Chapter X
Research Topics in Complex Systems

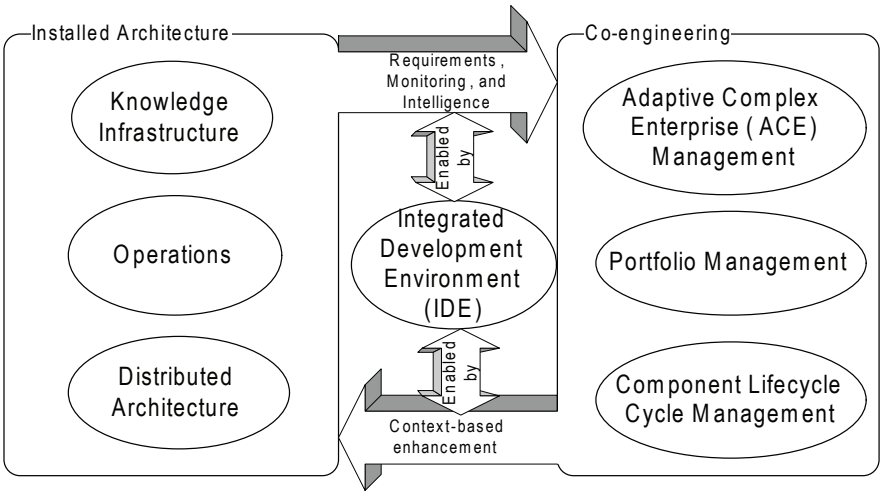
ABSTRACT

The Adaptive Complex Enterprise framework presented provides a basis for integrating many related areas of research into a services discipline. We have shown the framework is widely applicable to any kind of organization. Here our focus is on the articulation of further research needed for the IT-enabled business innovation, resilience and effectiveness. At a high level, see Figure 1, the related research topics are 1) ACE Co-engineering Theory which covers the development of context-based methods for the conceptualization, prioritization, and implementation of service-oriented solutions; 2) Knowledge Infrastructure for delivery of services, 3) Integrated Development Environment for service life-cycle management and continuous improvement of highly distributed complex systems, and 4) Transformation and Innovation Practice.

While it is true that technology research in emerging trends like bio-info-nano integration will increase in importance, there is also a fundamental realization that the management of complexity will itself become a critical area of research. This is especially true since other related IT trends like virtualization, miniaturization, and distribution will also increase the complexity of deployed systems. Here we will explore the underlying challenges.

Industry relevance: To leverage IT for enterprise transformation, we need to be able to reason about highly complex systems and maximize their performance to meet business and process Goals. The overall objective is to streamline the way by which value is delivered by technology both 1) within service-oriented primary

Figure 1. ACE research topics and relationships for complex systems



processes and 2) internal secondary IT and related processes that enable primary processes. In addition opportunities for new business process services and their enablement must be also identified and deployed without impeding the on-going services. This requires a conceptualization that enables us to make good engineering decisions about improving performance in the context of existing systems.

To begin an understanding, we turn to Figure 2 that puts into perspective the evolution in IT-related disciplines. As illustrated, IT has been evolving from making it easier to program (in the 80's and 90's) to making it easier for technology to adapt to the changing business processes (2000s). Consequently, the research issues are no longer just on the creational aspects of technology, but have shifted also to the service life-cycle management aspects. This shift is illustrated by increasing interest in the 'Co-engineering' areas on the right of Figure 1.

Adaptation is achieved through the alignment of service-oriented components as determined by the portfolio to meet the ACE needs for achieving the BioS goals. At the same time in Figure 1, there is a need to acquire knowledge (based on requirements, monitoring, and mining) from the distributed architecture and operational Agent Interactions. The information is synthesized to inform ACE decision making and the next generation of enhancements. Thus the role of the Interactive Development Environment (IDE) has evolved in recent years to the management of complex systems and the life-cycles of their constituent services. We cover each of these research areas next.