaining customized software.

3. There are requirements related to the software architecture such as:
   - Software ability to be integrated with other components
   - Software flexibility
   - Software portability
   - Scalability of software
   - Reusability of software
   - Integrity of software

   Moreover, it is essential to focus on the performance, reliability and security of the software. There is another set of requirements related to the domain. Regarding the existing gap between the developer and the end-user, the latter doesn't have the basic knowledge on how to set up the domain-specific requirements of the software. Therefore, it is helpful that the software includes domain standards.

   In addition, organizational requirements should be also taken in consideration. Those requirements are as follows:
   - Stability of a particular component (frequency and type of updates)
   - Vendor's credentials and stability on the market.
   - Component upgrade policy (e.g., based on new features and/or bug fixes)
   - References for component use (customer base)
   - Long-term component support strategy
   - User support record
   - Vendor's software development practice (e.g., ISO9000)
   - Vendor's popularity in a particular application domain
   - Vendors' vested interest in a particular domain (if sufficient it provides a scope for introducing component features relevant to that domain)
   - Contract practice (guarantees given, and obligations vendor is prepared to take on)

3. SDLC vs. COTS

SDLC	COTS	Common/Difference
Systems Investigation **Systems Requirements** **Software Requirements**	Requirements Analysis	Common. In both methods requirements should be identified & documented.
Preliminary Design	Survey of COTS products and preliminary evaluation	Common. Both methods use drawings to determine the software design.
Analysis	Evaluation of COTS	Different.
Design	Modification to requirements	Different.
Coding	Procurement of COTS and customization	Different.

Testing of the code	Testing of customized system	Common.
Launch	Implementation	Common. The launch process in both methods includes integration and maintenance.
	Integration	
	Maintenance	

4. Agile vs. COTS

Agile	COTS	Common/Difference
Display models in public	Candidate vendors are presented to the Board	Different.
Model to understand and communicate	Evaluation of COTS	Different.
Agree & follow a common set of modeling	Authorization of MEPP and VMP	Common.
Any team member can modify any model	Decisions should be made by the team	Different.
Seek stakeholders for active participation	MEPP and VMP	Common.

5. The benefits of MEPP and VMP:
    - Helping understand the problem as well as the proposed solutions
    - Motivating the project team by having the Board involved in the project
    - Discovering flaws and errors before implementing the project
    - Receiving the Board's recommendations that could improve the solution
    - Allocating the required fund to the project by estimating the project costs
    - Reducing the risk of selecting a vendor.
6. Issues to MEPP and VMP:
    - Underestimating the project costs which would reflect on the Board's future decisions.
    - Overestimating the project costs so the Board would reject the proposal.
    - Underestimating the strategic risk of selecting a certain vendor (e.g. selecting a vendor that is unable to provide future update.)
    - Taking a decision based on inaccurate information.

Craig Constructions, Inc.: A Home Improvement Project

1. Quality is important. In construction, quality is always in the midst of lawsuits between stakeholders of a project. Many customers do not mind paying a larger fee for quality work in construction because of safety concerns and compliance of regulations. Also, looking at it in a business point of view, having quality control in construction can really cut cost through reduction of redundant tasks, scrap,

mistakes, and time. It also promotes the construction company by having satisfied customers who can spread good words about the company at the end of the construction project.

2. Craig should try to follow all of the CIM principles. When time is limited for the project at hand, he should at least try to have customer focus which is very helpful in the design phase of the project to help meet customer needs. Also, employee involvement and process centered principles would help Craig to be in the right path during construction. These few principles will give the final project phase a great boost in quality management and improvement in processes that may not have existed before in Craig's company. Good communication can be used throughout the construction project lifespan.
3. In each of the three phases, Craig's company needs to:
    - Identify processes that can be improved upon
    - Form teams who will work to obtain scope or requirements of the process
    - Analyze processes and define desired outcomes that the improved process will achieve
    - Identify root causes and proposed solutions
    - Prioritize, plan and test proposed solutions
    - Implement solutions by refining processes
    - Measure progress and communicate the results
4. Craig's organization should consider:
    - Continuous improvement employee training and involvement
    - Being process-centric
    - Forming strategic alliances
    - Good communication with all stakeholders
    - Following the CIM process
5. The architect/engineer should consider following the eight basic concepts of ISO 9000 as well. The principles are:
    - Focus on the customer
    - Choose effective leaders
    - Involve people
    - Understand processes
    - Value a systems approach
    - Look for continual improvement
    - Exercise good judgment
    - Recognize common cause
6. The quality factors are continuous improvement, fact-based decision making, and good communication.
7. CIM success factors are customer focus, employee involvement, process-centered, and good communication.

Teaching Points – Use to close the case

- Importance of processes in projects
- Importance of understanding the benefits from project processes
- CIM and six sigma can be used in all types of projects

- Software processes should be understood by project managers

