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Chapter III

Adaptive and Evolutionary Systems: Lessons From Object, Component and Agent Approaches

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ABSTRACT

This chapter examines the issues surrounding the development of adaptive evolutionary systems by evaluating the characteristics of contemporary development paradigms. It categorises these characteristics as advantages or limitations with respect to the purpose of servicing adaptive evolutionary systems' requirements. The chapter considers the evolution of development paradigms and concludes that a key limitation in each case has been the preoccupation with addressing the shortcomings of the previous paradigm's implementation. The maturity of the paradigm is seen as a significant element in determining what the current research issues for that paradigm will be and this observation is used to recommend the line of development that should be taken to avoid recurrent pitfalls. The issues extracted are structured into a framework for the evaluation of any given approach with respect to its suitability for the development of adaptive evolutionary systems. Recommendations are given for future work including recommendations outside the accepted sphere of information systems research.

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INTRODUCTION

"Adaptive" and "evolutionary" are stereotypical characteristics of software systems that are increasingly being demanded by organisations needing to respond to changing market requirements. Given a background of acquisition/merger, globalisation, business process improvement, customer prioritisation, etc., it is the case that many organisations are necessarily "emergent" (Truex, Baskerville, & Klein, 1999). In short, they are required to continuously adapt to shifting environments. Testament to this is the fact that modern economies enable flexible and emergent marketplaces, encouraging combined service offerings that emphasise economies of scope (mass customisation) in addition to the traditional economies of scale (Best, 1990). In organisational transformation terms, this general trend is seen as a mandate for migrating from a top-down, strategy-led development philosophy to a bottom-up, competency enabling, emergent development philosophy (Sauer & Yetton, 1997).

The consequence of emergent philosophy for organisational information systems is that they need to be easily adapted to meet unpredictable new demands, increasingly at very short notice (witness "Internet time"). It is not enough to simply encompass "variation" in the normal process of business activity; systems need to be evolutionary is the sense that configuring them to exploit one opportunity should not inhibit future configurations necessary to support currently unknown requirements. Similarly, stakeholders and designers need to accept that conflicting ideas and requirements do not indicate bad practice and that systems will be under constant adjustment and adaptation to capitalise on opportunities (Truex et al., 1999). Management will thus need to accept an ecological view of systems where the various requirements and offerings should coexist or compete for resources on a "survival-of-the-fittest" basis. Clearly, ongoing development should be targeted to strictly relevant areas and incur costs in proportion to the scale of change in business activity. Concomitantly, the resulting system should not suffer substantial compromise in its effectiveness, particularly in those areas not targeted for ongoing development.

With the above ideals in mind, the aim of this chapter is to examine critically the desirable characteristics of adaptive evolutionary systems and the relationship of such characteristics to the potential of a development paradigm to deliver them. This aim is achieved via a critical examination of contemporary development paradigms, namely, object-oriented, component, and agent-based. The examination of each paradigm considers what are its key characteristics and at what level of maturity it is. Relevant work in the area is used to highlight the main advantages and limitations of the paradigm and the potential that it has to service the requirements of adaptive evolutionary systems. The issues surrounding the pertinent characteristics are structured into an evaluation framework for use in