Session 2
Project Context and Managing the Design

Session Speaker:
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Session 2A

Project Context

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Session Objectives

To study and understand:

• Concept of Project Context
• Influencing factors on Engineering Design
• Concept of resolution
• Engineering design viewpoint
• Macrolevel and Microlevel of Influence
Session Topics

• Engineering Projects
• Engineering Design in the Project Context
• Effect of Influences
• Influences at Macroeconomic and Microeconomic Levels
• Influence at Corporate Level
• Management Style, Skill and Staff
Engineering Projects

- Projects are a common denominator in engineering
- Design activities and the development of the designed systems need monitoring
- Every project is different with certain projects having comparable features
- Context makes each project an unique
- Importance of setting the project context right at the start
- Overall picture from different viewpoints and different levels of resolution
Engineering Design in Project Context

- Project within some kind of management system
- Company’s revenue and customer
- Operational life of a product
- Customers and users are not necessarily the same
- Product need to satisfy different needs
- Established product and company revenue – operating profit
- Need for development of new product through engineering project
- Minimization of Project cost, time, and risk involved
- Concept of Incremental design- new components and sub-assemblies are systematically introduced into an existing product
Project Context

- Outer Environment- Strong influence on within company and particular project
- Visualization of project – its management, within company, within a particular market and environment
- Engineering input to the project- different from marketing, quality assurance, and finance
- Engineering input as a subset within the project for visualization in terms of team activities and outputs, set in the context
- Design process is interactive decision-making
- Without decisions, there is no progress through steps and management involvement is critical
Phases in Engineering Design

- Problem definition through task clarifications with output as a specification
- Conceptual design - generation, selection and evaluation of solutions
- Embodiment Design - development of concept with final layout as a final output
- Detail Design - Shape and form of every component are fixed. Output is the manufacturing information
- Conceptual model or map is useful in visualizing the influence of numerous factors acting at different levels of resolution
- ‘Windowing in “ and “Windowing out” - from one resolution level to other level - Effective concentration on details
Effect of Influences

- Interest of the project, customer and the design team
- Inconsistency of those who are not interested in the design process - Frustrating factor for designers
- Course of the design is susceptible for such influences
- Awareness of the impact of influences to have control over those that can be controlled
- Influence is defined “people or things having power” with power “as the ability to affect outcome”
- Design Engineering Process - Goal Oriented activity - cannot be effective unless the balance of power favors the project goal attainment
- Project goal is distinct from other goals at different resolution levels

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Effect of Influences

- Influences range from positive through neutral to strongly negative
- Effect may be constant or highly variable
- At each resolution level, influence is a mixture of:
  - slowly changing “structure oriented“
  - continuously changing “process oriented”
- Impossible to Quantitatively define these influences
- Possible to judge and categorize the impact and the contributing factors within each category
- Subjective assessment
- Engineering Design is analogous to R &D
Effect of Influences

- Comprehensive set of influences specific to engineering design process
- Checklist and worksheet to identify the influence at a specific situation
- Monitor and deal with them in a systematic and control fashion
Macroeconomic Level

- Design deals with the future and is highly susceptible to cultural, scientific and random influences

- Cultural Issues – Social issues, political climate, economic situation and legal requirements

- Stable at a particular time instant and can vary rapidly

- September 11, 2001- effect on Aviation industry and middle east relations

- Scientific Issues - Technological developments and increasing concern on with ecological effects on environment

- Continuously changing and profound influence on the design process
Macroeconomic Level

• Example of Electronic watch on traditional Swiss-watch making industry

• Technological developments tend to go in cycle

• Trend studies, expert opinion and technological forecasting can predict some developments which might affect the project

• Design Engineer must lookout for ideas which might wipe out the whole project

• Appropriate technology for the particular situation is also important

• Intermediate technology – Level of technology is matched to the capabilities and resources of the user
Figure 2.6. Technological cycles (S-curves)
Macroeconomic Level

- Random Influences- Not controllable, effect on the project can be minimized by anticipation
- Effect of luck and chance
- Useful approach is to try and maximize the effects of good luck and minimize that of bad luck
- Inclusion of a displaced person from a different project
- Sudden exit of a key member of design team
- Importance of contingency plan to shorten the disruption of time
Microeconomic Level

• **Market, Resource Availability, and Customers**
  
  • Purpose of design is to address the need
  
  • What the need is, where it has come from and the likelihood of it continuing
  
  • Market information before the start of the project
  
  • Monitoring it during the project course
  
  • Bleak outcome in the absence of the market of the product
  
  • Demonstration of superiority of the product over current one
  
  • “Breakthrough product” new products - effective in practice
  
  • Mediocre design will not survive the competitive market

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Microeconomic Level

- **Market, Resource Availability, and Customers**

- Product Planning- Importance, systematic promising product ideas, selection and development

- Marketing view of the Project context- Marketing analysis, discovery of new ideas, selection of appropriate product new ideas, and the definition of particular products

- Expertise of marketing staff needs to be drawn in the beginning of the project

- Technologically marvelous project should not be a financial disaster

- Honest communication is absolutely essential

- Build of mutual trust between different types of point of view
Figure 2.8. Project life cycle
Resource Availability

- Resource is often a sore point between the design team and the management
- Design work is always a heavy cost item directly and negatively affecting the cash flow
- Without a high quality design, a company is doomed and cutting back on the design team resource is a clear path for poor quality design
- After the viability phase, major role for design manager
- Design Manager to negotiate to get the best possible resources for the design team
- Best Possible: People, funding, information, technology, working environment and all round support
Resource Availability

• Failure to negotiate sufficient resources for the project leads to eventual failure – may not become apparent and too late to recover

• Guess estimates replace Calculations, sketches in place of drawings, sick time replacing overtime

• Demand for results and request for additional time usually not welcomed-Design Managers experience it and daunting feeling

• Systematic approach in the design process is advantageous in allocation of resources

• Management’s direct involvement in the project- More visible design process, tangible output to share and discuss, additional respect and goodwill for professionalism

• Resource Needs- Precise definition, Early identification of problem areas and design through less volatile manner
Customers and Users

- Product or technical system bought by some and used by some
- Perception of Value and appeal of the product by the customer and user determine the success of the initial design
- First step will be to try to find out what the customer would like to have
- Not an easy task- what they say may not be the what they want
- Difference between the real needs of the customers and users
- Example of carpet cleaning machine- Rental
- Design team has to foresee how the design will be perceived by all the different parties involved in the use including the foreseeable misuse
Customers and Users

• Continually changing expectation
• Pleasing the customer is like aiming a moving target
• Environmental and safety measures are getting lot more emphasis in the design
• Legal ramifications of non compliance are enormous
Influences at Corporate Level

• Structure of the company and its organizational behaviour have strong influence on the design process

• Opinion and terminology in the management literature widely vary from author to author

• Engineering design process is usually ignored in organizational theories

• Design manager has to develop the management approaches alone

• Condensed set of proven factors of importance to engineering design
Corporate Structure

- Difference between project executed by MNC and small company
  - Vast resources of a big company - If access is cumbersome, design may start from scratch
  - Virtual communication gap between Engineers of different departments
  - Small Companies have advantage of “lean” and closeknit but may lack the resources for design process
  - Large company - need to work on communication
  - Small company - outside help may be required for resource boosting
  - Preferable for design team to have control over its affairs
Corporate Structure

• Generate Enthusiasm, involvement and tenacity
• Positive and continual encouragement from upper management
• Company’s organizational structure may not be conducive for effective or efficient design in the area of accounting
• Kind of thinking that restricts the design work and impossible for a design team to compete should be looked into
• Pay Package- best approach to most employees
Shared value

- Attitude and approach of corporate management
- Clear Objectives, statement about risk taken, clear commitment to projects and active involvement
- Likely to bear positive effect
- Motivation to work for the success of the project
- Design Manager to keep spirit of enthusiasm even when things contrary to the desirable expectations are happening in the company
Management Style and Skill

• Extremes of Management

  Autocratic- What the boss says goes
  Benevolent- What the team says goes
  Consultative- Others are heard and what the boss says goes
  Participative – What the boss and team says goes

• Advantages and demerits are associated with each of the above

• Type of Project, type or mixture of styles- appropriate for the success

• For any specific project- degree of design team freedom and degree of design-team participation may be appropriate
Management Style and Skill

• Design team needs the management support with the skill to:
  ensure the planning
  proper coordination
  availability of adequate resources at the right time

• Management must show:
  keen interest
  element of the ‘project champion’ to boost the confidence in the project

• Design team has to be:
  Effective (Doing Right things)
  Efficient (Doing things Right)
Management Style and Skill

- Design team needs managers who:
  
  Can communicate well
  
  Have good judgement
  
  Are motivated themselves
  
  Have sufficient self confidence
  
  Guide the team all the way from the scratch
  
  Focus from design specification to a product
Session Summary

- Design projects take place within a specific context
- Mapping the context helps in visualization of the “Big Picture”
- Five level of resolution provide a useful framework for the context:
  - Macroeconomic Level - Environment External to the market
  - Microeconomic Level - Market within which company is operating
  - Corporate Level - Company executing the project
  - Project Level - Project with Engineering design Input
  - Personal Level - Individual/Team Inputs to design
- Different viewpoints at various levels should be identified and understood
Session Summary

- Design projects involve team activities, team outputs and contextual influences
- Influences on the engineering design should be explored at various levels
- “Big Picture“ should be kept in view, while still “windowing“ in and out on the details
- Check list should be used to identify the key influences
- Positive and negatives of the design should be summarized on the work sheet
Session 2B

Managing the Design Team

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Session Objectives

• To understand how to manage the design team
• To understand the factors influence the design team
• To learn about the knowledge, skills and attitude of the team members
• To learn about the motivation of team members
• To learn about the project profile checklist and worksheets
Session Topics

- Influences at the Personal Level
- Knowledge, Skills and Attitude
- Motivation
- Personal Output
- Personnel Profile Checklist and Worksheet
Influences at the Personal Level

• Engineering design involves teamwork

• Better the team work, the more likely that a high quality design will emerge

• Typical design teams are multidisciplinary

• Demands on the team change during the course of a project

• Composition of the team may need to be adjusted as the work progresses

• Team members are now often “geographically dispersed” working far apart from each other, perhaps in different countries, cultures, and time zones
Influences at the Personal Level

• Communication become an even more critical issue

• No longer simply a matter of making sure that information is sent and received

• But ensuring that it has been interpreted and understood as originally intended

• Computer systems for communication become essential for the competitive rather than optional
Influences at the Personal Level

• Many factors contribute to the success of a team and for ideal engineering design team should be
  – Competent
  – Experienced
  – Well balanced
  – Cooperative
  – Committed
  – Motivated

• Some other factors identified
  – Morale level
  – Negotiating ability
  – Strength of power base within the company
  – End user involvement
  – Appropriate matching of design team composition to project requirements for each phase of the work
Influences at the Personal Level

- Factors may sound academic, in practice they are extremely important

- Factors are assembled in a checklist, with a corresponding work sheet, for evaluating the capability of a team working on a particular design project

- Check list and worksheet assess the contribution of each team member individually
Knowledge, Skills and Attitude

• Design work requires certain levels of knowledge and skill with an attitude of mind conductive to producing high-quality work in a team environment.

• Creativity is the key to design, but only part of the answer.

• Many important tasks require systematic and detailed thought of a routine nature rather than design creativity.

• Very difficult to change the team once the project has started.

• Too risky to assume that there will be improvements in knowledge, skills, or attitude during the course of the project.
Knowledge, Skills and Attitude

- It is important to assess characteristics of the person at the beginning of the project such as
  - Does the person have a sound knowledge base for the work in hand?
  - Is the person able to communicate ideas persuasively?
  - Does the person work effectively and reliably to complete assigned tasks?
  - Is the person’s standard of work adequate for the particular project?
  - Can the person prepare legible and neat handwritten notes?
  - Can the person produce adequate sketches and drawings by hand?
  - Does the person have a good attitude towards the management and the project?
  - Does the person act as a good ambassador when meeting with customers or working with other companies
Motivation

- Responsibility of the design manager to develop, encourage and maintain a team that works well and produces a high-quality results.

- Requires a abundance of enthusiasm and personal commitment on the part of the manager.

- Without enthusiasm and commitment the project is likely to fonder when the inevitable problems arise, such as shortage of time, money, or competent people.

- Enthusiasm motivates and helps to build up reserve fund of goodwill for the future.
Motivation

• Commitment, as used in the context of the design team, means full involvement with every aspect of the project and the tenacity or determination to see it through.

• Dedication to the project in hand, is appreciated by higher management.

• Puts the manager in a powerful negotiating position.

• Very difficult to turn against someone who is obviously trying to do the best job possible for all those concerned or to refuse reasonable request with regard to resources.
Motivation

• Manager may personally choose to work according to fixed hours of attendance, such as, 8 am to 5 pm, or choose to work according to the needs of the project

• Design projects do not necessarily progress well when confined to fixed hours in the day

• If the manager is prepared to put in whatever it takes to make a success of the project, then this will be appreciated and will set the working tone for the team

• Manager who works according to the project needs rather than by the time clock is also in a stronger position to deal with any personnel problems that should arise within the team
Motivation

- Dedicated design manager tends to become relied upon to do more and more to the point of being totally overloaded, while others are not extended to their full capabilities.

- Necessary for the manager to develop an awareness of when to push the project forward with an additional burst of energy and when to let things progress at a more natural pace.

- Direct involvement with all aspects of the project is essential for building up credibility and respect within the team.
Motivation

• Provides access to the inner workings of the team that helps the manager understand the technical and human issues well enough to deal with them competently at any particular level of detail

• Also offers forewarning of any interpersonal problems that may cause severe setbacks

• For example, the matter of some people working to the clock while other work to project needs is worth resolving immediately

• May lead to unnecessary and unwanted friction between team members
Need for Design Context

• Often few others care about the failure of the project, as a project, though the cost of any design work carried out may be quibbled over for a long time

• Part of the reason for developing the design context checklist and work sheet was to provide the design manager with a means of assessing where a project stands in order to make a personal decision as to how to deal with the uncertainties identified

• Humor is a useful tool for a design manager and may sometimes be used to advantage in defusing difficult situations or breaking a log-jam in project progress
Need for Design Context

• Can easily backfire in serious situations

• Best treated as a specific technique like any other, with times to be used and times not to be used

• Worth developing the ability to use humor effectively and in understanding differences in humor from one culture to another
Relationships

- Many team factors likely to affect a project
- Design team composition would be an important aspect
- Compatibility between the team members, which will bind the team together rather than split it apart
- Dynamic situation, rather than a pre-existing condition, the design manager can do a lot towards encouraging and maintaining team – role compatibility
- Each person in the design team has relationships within the company and relationships outside the company
Relationships

- Relationships are important to the design manager as they can greatly affect the productivity and work quality of the team.

- For example, a person who calls friends and family on the telephone for much of the day is unlikely to be adequately productive.

- Yet maintaining happy family relations comes into the equation too.

- Up to the design manager to be aware of what relationships exist and to deal effectively with those that show signs of being detrimental to the project.
Personal Output

- People are individuals with individual personalities and ways of working
- From an engineering design point of view, important influences affecting the productivity, quantity of work, power and effectiveness of the design-team members may be summarized as follows
  - Enthusiasm
  - Involvement
  - Tenacity
  - Compatibility
Personnel Profile Checklist and Worksheet

• To help the design manager in the difficult task of creating and maintaining as effective design team, a personnel profile checklist and a personnel profile worksheet have been developed.

• For a small team of only three or four people, the questions in the checklist could be asked with reference to the team as a whole and the work sheet used to record the assessment at a time.

• For larger teams, it is intended that the checklist and worksheet be used to assess individual contributions within the team.
## Personnel Profile Checklist

<table>
<thead>
<tr>
<th>Level</th>
<th>Influences</th>
<th>Contributing Factors</th>
<th>Some Questions to ask: Effects on project?</th>
</tr>
</thead>
</table>
| Knowledge | Knowledge base              | Knowledge applicability                | Are there knowledgeable specialists?
|         | Perception                  |                                       | Is knowledge matched to needs?          |
|         | Use of knowledge            |                                       | Team decision-making OK?                 |
|         | Communication               |                                       | Are individuals knowledgeable?          |
|         | Creativity (imagination)    |                                       | Team communications open?               |
|         | Versatility                 |                                       | Sufficient? Too much?                   |
|         | Negotiation                 |                                       | Adaptability in team?                   |
| Skills  | Work standards              |                                       | Team bargaining position?               |
|         | Self-discipline (habits)    |                                       |                                           |
|         | Integrity                   |                                       |                                           |
| Attitude| Enthusiasm                  |                                       | Level of enthusiasm OK?                  |
|         | Involvement                 |                                       | Level of involvement OK?                 |
|         | Tenacity (determination)    |                                       | Are team members persistent?            |
|         | Frustration/anxiety         |                                       | Effect of these on project?             |
|         | Humor                       |                                       | Do team members possess humor?          |
| Motivation | Team role compatibility    |                                       | Are team members compatible?            |
|         | Relationships within company|                                       | Good relations between departments?      |
|         | Relationships outside company|                                      | Good relations with suppliers?          |
| Relationships | Productivity               |                                       | Is productivity of members good?        |
|         | Quality of work             |                                       | Is work produced of high quality?       |

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Personnel Profile Work Sheet

- **Knowledge**
  - Knowledge base
  - Knowledge applicability
  - Perception
  - Use of knowledge
  - Communication
  - Creativity (imagination)
  - Versatility
  - Negotiation

- **Skills**
  - Work standards
  - Self-discipline (habits)
  - Integrity

- **Attitude**
  - Enthusiasm
  - Involvement
  - Tension (determination)
  - Frustration/anxiety
  - Humor

- **Motivation**
  - Team role compatibility
  - Relationships within company
  - Relationships outside company

- **Output**
  - Productivity
  - Quality of work

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Session Summary

- From an engineering design point of view, important influences affecting the productivity, quantity of work, power and effectiveness of the design-team members may be summarized as follows
  - Enthusiasm
  - Involvement
  - Tenacity
  - Compatibility
Summary

• People are individuals, with individual personalities and ways of working
• Each person comes with certain knowledge, certain skills and a certain attitude
• Design manager is in a position to motivate each person, and to encourage
  – Enthusiasm for the project
  – Involvement with the project
  – Tenacity or persistence in getting the job done
  – Compatibility and cooperation with others on the project