

SDM5001 Systems Architecture

In this course we define systems generally and investigate important properties of systems in a number of industrial, commercial, and organizational contexts. We develop the concept of architectures as a means for defining systems in terms of their functional components and interactions between system components. We also explore the impact of modularity on the configurability, evolvability, and costs of system designs. We consider:

- the nature of systems;
- the dynamic behaviors of systems;
- properties of self-organizing systems and natural systems;
- the systems nature of product and process designs;
- nature of product, product, and knowledge architectures;
- the strategic and operational uses of modularity in systems architectures;
- the role of well-defined architectures in organizing and facilitating organizational learning.

Syllabus

1. Introduction and overview of course: Basic concepts for representing systems
2. Group exercises in dynamic systems behaviors
3. Architectures of systems
4. Architecting designs as systems of functional components and component interactions.
5. Architecting supply chains system designs
6. Supply Chain Management Systems
Forecasting; Interfacing; Role of IT
7. Architecting product and process designs
Interaction between information, systems and organization; Changing organizational needs; The architectural approach; The significance of architectural design and alignment; Notions of architecture at the levels of technology platforms, information systems, information management, organizational design and strategy; The need for architectural perspective.
8. Self-Organization
Principles of organization of a system which organizes automatically without being guided or managed by an outside source; Emergent properties; Emergent structures in nature, physics, culture and engineering; Stability of emergent structures; Colonies, cities, stock-markets, utility systems, evolutionary systems;

Implications for systems architecture; Reductionism and beyond; Segregation and integration; Trade-off between design and self-organization.

9. Complex Systems
Beyond first use properties: flexibility, modularity, emergent properties; Interface of technology, policy and management; Complexity as the result of a lack of appropriate data or accepted theory; Complexity as disagreement on leading values and evaluation criteria; Uncertainties and connection of problems at different temporal and spatial scales.
10. Framework for architectural design
Framework for the systematic design of systems: information and organizational architectures; Major dimensions: distributedness, conception-design-implementation, evolution; Alignment among architectures; Architectural modeling techniques; Process modeling, data and information modeling, intentional and organizational modeling; Spiral models, Waterfall models, VEE models; Design Structure Matrix (DSM).
11. Creativity workshop: A systems perspective on creativity
Improvisation and Innovative Performance in Teams; Time and Organizational Improvisation; Architecting and Innovating; Radical Innovation; Lateral Thinking; TRIZ
12. Modular design strategies for systems - Introduction to modularity in systems architecting
13. “Modular platform” system designs
14. Modular architecture development processes
15. Architecting software systems and related organizational architectures in proprietary versus open source contexts

Readings

A list of specific chapters from books and case study readings will be distributed to students to follow up.