Chapter 4
The Foundations of Service Eco-Systems

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ABSTRACT

The literature on services is replete with references to service eco-systems, yet no attempt has been made to develop a set of principled conceptual underpinnings for these. This chapter aims to address this gap. This chapter also seeks to design the formal basis for practical tools to support the design and maintenance of service eco-systems. It describes a high-level Business Service Modeling Language (BSRL) that is general enough to support the modeling the full spectrum of services, spanning from web services on the one extreme to abstractly defined business services on the other. Based on this language, it describes a taxonomy of relationships that might hold between services in an eco-system. These relationships are then leveraged to formally define a notion of equilibrium in a service eco-system. The chapter then extends the analysis to a deeper level of detail, by considering inter-operation relationships between the process designs that realize services. The chapter briefly considers the challenge of service-oriented analysis and design, and in particular, addresses the question of which combination of functionalities might be packaged as a service, thus leading to the set of inter-related components constituting a service eco-system.

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INTRODUCTION

Most large-scale service delivery settings involve complex collections of inter-dependent services. Consider an airport, where the services on offer include passenger check-in, baggage handling, passenger security screening, customs, cargo handling, food courts, lounges, aircraft refueling, aircraft maintenance and air traffic control (to name just a few). There are several interesting features of service delivery settings such as these. First, the number, scale and complexity of the services on offer are large. Second, most of these services are inter-dependent (both in terms of design and execution). For instance, the design of the passenger check-in service is determined in critical ways by the design of the passenger security screening service (should visas be checked at check-in or at the security screening stage?). Third, changes to any one of these services are likely to impact several other services. Fourth, there are multiple alternative ways in which changes might be implemented. For instance, a change to aviation authority regulations requiring that all passengers must be checked against a national “watch-list” could be implemented by requiring airlines to perform this check, or by having this check performed by the customs service at emigration checkpoints. Fifth, some of these services exist to realise component functionalities of other services. For instance, a small airport supporting short-hop flights might offer a catering service only because some of the airlines using the airport would like to offer a lounge service to their premium passengers. Sixth, there are multiple design alternatives for determining a service landscape that realizes the required functionalities (some of the preceding examples have illustrated this on a smaller scale). Finally, these collections of services must operate under complex constraints imposed by the domain (including compliance constraints).

There are no easy ways of dealing with the design, maintenance and full life-cycle management of such complex collections of services. In this chapter, we argue that a formal service eco-systems view can provide a particularly useful solution to the problem. Our intention is to leverage the eco-systems metaphor by using mathematical characterisations of such eco-systems – in particular of equilibria. In our conception of service eco-systems, service designs will play a role analogous to that of biological entities in a biological eco-system. As in biological eco-systems, service designs are created (or discovered, using automated toolkits (Ghose et al., 2007)), modified during their lifetimes, and eventually discarded. Like biological eco-systems, service designs undergo constant change, driven by changing requirements or changes in the operating context. Like biological eco-systems, perturbations in a service eco-system propagate across its constituent services, driven by the need to maintain a range of critical inter-service relationships. These include:

- **Functional dependencies**: These exist between a pair of services when one of the services depends on the other for realizing some of its functionality. We may interchangeably describe these as realization links. In many settings, these links provide the existential rationale for a service, i.e., the reason why a service exists (these are critical in any account of servitization).

- **Consistency links**: In many cases, service designs might be related via consistency constraints. These are distinct from realization links in the sense that the services might not depend on each other for realizing their functionality, but might have intersecting functional signatures (the set of objects/artefacts impacted by the service).
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