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Issues in the study of organisational resilience in cloud computing environments

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Abstract

Cloud computing is a promising ICT service delivery model that has already had a significant impact on government agencies, SMEs and large organisations. Even though its current adoption is moving away from the early stage to the mainstream, many organisations are still concern about the additional levels of abstraction that cloud environments introduce. Particularly, this additional complexity represents a hurdle in the assessment of ICT readiness for organisational resilience, and no consensus exists yet for its analysis. Based on a literature review of cloud computing reference architectures, and organisational resilience and business continuity frameworks, this paper suggests a framework to guide research into this field from an operational perspective.

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Keywords: ICT services resilience; cloud computing environments; research framework; organisational resilience

1. Introduction

Cloud computing (CC) is a new way of delivering computing resources. For some, it is the most important development in recent times in the field of ICT, while for others, it is only another step towards utility computing. It promises numerous benefits and organisations are increasingly turning to these services. IDC forecasts that by 2016, US $1 of every US $5 spent on computing will be spent on CC[1]. However, cloud environments (CCE) have also

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raised various concerns and an increasing number of researchers are developing knowledge about CCE from technical to business issues[2]. In the former, issues regarding portability, interoperability and security have been studied [3, 4]. In the latter, researchers have been working specifically on economic impact, costs, reasons for adoption and growth trends[5]. A topic that incorporates issues from both perspectives, known as availability in CCE, has been identified as one of the main obstacles to and opportunities for the growth of CC[6, 7]. Therefore, CC failures and their effects in organisational resilience (OR) need to be understood.

This necessity is also the result of the considerable attention that the OR concept has gained in the last few years[8] and, consequently, the increased demand for organisations to exhibit high reliability in the face of adversity. These two factors have heightened the need to strengthen the ability of organisations to respond to disruptive incidents when working in CCE. Specifically, Herrera and Janczewski[9] discuss previous studies of OR in the ICT context and conclude that many avenues are open for research in ICT operational resilience in CCE. Based on this, this paper presents a research framework which addresses key issues when studying OR in CCE. The framework is constructed from a literature review of CC characteristics derived from well-known reference architectures, and a compilation of OR specifications also derived from the most popular OR / Business Continuity (BC) standards and models.

This paper is in five sections, including this introduction. Section two begins by presenting a brief overview of CC, and then describes how the baseline architecture and its characteristics have been defined. In the third section, a set of resilience specifications for discussing OR key issues in these environments is presented while the fourth section describes the proposed research framework. Each of these middle three sections also discusses relevant methods and design decisions. Finally, section five summarises the contributions.

2. CC baseline architecture

The baseline architecture serves as a reference point to study how existing OR specifications are affected by the CC adoption from an operational ICT perspective.

2.1. Overview of CC

The most popular definition of CC is the National Institute of Standards and Technology (NIST) definition: "model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction"[10]. Particularly, architectures that are part of this study have adopted it to some extent and there is a strong agreement about its three fundamental components: characteristics, service delivery models and service deployment models. (1) The five essential characteristics are: on-demand self-service, broad network access, resource pooling, rapid elasticity, and measured service; (2) a taxonomy of three service delivery models: infrastructure as a service (IaaS), platform as a service (PaaS) and software as a service (SaaS) and (3) four deployment models describing how these services can be shared: private cloud, community cloud, public cloud, and hybrid cloud. Regarding the last two components, some architectures have identified a fourth type of model that goes beyond SaaS, known as business process as a service (BPaaS) and the majority of them disregard the community model. As this research has adopted the NIST definition, it maintains the 5x3x4 original scheme.

2.2. Baseline reference architecture – Methodology

A literature review approach was adopted and an online search was conducted in four online databases: ACM Digital Library, IEEE Xplore, ProQuest (ABI/INFORM), and ScienceDirect (Elsevier), resulting in the identification of eight architectures. These architectures can be grouped into two types according to their main focus: Role-based and Layer-based, as show in Table 1. The first step was to review the full text of each architecture. The DMTF was discarded because of its exclusive focus on the IaaS model. In the next step, architectures were compared by group. This task was relatively simple for the role-based group because there are many shared concepts and elements. On the other hand, the consolidation of characteristics into a meaningful set for the layer-based group was more demanding given the wider range of approaches. After this step, architectures (1), (2), (5) and (8) were chosen as the most relevant and from these the baseline architecture, the main outcome of this process, was compiled.