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Published in London, United Kingdom







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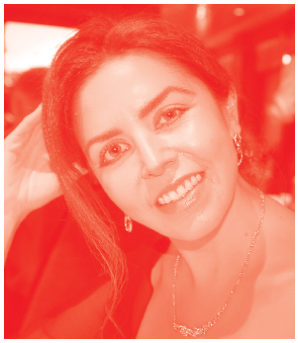

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http://dx.doi.org/10.5772/intechopen.91101
Edited by Kyeong Kang

Contributors
Taiseera Hazeem Hazeem AlBalushi, Shirumisha C. Kwayu, Zuhara Chavez, Jannicke Baalsrud Hauge, Monica Bellgran, Alvis Sokolovs, Darrell Mann, Aghaegbuna Obinna U. Obinna U. Ozumba, Chineme Ozumba, Eduard Babulak, Wagdy Anis Aziz, David Al-Dabass, Ani Matei, Dincă Dragoș Valentin, Kyeong Kang, Fatuma Namisango, Aliaksei Kuzmich Dadykin, Józef Bohdan Bohdan Lewoc, Mieczyslaw Rozent, Erich Leitgeb, Eduard Babulak, Swieta Cukier

First published in London, United Kingdom, 2021 by IntechOpen
IntechOpen is the global imprint of INTECHOPEN LIMITED, registered in England and Wales, registration number: 11086078, 5 Princes Gate Court, London, SW7 2QJ, United Kingdom
Printed in Croatia

British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library

Additional hard and PDF copies can be obtained from orders@intechopen.com

Digital Service Platforms
Edited by Kyeong Kang
p. cm.
Print ISBN 978-1-83969-101-0
Online ISBN 978-1-83969-102-7
eBook (PDF) ISBN 978-1-83969-103-4

Meet the editor

Dr. Kyeong Kang is an academic in Australia. She received a Ph.D. in Computing Sciences, and her research focuses on e-commerce, e-service, digital service platforms, and human–technology innovation in diverse cultures. As a leading researcher, she completed projects for the Australian Information Industry Association (AIIS) and the Department of Foreign Affairs and Trade (DFAT). She is currently conducting a project for the Asian Productivity Organization (APO). Her research contributions are well-known internationally. As a visiting scholar at the Georgia Institute of Technology, Dr. Kang engaged in the ICT international development project. Additionally, she is an editor of the book *E-commerce*.

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Preface

Digital service platforms for electronic services (e-services) are a critical part of supporting the global information society and systems. E-service is defined as "performing service electronically." E-service incorporates communication, sharing, transferring, and generating of ideas and values on a digital platform. Digital service platform may be changing the traditional social or business platforms and represent an utterly convertible service. Challenging issues in digital service platform providers and users are accumulative engagement and collaboration on digital platforms. Individuals with different social circumstances and experiences are affected by the quality of e-service.

The book "Digital Service Platforms" addresses e-service implementation and applied issues in three areas: e-service and social media, e-service concepts, and e-service quality and development. Ten chapters offer valuable ideas and information in e-service that will stimulate the improvement of information society and systems.

Digital Service Platforms and Social Media

Chapter 1 presents three stages of organization–community relationships: emergence, growth, and collapse. It analyzes these stages based on existing empirical observations and theoretical perspectives. The chapter also reveals four levels of ecologically based factors that influence different stages of organization–community relationships on co-creative social networking platforms. The chapter indicates the potentially strong and weaker influences on organizational relationships.

Chapter 2 is an investigation of systematic e-service innovation and delivers ideas on what to listen to and how to understand what customers want. The chapter also explores service challenges, compromises, and trade-offs conventionally viewed as inherent to service operations, strategy, and business evolution trends.

Chapter 3 presents a study about the social media ecosystem, which is crucial for enacting a small business strategy, and how changes within the ecosystem influence the whole design. This chapter highlights the significance and the need for developing countries to synchronize their soft infrastructure to help small businesses exploit the benefits of globalization during this era of social media.

E-service Concepts

Chapter 4 presents a management system concept for forming adult language skills, using English as an example. It explores how to create a new technology for applying the most effective methods of developing speech skills of foreign language proficiency in adults. The investigation demonstrates a proposed training management system. The system assesses the level of competence of the learner, leads to the formation of the logarithmic learning curve, and compensates for the prerequisites of the degradation of a learning curve in the direction of loss of expected competence.

Chapter 5 discusses accessibility experience design (AxD). It proposes the accessibility experience design for e-business services as a bi-directional accessibility perspective for e-business growth in market share. It is based on the needs for social justice, inclusion,

and access, on one hand, and business profit, on the other hand. The chapter explores the current drivers of accessibility practices, adoption by e-business services, and their market implications via demographic analysis of the existing population. The information in this chapter assists relevant people in advocating and making proper proposals for investment inaccessibility. The chapter provides a basis to motivate the adoption of bi-directional accessibility for e-business services.

Chapter 6 proposes a conceptual model that connects to Industry 4.0 for deploying e-service in small and medium enterprises (SMEs) through capability building. The proposed model is based on gradually developing industrial capabilities that can influence the performance of production processes. It advocates for a complete digital transformation by following a gradual approach to resource efficiency and integrating business needs.

E-service Quality and Development

Chapter 7 presents a comparative study on public electronic employment services in Austria, Spain, Estonia, and Romania. This chapter analyzes public employment services in four European countries to identify the extent to which they have adapted to the global pandemic situation. Measures to protect jobs and support workers in identifying new jobs are a permanent concern for most countries. The emphasis is on the workers' protection in digitalization and e-service implementation.

Chapter 8 proposes network function virtualization over cloud–cloud computing as a business continuity solution. It discusses cloud computing as a business continuity solution and cloud service availability. It also examines the causes of service unavailability and related impacts. Further, this chapter covers various ways to achieve the required cloud service availability. It explores the importance of business continuity in a cloud environment and how business continuity enables achieving the required service availability. Finally, this chapter discusses various challenging issues of cloud infrastructure and data protection solutions.

Chapter 9 presents issues of e-service quality factors. It provides recommendations for different players' roles in e-services, along with definitions, components, and characteristics through studies of examination about the perspective of providers and users of government e-services. The chapter proposes eight quality dimensions for government e-service.

The last chapter presents book reviews of ICT project aspect case studies. The chapter explores different ICT development aspects and discovers important e-service issues. It has written for supporting International Federation of Automatic Control (IFAC), Technical Committee 9.5, Working Group WG 03.

Very few e-service books address concepts and practical recommendations through case studies, which is significant as a considerable portion of e-service needs to be between businesses and users. This book "Digital Service Platforms" is a comparatively rational approach with strategic support for e-service professionals and academic researchers.

Kyeong Kang
Faculty of Engineering and IT,
University of Technology Sydney,
Sydney, Australia

Section 1

Digital Service Platforms and Social Media

Chapter 1

Building Organisation-Community Relationships in Co-Creative Social Networking Platforms: An Ecological Systems Perspective

Kyeong Kang and Fatuma Namisango

Abstract

Nonprofit organisations use social networking platforms to interact, engage, and build productive relationships with target audiences for co-created outcomes. This chapter pursues two interrelated objectives: First, it identifies key stages in the growth of organisation-community relationships on co-creative social networking platforms. Second, it discusses the multi-levelled factors influencing these relationships at the respective stages. To achieve these objectives, we make a general review of scholarship on nonprofit use of social media, social networking platforms for co-creation, and organisation-public relationships on social media. We used the ecological systems perspective to identify the internal and external environmental influences on organisational relationships in social networking platforms. This chapter presents three abstract stages of organisation-community relationships: emergence, growth, and collapse, based on existing empirical observations and theoretical perspectives. We reveal four levels of ecological-based factors that influence different stages of organisation-community relationships on co-creative social networking platforms. We indicate the potentially strong and weaker influences on organisational relationships.

Keywords: Social Media, Organisation-Community Relationship, Co-creation, Services, Social Networking platform, Nonprofit Organisations, Ecological systems

1. Introduction

Nonprofit organisations (NPOs) co-create services and social value through public participation in resource integrating activities such as donations, advocacy, social support, and recognition. The need for public participation has prompted the adoption of social networking platforms (SNPs) to allow supporters, donors, and volunteers, who act as "free agents", to work jointly with organisations [1]. SNPs, often called social media, "employ mobile and web-based technologies to create highly interactive platforms via which individuals and communities share, co-create, discuss and modify user-generated content" ([2], p. 241). The power of SNPs for organisations remains in the opportunities for public participation,

involvement, and engagement in organisational activities. For NPOs, Twitter enables strategic engagement of stakeholders through dialogic and community-building practices better than company websites [3]. Broadly, SNPs are recognised for organisational visibility, information sharing, community, relationship building, and taking action [3, 4]. Beyond such basic capabilities, SNPs are increasing getting recognised for their interactive resources that enable collaboration [5], co-creation [6], and innovation [7].

The many opportunities afforded by SNPs are not just an end in themselves but mechanisms for the co-creation of nonprofit services [8]. Co-creation involves interactions between the community and organisations in creative activities [9]. SNPs have become instrumental in public *participation*, *involvement*, and *engagement* in nonprofit services [10]; moreover, the three activities are critical pillars of service co-creation [11]. Similarly, collaborative networked organisations and communities enable co-innovation and value co-creation [9]; but such outcomes are driven by the platform capabilities and the relationships between actors [12, 13]. Collaborative networked organisations often seek to build productive and sustainable relationships with a target community, and such relationships are here coined as organisation-community relationships (OCRs). OCRs are seemingly productive at the start, especially when NPOs pursue advocacy-based goals [14]; but, the relationships slowly collapse and become unproductive in due course [10, 15]. This trend can be attributed to the limited use of SNP interactive capabilities, which reduces the organisation's network activity [16, 17]. Particularly, the use of SNPs as co-creative platforms calls for a thorough understanding of the properties, structure, or types of OCR [13].

Most NPOs have a social media page, but such presence does not in itself advance OCR, create awareness of the organisation's activities, or trigger an influx of community participation [18]. Similarly, information sharing is a common practice but does not directly facilitate community engagement [17] and service co-creative activities [8]. Conversely, research, planning, and focused implementation of SNPs could pave the way for productive OCR [18]. NPOs could succeed in SNP implementation if two considerations are met [19], i.e., understand how to build online relationships and establish an ongoing positive and valuable bond with their audience. Increasing online network activity (involvement) is the first step to generating significant returns for NPOs and building long-term support from their community (ibid). Undeniably, "cultivating supporter relationships" is crucial and is the next best step to enabling collaboration and building affinity in stakeholder communities [20]. However, the dynamics of surrounding these relationships are often lost in translation, for instance the nature of such relationships, influencing factors, and associated outcomes. Responding studies, e.g., [21–25] have articulated relationship types and characteristics but the factors for productive OCR are yet to be explained. Responding to the issues and research gap mentioned above, this chapter seeks to address the question that what factors influence the organisation-community relationships in CoSNPs and how can such factors be classified?

This chapter discusses the co-creative potential of SNPs coined as co-creative social networking platforms (CoSNPs), the cultivation of OCR on these platforms, and the influencing factors. We discuss the potential of such platforms to drive productive OCR in the co-creation of nonprofit services and draw on the ecological systems perspective [26] to identify the influencing factors. The ecological systems perspective draws our attention to how organisations operate with their environment, internal and external [27]. Based on this perspective, the chapter illustrates multi-level influences shaping OCR in CoSNPs. The rest of the chapter is divided into six sections. In Section 2, we provide related work on the characteristics of CoSNPs and OCR and articulate the emergence, growth, and collapse of OCR in

CoSNPs. Section 3 introduces the ecological systems perspective into the organisational context to classify multi-level influences of OCR in CoSNPs. In Section 4, we deduce four theoretical propositions and present a model of multi-level ecological influences of OCR in CoSNPs. In Section 5, we discuss our observations and provide implications for practice. Lastly, in Section 6, we conclude our discussion and provide some directions for future research.

2. Related work

In this section, we review SNPs, co-creation, and organisation-public relationship literature to; (1) explain the potential characteristics of CoSNPs, not just SNPs, and (2) the key stages that ought to be recognised in building OCR in SNPs. With such insights in hand, we can then trace the shapers of OCR in CoSNPs.

2.1 Characteristics of co-creative social networking platforms

Social Networking Platforms are also known as social networking sites, social networking services, social networking systems, or simply social media. These platforms represent "websites that encourage social interaction through profile-based user accounts" ([28], p. 439). SNPs allow users to create social presence, navigate relational connections, and co-create [2, 29, 30]. With technological advances, the "boundedness of [SNPs] is diminishing as these sites extend their functionalities beyond the confines of a website" ([29], p. 278). Recently, SNPs have translated into collaborative co-innovation platforms [31] and service co-creation systems [32, 33] that enable open innovation. CoSNPs in service contexts are also coined as service co-creative systems and known to support cooperative, coordinative, and collaborative activities [32]. While SNPs possibilities for open innovation and social product development are anticipated, the structure of these platforms for different organisational processes must be understood.

Today, customer-centric or community-centric approaches are believed to be more successful than organisation-centric approaches. The practice of co-creation has become popular due to its customer-centric approach. However, we must understand the enabling technology (SNP) structures to leverage the hidden potential of these platforms. Frow, Payne, and Storbacka ([34], p. 1) have defined co-creation as "a*n interactive process, involving at least two willing resource integrating actors, which are engaged in a specific form(s) of mutually beneficial collaboration, resulting in value creation for those actors".* From this definition, one can infer that interaction, engagement, collaboration, resource integration, and mutual benefit are the key aspects sought. Therefore, for organisations to co-create with customers, they should adopt or build not just SNPs but CoSNPs that drive the aspects mentioned above.

CoSNPs provide far-reaching capabilities that present a promising paradigm on co-creation networks, platforms, and systems [9]. Their potential has attracted interest in SNP-enabled collaboration, co-creation, and innovation, and the enabling capabilities or characteristics for such outcomes are notable. For "networked nonprofits", SNPs offer conversation starters, collaboration capabilities, and network builders [1]. For collaboration and co-creation, opportunities for information sharing, socialisation, and visibility are crucial [8]. Otherwise, in general, co-innovation platforms provide the opportunity for ideation, collaboration, and communication to develop social products [35]. The characteristics of CoSNPs that distinguish them from "regular" SNPs are discussed below, starting with foundational attributes towards interactive attributes.

2.1.1 Conversation drivers

The conversation features support content creation and two-way discussions between people and between the organisation and people; therefore, NPOs listen and engage in lots of conversation to build their networks and spread their activities through the community [1]. SNPs not only facilitate conversations but enable socialisation for knowledge sharing because they create a larger content space for users to express their opinion, experiences, and findings [36]. Socialising involves integrating into a community by learning the norms, values, and roles to enable an entity to function as a member of that community [37]. By socialising, organisations improve their communication with the community and pave the way for community-based problem-solving, which is a key tenet of co-creation [38]. Enabling organisations to connect, be present, and create groups are key SNP capabilities that facilitate socialisation for co-creation [37].

2.1.2 Network builders

Network builders are functionalities that allow users to establish relational connections, communicate and share content. Such tools are common on public social media such as Facebook and Twitter. Networking opportunities are vital in co-creation because they transition organisations towards a customer-centric and network-centric approach [32]. Networks allow multiple actors to form alliances and mobilise resources through various channels to achieve the desired goals [39]. Resource mobilisation is central to service co-creation activities [11, 40]. Networks provide a rich ground for cultivating interest in a group of people, informal knowledge practices and locating expertise [41, 42]. In SNPs, engaging in informal knowledge sharing practices is a critical component of co-creation [43].

2.1.3 Ideation forum

Ideation is a central component of collaborative and innovative platforms because such platforms allow actors to submit, evaluate, and refine new ideas [35]. Ideation in collaborative communities results in the co-creation of new product ideas [35] and has been noted as a key component in the co-creation of nonprofit services on public social media [30]. In the public sector, online citizen communities play the role of ideators in co-creating public services by defining problems and conceptualising solutions [44].

2.1.4 Collaborative energy

Collaboration involves encouraging contribution from a community such as thoughts, questions, suggestions, ideas and opinion; receiving feedback through commenting, rating, reviewing, and liking; building collective judgement and assessment of community contributions and feedback; and creating change [41]. SNPs that foster collaborative activities provide functionalities participation, collectiveness, transparency, independence in points of view, the persistence of contributions, and the emergence of community-driven results [41]. In NPOs, the collaborative functionalities of SNPs facilitate volunteer enrolment, group coordination, and a sustained virtual community [39]. Increasingly, such collaborative power and creativity of SNP-enabled communities are associated with the formation of OCR for co-creative activities [13], several forms of nonprofit service co-creation [30] and the development of social products in innovation processes [35].

While the above characteristics are vital for CoSNPs, the power of SNPs lies not only in the technology wizardry (i.e., functionalities) but in the ability to connect people and build strong, resilient, and trusting relationships [1]. Thus, we must understand how organisations can build productive relationships for co-creation using SNPs, and this is our focus in the next section.

2.2 Social networking platforms and organisation-community relationships

SNPs are about the technology, and the relationships between users (or social networks), as recent studies [12, 45, 46] have confirmed. Such studies emphasise that organisations use SNPs to build organisation-public relationships (OPR) though the evolution of such relationships remains unexplained. Public relations literature is dominant in this area, and the determinants, types and properties, and consequences of OPR are emphasised. In this section, we define OPR (or OCR) and utilise the community-cultivation cycle mentioned by Bradley and McDonald [41] to explain the crucial stages that must be assessed in building OCR.

2.2.1 Defining organisation-public relationship

OPRs are "the patterns of interaction, transaction, exchange, and linkage between an organisation and its publics" ([47], p. 18). From a managerial perspective, OPR refers to "the development, maintenance, growth, and nurturing of mutually beneficial relationships between the organisation and its significant public" ([48], p. 14). While OPR has been used in relation to organisation-public wide interaction and relationships, we use OCR to indicate organisational relationships with specific or targeted groups or communities. Building OCR may vary depending on the platform of engagement and purpose – i.e., offline versa online platforms. One should not naturally assume circumstances under which offline or formal interactions thrive when organising online and informal interactions such as those we see on SNPs. Building OCR using online platforms requires openness, information sharing, interactivity, and involvement [49], while leadership, networking, legitimacy, and positivity are required in offline settings [50]. Moreover, openness (transparency), information, and interactivity are vital for collaborative activities on SNPs [41], while interactivity and involvement are core standards for co-creation [11].

2.2.2 The community-cultivation cycle

The Community-cultivation cycle [41] presents three crucial steps in online collaborative activities between organisations and target communities. These stages involve launching, guiding, and refining. Firstly, organisations will have to *launch* community engagement towards a defined purpose, *guide* the community towards creating value for members and the organisation and *refine* the community purpose to direct ongoing interaction and lasting relationships. This cycle is useful for SNPs that support the following collaborative and social principles [41].

1. Enable participation.

2. Promote collective effort.

3. Allow independent contributions.

4. Ensure transparency.

5. Enable persistence of other's contributions to be viewed, shared, and judged.

6. Allow the emergence of behaviour, new ways, and solutions to intractable problems.

Previously, in paragraph 2.1.4, we mentioned the collaborative power of CoSNPs, and it is such power that drives the six principles mentioned here. Conversational starters will attract and steer participation. Ideation forum will promote the independent, transparent, and voluntary contribution of ideas, while network builders will facilitate the persistence of ideas and discussions across the entire community. Also, network builders are vital for reaching out and fostering collective effort towards defined outcomes.

3. An ecological systems perspective in building OCR on CoSNPs

The ecological systems perspective is adopted from Bronfenbrenner [26]'s bio-ecological theory of human development. The theory is applied to study human behaviour – e.g., C.-H. Lee [51]; but we find this theory useful to understanding the environmental constituents in the development and functioning of organisations. The approach bridges the technological, organisational, and environmental aspects surrounding organisation-public interaction and relationships. The general premise of Bronfenbrenner's theory is that there are different layers of human environmental that influence a person's wellness and development. In a nutshell,

> *The ecological perspective builds our "understanding of social processes like, social learning and social memory, mental models and knowledge–system integration, visioning and scenario building, leadership, agents and actor groups, social networks, institutional and organizational inertia and change, adaptive capacity, transformability and systems of adaptive governance that allow for management of essential ecosystem services" ([52], p. 263).*

The ecological system contains five systems, including the individual, microsystem, mesosystem, exosystem, and macrosystem in that order. The individual is at the centre of these systems, and their behaviour is influenced by their traits and the ecological environment in which they interact (C.-H. [51]). The ecological systems perspective or ecological embeddedness is a social construct that can explain how individuals and organisations build and maintain relationships across their environment [53]. In OCR, for instance, there are three interacting actors – i.e., the organisation, the individuals, and the community. On social media, the NPO community is built by fans, followers, supporters, promoters, fundraisers, well-wishers, and other publics. Entities (i.e., individuals or organisations) are ecologically embedded within an ecosystem when they understand the interactive effects of the environment around them; and, are ecologically disembedded when they bear no knowledge of the interactive effects of their ecosystem [53]. An NPO's ecological system stops not at its SNPs community but extends to its governing bodies, volunteers, society and industry of operation, governments, and the world. In the organisational context, this perspective offers a unique opportunity for multi-level analysis of SNPs and organising with more emphasis on OCR and how organisations as entities are influenced by several institutional, social, and environmental forces.

Microsystem refers to "a pattern of activities, roles, and interpersonal relationships experienced by the children" (C.-H. [51], p. 1667). The microsystem represents influences from the organisation's structural elements such as employees,

business processes, and technologies. At this level, organisational characteristics such as size and the nature of services offered play a significant role in attracting social media engagement and relational outcomes [54]. Then the organisational leadership, such as executive directors, board members, and employees, determines the strategic focus, financial commitments, budget limitations, and those attached to SNPs use [55]. Besides organisational characteristics and leadership, microsystem influences will relate to organisational resources and capabilities. IT capabilities, networking competencies, adaptiveness, and absorptive capacity have been identified in enabling OCR [5, 13, 56]. Recent studies [30, 40] have emphasised that organisations should consider capabilities with generative properties when interacting with SNPs. Nonetheless, organisational culture and strategy are considered shapers of social media use [41].

Mesosystem refers to "interconnections among two or more microsystems, and the [organization] actively participate in this setting", such as relationships between individuals, community, and other organisations (C.-H. [51], p. 1667). Influences at this level emerge from the interaction between organisations and online communities and will range from cognitive, affective to conative aspects such as perceptions, emotions, and behaviour. During such interaction, NPOs face pressures for assurance of social legitimacy from supporting bodies such as boards, committees, or society [57]. Other mesosystem influences will be defined by the needs and expectations of such stakeholders [58]. On the platform side, the social media conversation, i.e., content, topics, comments, discussions, criticism, and demands from stakeholders, influence network structures [59]. And on the relational side, relationship quality, including relational commitment, trust, satisfaction, and control mutuality [21, 50, 60] and perceptions of mutual benefit are fundamental [21]. Also, organisations engage in different types of OCR such as communal, exchange, covenantal, exploitive, and symbiotic relationships [22], which could be associated with different determinants and outcomes. SNPs, in particular, enable strong, cohesive and symmetrical interaction, which drive communal, symbiotic, and exchange relationships [45].

Exosystem refers to "the social setting in which [organisations] can be influenced, but they do not necessarily actively participate" (C.-H. [51], p. 1667). The exosystem represents the layer of a broader system in which CoSNPs based OCR do not exist directly, such as the industry or sector of operation and the regulatory authorities or institutions involved. The type of industry, size of partnering organisations, duration and type of industry alliances indirectly influence relational outcomes through the operating structure and functioning of the organisation [60]. Also, the degree of market orientation, such as attainment of competitiveness on social needs or services, may play a central role [61]. Market orientation also shapes NPO outcomes and fulfils the mission and social value [61]. Vázquez et al. [61] found that NPOs must specify their target community, develop activities deep-rooted in societal needs, and nurture relationships with donors and service consumers. Social structures inherently influence behaviour and resource flow in a relationship [62]. From a technological perspective, social media diffusion within a sector can build institutional pressures which influence how organisations use social media and the overall impact [63].

Macrosystem refers to "consistencies found at the level of the culture, which includes belief system, norms, or ideology" (C.-H. [51], p. 1667). The macrosystem represents the largest and wider layer of the organisation's environment, which comprises socio-cultural systems, trends in technology adoption, legal and political systems, and socio-economic forces. The underlying mechanisms for cultivating OCR in CoSNPs will exceed organisational factors or resource commitments to several policy issues in the greater SNP landscape [64]. For instance, competition

intensity shapes technology use and adoption decisions among NPOs [57]. Sometimes, it's the political and socio-economic factors such as loci and population demographics [65]. From the perspective of the organisation-environment relationship, environmental capacity, environmental dynamism, and environmental complexity tend to influence organisational structures [66], such as the organisation's technology use capabilities and functional performance [67]. Environmental capacity, dynamism, and complexity are defined and explained further in Section 4.2.

4. Theoretical propositions on OCR in CoSNPs

To understand the phenomena of OCR in CoSNPs, we must understand; (1) the stages through which OCRs develop and (2) classify the factors that influence these relationships. With these two aspects, organisations can better build and utilise OCR for co-created outcomes. The theoretical propositions developed are based on the theoretical perspectives of the ecological systems and empirical evidence on SNPs and organisation-public relationships.

4.1 The three key stages in building OCR: emergence, growth, and collapse

Previously, in paragraph 2.2.2, we identified three important stages in community cultivation, which we now draw on to define three stages of OCR. When launching community engagement, organisations initiate and attract involvement and participation from the community, which indicates the *emergence* of OCR. Progressively, the community may grow and serve a purpose for community members and the organisation. The organisation will guide its community through purpose and structured content towards individual contributions for co-created outcomes, and we anticipate that OCR function productively to achieve those outcomes. Such productive functioning relationships indicate the *growth* of OCR. However, growing a community does not sustain it over time. Thus, organisations will need a purpose roadmap to redefine their relations with the community [41], or the relationship may *collapse*. A "purpose is a specific and meaningful reason for collaboration that will motivate members of a community to interact and contribute" ([41], p. 80). OCR should be redefined in purpose, or they will fizzle. Nonetheless, SNP-enabled collaborative activities (such as co-creation) will not produce anything of value without a clear purpose, positive value perceptions of SNPs, organisational culture, systems, processes, and policies for relations and community functioning [41].

Looking at the four basic features that drive interaction and relations on SNPs – likes, shares, comments and posts [10], posting content, inviting and accepting follower requests, receiving and offering feedback facilitates the emergence of OCR. Such relationships grow with increasing likes, comments, and replies, steering two-way communication and community feedback. Relationships may also grow as followers respond to event notifications and requests for collective action. However, they may collapse, die, disappear, become unproductive, or be refined in purpose into renewed relationships. NPOs are often faced with collapsing or unproductive relationships when they use SNPs [10, 15], but rebuilding those relationships remains a huge challenge that is worthy of consideration [68]. Learning from the community-cultivation cycle and the basic modes of interaction on SNPs, **Figure 1** below illustrated the core stages that one should expect when building OCR on CoSNPs.

Figure 1 adds to existing studies on OCR on SNPs, such as Namisango and Kang [45], Qin and Men [46], and Sisson [25], by articulating three stages of relationship building that could guide relationship planning and strategy. Additionally, this

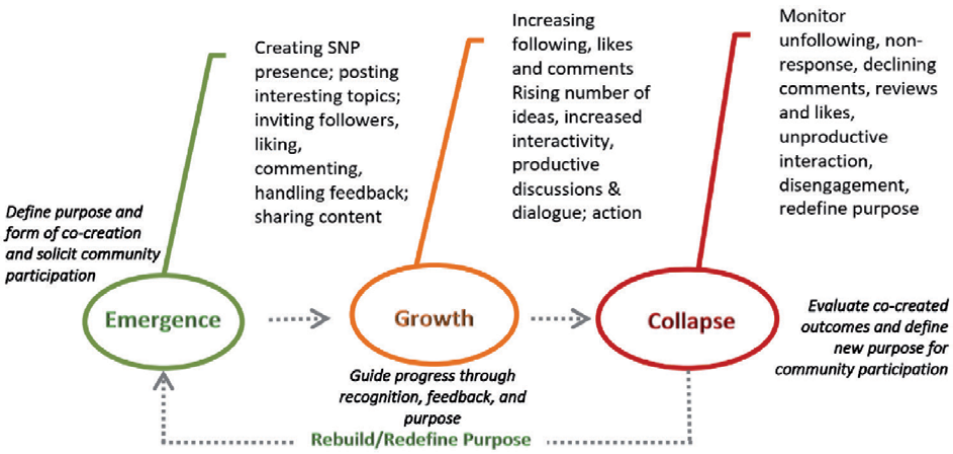

Figure 1.
Three stages in building OCR on CoSNPs.

chapter examines what influences the emergence, growth, and collapse of OCR on CoSNPs based on the organisation's ecological system. The ecological systems perspective allows us to classify and understand the multi-level influences of organisational relationships. Recognising the different levels involved allows the organisation to understand the priority areas and to respond to these influences efficiently and effectively.

4.2 Ecological system influences on OCR in CoSNPs

Using the ecological systems perspective, empirical studies on social media use in NPOs, and public relations literature, we develop propositions of the multi-level factors influencing the OCR on CoSNPs.

The microsystem is internal and includes organisational characteristics, resources, and capabilities. Organisational leadership drives decisions about SNPs, co-creation activities, and resources. Equitable resource allocation facilitates relationship management [23] and the organisation's resource width influences the formation of multiplex ties (S. [69]). Organisational dynamic capabilities, such as technology and relational capabilities, enable relationships for co-creation [30]. Other capabilities, such as the adaptive capability, allow the organisation to sense opportunities and reconfigure resources to respond to environmental dynamism [70]. Adaptiveness also improves the ability to utilise SNP opportunities for service co-creation [40].

Also, organisational culture plays a key role because it manifests in its social media governance, management support for SNPs, and recognising of SNPs as valuable rather than risky [70]. While the perception of benefit improves SNP outcomes, perception of security risks inhibits anticipated outcomes [71]. The social media policies and strategy balance the privacy concerns against high interactivity, and the latter is known to facilitate social media use and success [63]. Privacy concerns are common risks associated with SNPs, and these prompt users to control their interactions with others. Privacy concerns present a social issue and therefore shape online interactions [72] and could undermine relationship growth and result in relationship failure [13]. The challenge for organisations is to find ways to preserve privacy while promoting productive and long-lasting OCR. The non-profit sector has a complex stakeholder portfolio (i.e. multiple publics or audiences) that includes donors, volunteers, consumer communities of nonprofit services

[58, 73] and often organisations are expected to meet the service expectations for all stakeholders [61].

> **Proposition 1:** *Microsystem relates to the organisation's internal influences ranging from its characteristics to capabilities. These will include organisational characteristics, leadership, culture, social media strategy, dynamic capabilities, absorptive capacity, and adaptiveness to technological and dynamic environments. Organisational characteristics and leadership will facilitate the emergence of OCR, while its culture, resources and capabilities will facilitate the growth or collapse of its relationships.*

At the mesosystem, influential factors are mainly relational and shared between the online community and the organisation. This implies that such influences could be community-driven or organisation-oriented but are based on either entity's evaluation of the interaction or relationship. These influences will include a sense of control mutuality, relationship trust, relational commitment, satisfaction, and perceived benefit. Control mutuality is the degree to which actors can influence relational goals and routines [74]. A sense of control mutuality is critical for relational stability [74] and improves the organisation's ability to achieve the intended benefits in social media relationships [25]. Additionally, trust or distrust, relational satisfaction and relational commitment drive OCR [24]. Relational commitment is the extent to which parties involved in a relationship believe it is worth spending time and energy to maintain the relationship [75]. On the other hand, relational satisfaction is the extent to which the parties feel that their expectations are met [75].

Nonetheless, ideal relationships and patterns of interaction are essential for co-creation in SNPs [13]. Relationship types that offer win-win situation – such as communal, covenantal, and exchange, could build trust and relational satisfaction, thus promote the growth of OCR. From a technological perspective, privacy concerns often influence online interaction and relationships [13, 72] and ultimately affect social capital needs [76]. Also, social media conversation is key. When organisations tweet topics of interest to audiences and replies to followers, they tend to attract interconnected, decentralised and reciprocal networks [59]. Also, related to trust issues and the uncertainties of the online setting, people will want to interact and collaborate with organisations they consider socially legitimate [77].

> **Proposition 2:** *Mesosystem influences relate to organisation-public interaction on Co-SNPs, and these are primarily relational factors shared between the organisation and its online community. Such influences will include patterns of interaction, types of relationships, relational commitment, benefits and satisfaction, trust, control mutuality, social media conversation, privacy concerns, and social legitimacy. Since mesosystem factors are interaction-oriented influences, they will affect the growth and collapse of OCR rather than the emergence of OCR; but social legitimacy will influence the emergence of OCR.*

Sectoral and industry drivers of exosystem influences and may often not directly affect OCR in CoSNPs. Community demands and expectations, community orientation, social capital, market dynamics, beliefs and regulations, and social media diffusion are important influencers at the sector level. Community orientation relates to the concept of market orientation in business firms [78, 79] and NPOs [61]. Community orientation reflects the degree to which an organisation generates intelligence and responsiveness on a specific community group's current and future needs and the forces that affect that group, e.g., women in entrepreneurship or youth employment program. Communities expect NPOs to be responsive to social

service needs; but, achieving value and meeting service expectations of multiple stakeholders are visibly challenging [73] but important in fostering stronger community relationships.

Alternatively, SNPs are recognised as an avenue for maintaining and solidifying existing offline relationships [80, 81]. SNPs, therefore, strengthen relational capital [82], structural [80, 81] and cognitive capital [83]. They also build a sense of connectedness, increase members knowledge of others, which facilitates reciprocity and trust and creates opportunities for collective action [84]. Norms of reciprocity and trust often result in productive relationships [50, 60].

> **Proposition 3:** *Exosystem influences relate to the sector or industry dynamics, which include community demands, community orientation, social capital, and industry or sectoral characteristics, beliefs and regulations, and social media diffusion with the sector. These will indirectly influence the emergence, growth, and collapse of OCR in CoSNPs through the mesosystem (P2) and microsystem (P1).*

Under the macrosystem, countrywide ICT laws and regulations, global advances in social media, socio-cultural systems, and environmental dimensions, i.e., capacity, complexity, dynamism, internet adoption, and political and socio-economic factors, are reported. The socio-cultural system is a set of large-scale beliefs, values, and norms as forces within society that support the formation of social structures. The socio-cultural system presents multiculturalism, diversity, individualism, or collectivism; moreover, multiculturalism and diversity influence social cohesion [85]. Cohesive relationships foster a sense of connectedness between individuals or groups, strengthening the social network [86]. In SNPs, cohesiveness fosters communal and symbiotic relationships [45], and such relationships could drive co-creation [13]. Moreover, national cultures will influence organisational culture and ultimately shape social media adoption and use [87].

Country-wide internet adoption promotes emerging technologies such as SNPs [88]. Emerging technologies create many social affordances that promote, threaten, or constrain relationships [89]. Internet evolution may decrease, transform, or supplement a community [89]. Similarly, studies [13] have noted several types of SNP affordances for OCR, but technologies not only afford but also constrain outcomes. Therefore, advances in SNPs may promote or constrain OCR in CoSNPs. Also, environmental capacity, complexity and dynamism, influence organisational structures; for instance, environment dynamism heightens uncertainty [66, 67]. Such environmental dimensions also affect the organisation's technology capability [67]. Environmental capacity is the extent to which the environment can support the flow of relational resources for the sustained growth of OCR. Environmental complexity, on the other hand, means the extent of heterogeneity and variation in relational activities enabling OCR. Environmental dynamism relates to the absence of patterns and the unpredictability of change. In other cases, country-level factors such as internet adoption, human development, and ICT laws and regulations facilitate the adoption and use of social networking systems [88, 90].

> **Proposition 4:** *Macrosystem influences relate to the countrywide or global environment. Such influences emanate from the socio-cultural system, environmental capacity, complexity and dynamism, political and socio-economic factors, ICT laws and regulations, internet adoption and advances in social media. They will indirectly influence OCR but directly influence the exosystem (P3), such as industry regulations, market dynamics, and social media diffusion. They are also likely to influence the microsystem (P1), particularly organisational culture, strategic focus, and dynamic capabilities.*

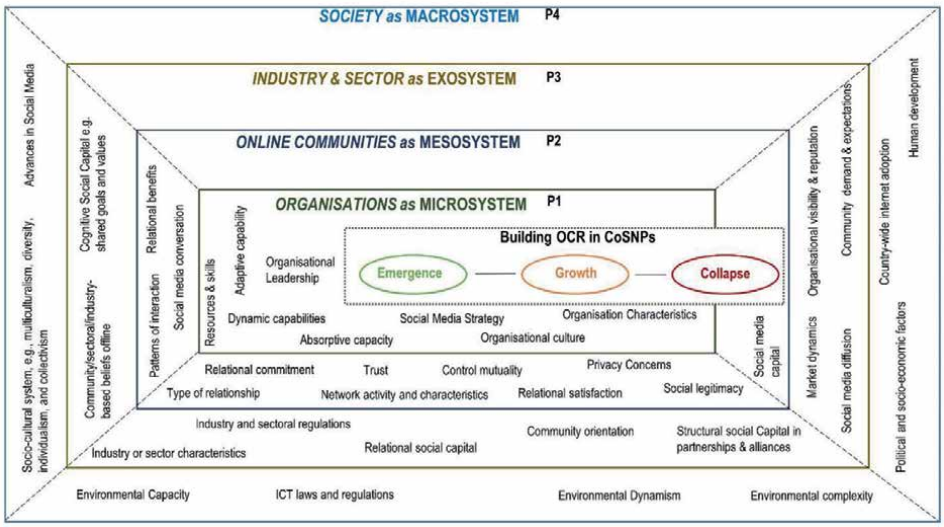

Figure 2.
An ecological system based model of factors influencing OCR in CoSNPs.

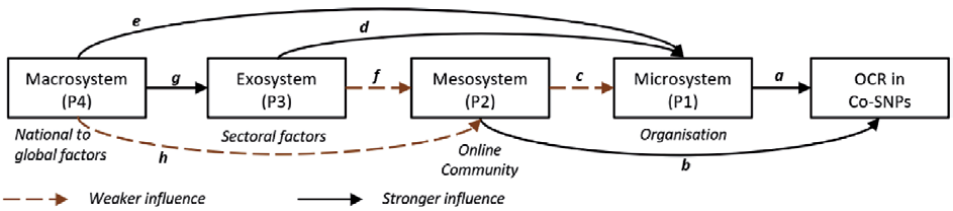

Figure 3.
Strength of influences between ecological systems surrounding OCR in Co-SNPs.

The propositions on multi-level influences of OCR in CoSNPs are visually summarised in the model below. The model provides a basis for examining and predicting OCR on CoSNPs.

The model in **Figure 2** presents the proposed scope of factors that influence the emergence, growth, and collapse of OCR in CoSNPs. For each of the four ecological systems, we derive a proposition that identifies the factors involved and the nature of influences anticipated, i.e., direct or indirect influences on other ecological systems and OCR. The microsystem and mesosystem will directly influence OCR (that is why the OCR dashed box appears in both system boxes in **Figure 2**). The exosystem and macrosystem will indirectly influence OCR through their influences on the meso and microsystems. Certain microsystem and mesosystem influences are more apparent at a given stage of the relationships. For instance, organisational characteristics and leadership (at microsystem level) and social legitimacy (at mesosystem level) would influence the emergence of OCR than their growth. In contrast, patterns of interaction (at the mesosystem level) would influence the growth and collapse of OCR. Such potential differences have been pointed out in the propositions provided above. We also considered how strong these influences could be when examined in a path model (see **Figure 3** below).

Based on the studies in **Table 1**, the effects observed varied in strength and between contexts. Using **Figure 3**, we summarise the potential strength of influences proposed in P1 to P4. Arguably, the micro and meso systems are directly involved in the cycle of OCR on Co-SNPs and will strongly influence these

Ecological system	Influencing Factors	Related sources
Microsystem	• *Organisation culture*, e.g., management values & goals, management approval and support, entrepreneurial orientation, innovativeness & creativity, aggressiveness, and people-orientation	Faber, Budding, and Gradus [65]; Schlagwein and Prasarnphanich [87]; Sharif, Troshani, and Davidson [71]; Siamagka, Christodoulides, Michaelidou, and Valvi [91]; Tajudeen, Jaafar, and Ainin [63]
	• *Organisation characteristics,* e.g., size, age, and type of organisation, and services offered	Adjei, Annor-Frempong, and Bosompem [92]; Beier and Früh [93]; Bhati and McDonnell [54]; Hu and Shi [94]
	• *Organisational resources and skills,* e.g., annual budget (and financial allocation to social media), social media competencies (skills and knowledge)	Bhati and McDonnell [54]; Faber et al. [65]; Hu and Shi [94]; Sihi [55]
	• *Strategic use of social media (social media strategy),* e.g., goals and objectives, content management, monitoring and control, social media analysis, and time commitments	Hu and Shi [94]; Shahin and Dai [59]; Swart [58]
	• *Organisational leadership and governance – i.e.,* directors, board members and committees' background, experience, age, education, and outlook on SNPs	Aspasia and Ourania [95]; Sihi [55]
	• *Organisational dynamic capabilities,* e.g., social technology capabilities, social networking competencies, absorptive capacity, adaptive capability	McLaughlin [56]; Schlagwein and Hu [5]; Namisango et al. [30]
Mesosystem	• *Relationship quality*, i.e., trust, perceptions of control mutuality, relational commitment, relational satisfaction, and perceived benefits, cost-effectiveness, relational value, or worthiness	Hon and Grunig [75]; Huang [96]; Jo et al. [48]; Sharif et al. [71]; Shen [24]; Siamagka et al. [91]; Sisson [25]; Swart [58]; Zhou and Ye [77]
	• *Network activity and characteristics* – network position, network size, and structure, audience engagement, the types of relationships and patterns of interaction	Bhati and McDonnell [54]; Kusumaningdyah and Tetsuo [12]; Shahin and Dai [59]
	• *Social media capital, legitimacy, and reputations*	Guo and Saxton [97]; Saxton and Guo [98]; Sisson [25]; Zhou and Ye [77]
	• *Social media conversation* – message content, topics discussed, comments, criticisms, communication style, and tone	Shahin and Dai [59]; Wukich and Khemka [99];
	• *Privacy issues,* i.e., uncertainties, concerns, preferences, and privacy behaviour • *Perceived Security risks*	Acquisti, Brandimarte, and Loewenstein [72]; Sharif et al. [71]
Exosystem	• *Community demands* in terms of social value and service expectations.	Botha [60]; Sharif et al. [71]
	• *Sector or industry forces,* e.g., community or market orientation, sector type, regulations, market dynamics, competition, and targeted audience	Beier and Früh [93]; Hu and Shi [94]; Sihi [55]
	• *Sector-wide social capital and organisational visibility, identity or publicity,* particularly structural capital such as industry-based alliances, network, and partnerships	Beier and Früh [93]; Botha [60]; Wukich and Khemka [99]
	• *Social media diffusion* and institutional and stakeholder pressures.	Larosiliere, Meske, and Carter [88]; Siamagka et al. [91]; Tajudeen et al. [63]

Ecological system	Influencing Factors	Related sources
Macrosystem	• *National level ICT laws and regulations* • *Advances in social media,* e.g., social media trendiness • *Country-level internet adoption,* e.g., digital divide issues	Alhassan, Adam, and Nangpiire [90]; Wukich and Khemka [99]
	• *Technological–to–service environmental considerations,* e.g., environmental capacity, dynamism, and complexity	Kumar and Bhatia [100]
	• *Socio-cultural systems,* e.g., multiculturalism and diversity, individualism, and collectivism	Schlagwein and Prasarnphanich [87]
	• *Political and socio-economic factors,* e.g., locations and population demographics such as age and education, national resources • *Level of human development*	Alhassan et al. [90]; Faber et al. [65]; Larosiliere et al. [88]; Wukich and Khemka [99]

Table 1.
Deducing ecological system-based influences for OCR in CoSNPs.

relationships (*a* and *b*). Online communities present a range of interaction influences that may strongly influence OCR. Still, such factors may not necessarily reshape the organisation and thus have weak influences on the microsystem (*c*). National (macrosystem), industry, and sectoral (exosystem) factors will strongly influence organisational structures, processes, and other value-creating activities because they provide the organisation's external operating environment (*d* and *e*). Sector-wide aspects may not strongly affect online communities except for community-oriented factors such as community demand and expectations, community orientation, and organisational visibility, reputation, or recognition in that sector. Therefore, the exosystem would have a weak influence on the mesosystem (*f*). National and global aspects shape the functioning of sectors. Hence, the macrosystem factors in this context will strongly influence the exosystem (*g*); however, the influence could be weaker on the mesosystem (*h*). The weak influence would be because only a few influences such as advances in social media, internet adoption, and socio-cultural systems could influence organisation-public interaction (mesosystem).

5. Discussion and implications of the study

While many studies have indicated the need for organisations to build OCR, they rarely explain how these relationships can be cultivated nor their influencing factors. This study proposes an OCR analysis, particularly in CoSNPs, driven by an ecological systems assessment. Such an assessment extends beyond the organisation, individual, and community who are the central actors in CoSNPs. The chapter delves into the factors that could influence OCR in CoSNPs, and such factors have been categorised based on four layers of the ecological system.

This chapter pursued two overall objectives. The first objective was to determine the stages of OCR cultivation in CoSNPs. We indicate that the cultivation of OCR in CoSNPs can be traced in three stages, similar to community cultivation. First is the emergence of OCR, which relates to connection and initiation of community relationship defined by purpose. Second is the growth of OCR fostered by

guiding the interaction and achieving the purpose of relationships. Lastly, OCRs will collapse after achieving their purpose when organisations do not redefine future activities.

The second objective was to develop a multi-level analysis of the factors influencing OCR in CoSNPs based on the four ecological systems, including the microsystem, mesosystem, exosystem, and macrosystem.

The microsystem forces are *organisational* and emerge from organisational structures, processes, and capabilities, while mesosystem forces are *interactional* and emerge from organisation-public interaction on the platforms. At the micro-level, organisations should focus on the organisation's nature, resources, capabilities, and leadership. At the same level, the organisational culture and strategic emphasis are vital. At the meso level, interactions, relationships, and networks are central points of reference, while social media conversations amidst concerns about privacy and social legitimacy influence organisational networks. Mesosystem influences may have a direct but moderate to weak influence on organisational structures, process and capabilities (microsystem). However, focusing solely on the microsystem and mesosystem forces overlooks broader environmental dynamics, which are vital in the functioning of communities and organisations [66].

The exosystem and macrosystem present broader environmental forces that indirectly influence OCR on CoSNPs through the meso and microsystems. The exosystem forces are *sectoral* or industry dynamics reflected in the nature of the industry and its operations in the offline environment. Such influences will relate to social capital resources at a sectoral level, such as the nature of partners and alliances in service delivery, community demand, orientation, and market dynamics, organisational representations, as well as technical considerations such as the diffusion of social media technology in that sector. On the other hand, the macrosystem forces are *national* or global, emerging from the greater operating environment. They constitute socio-cultural contexts, environment capacity, complexity, dynamism, countrywide internet adoption and global advances in social media, national ICT laws and regulations, and the political and socio-economic forces such as human development. Macrosystem factors naturally influence the exosystem causing sector-wide effects; but, they will indirectly influence the meso and microsystems. It is also possible that macrosystem factors (such as socio-cultural contexts, socio-economic factors, and advances in social media technology) will directly influence the organisation as a microsystem, particularly its culture, resources, and capabilities.

The first managerial implication is that CoSNPs offer several capabilities such as conversation, collaboration, networking, and ideation that allow NPOs to co-create services through co-ideating, co-promoting, co-evaluating, and co-delivery [30]. Such service co-creation activities are facilitated by the nature of OCR and the capabilities of SNPs. Still, the emergence, growth and collapse of OCR on SNPs are associated with several environmental forces. Recognising the role of the ecological system in different operations of the social sector promotes shared values and improved collective impact [101]. Collective impact "does not, of course, require that all participants do the same things. Instead, diverse stakeholders engage in mutually reinforcing activities" ([101], p. 8). Participants engage in voluntary and independent contributions to achieve collaborative outcomes [41].

Secondly, OCRs emerge, grow, and collapse. OCR will organically emerge when the organisation creates a social media presence, initiates interaction, and defines a co-creative focus. However, such relationships will grow by guiding the community through a defined co-creative activity and showing progress towards co-created outcomes. OCR will potentially collapse when the goal is achieved; hence, organisations must redefine the purpose of interaction (a new form of co-creation) for

the SNP community. Based on the patterns of interaction on the platform, OCR will emerge in different types, and these can be defined based on how resources are exchanged between the organisation and the community. Organisations must pay attention to the quality of these relationships reflected by commitment, trust, satisfaction, control mutuality, and mutual service benefits. Such relational elements will shape the growth of current service relationships and define future relationships. The growth and collapse of OCR rely on relational outcomes and organisational dynamics such as organisational resources and capabilities dedicated to building community relationships on CoSNPs. Other organisational factors will include organisational policies and culture around the use of CoSNPs. Besides the organisational aspects, online settings raise privacy and social legitimacy questions that often undermine relational and network prospects.

Lastly, OCR in CoSNPs, not only emerge, grow, and die because of organisational and interactional influences, but also the seemingly distant sectoral, national, or global forces. Inherently, these provide the operative environment for organisation and interactions. Organisations should consider social beliefs running in the offline communities and how they affect interactions in CoSNPs. Organisations should also consider promoting shared beliefs and values with target communities, establishing sectoral based social capital (i.e., partnerships and alliances), and using CoSNPs community intelligence to identify and respond to service needs. Other studies [58] have emphasised the need for organisations to meet stakeholder needs, consider stakeholders as partners, consider a stakeholder-oriented approach, and continuously review their relationships. NPO practitioners must recognise that running a funding model (as opposed to a business model) may attract a different set of socio-cultural, political, and socio-economic issues in co-creative activities, SNPs use, and OCR. Nonetheless, understanding advances in social media and the complexities, capacity, and dynamism will be key in building OCR. These issues could imply that CoSNPs may not function uniformly across all contexts (e.g., countries).

6. Conclusion and direction for future research

In conclusion, this chapter introduced an ecological systems perspective to argue that forces will influence the possibilities for building OCR in CoSNPs from four layers of the organisation's operating environment. These layers include the micro-system, mesosystem, exosystem and macrosystem forces. These systems affect each other in shaping OCR on CoSNPs, and such influences will be direct, indirect, strong, or moderate-to-weak. The ecological systems perspective is essential to engaging a multi-level analysis of the mechanisms driving OCR on CoSNPs. The chapter also argued that OCRs are affected at three stages – i.e., emergence, growth, and collapse, which are transformed through purpose, progress, and goal attainment. Overall, the chapter provides a basis for an ecological prediction model of OCR in CoSNPs and offers a foundation for future studies on SNPs, organisational relationships, and co-creation. Future studies should consider examining the influences discussed in this chapter using a quantitative approach using the explorative and robust partial least squares structural equation modelling (PLS-SEM) technique. This approach would confirm the most significant and high priority influences that the organisations must consider. Such studies could isolate the factors that are more influential at different stages of OCR. Future studies should also examine the properties of OCR that are specifically affected by the factors identified. Nonetheless, the model provided should be tested in different contexts (e.g., in different business models, sectors, countries, and socio-cultural contexts) to establish how such influences could differ.

Author details

Kyeong Kang* and Fatuma Namisango
School of Professional Practice and Leadership, University of Technology Sydney, Australia

*Address all correspondence to: kyeong.kang@uts.edu.au

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Chapter 2

Systematic e-Service Innovation

Darrell Mann

Abstract

Most service innovation attempts end in failure. Systematic e-Service Innovation is the result of a twenty-year program of research to reveal the 'DNA' of the successful attempts. The research shows: 1. Most service innovation attempts fail on their first day because they begin from a false understanding of what customers want. Organisations know they are supposed to listen to the 'voice of the customer', but, despite massive amounts of digital data capture, they still have little idea what to listen for. 2. The number of service challenges is very finite, and guaranteed that someone, somewhere has already solved your service problem. 3. The most powerful solutions are the ones that successfully eliminate the compromises and trade-offs conventionally viewed as inherent to service operations. 4. There are only a small number of possible strategies for overcoming such contradictions. 5. Service industry strategy, business and market evolution trends follow highly predictable paths.

Keywords: first-principles, big data, TRIZ, intangibles, experience economy, contradiction, s-curve, Hero's Journey

1. Introduction

In 2016, the digital economy worldwide was worth US$11.5 trillion, or 15.5 percent of global GDP. The outstanding performance of the digital economy is mainly attributable to the development of a consumer-driven Internet. By 2025, the industrial Internet is predicted to experience massive growth, with industries across the board seeing high levels of digitalization and intelligence. By then, the digital economy is expected to grow further, to 24.3 percent of global GDP. This rise, even taking into account the fact that the value of digital offerings is underrepresented in GDP figures [1], if it happens will come about largely through innovation. The digital economy, and particularly its service elements, in this sense is the fastest changing sector the world has ever seen.

1.1 Service

In some countries, the economy is already dominated by services rather than products. Recognition that customers want the functions that products deliver but do not necessarily want to own the product is the primary driver behind this trend. Customers receive all the upside of being able to perform the jobs they wish to get done (mobility, communication, eating, laundry, learning, managing their finances, etc), without all of the downside of initial capital outlay, maintenance, or eventual replacement of the products required to deliver the required functions. This product-to-service shift represents a vital step towards a more sustainable society.

Prior to their shift to a 'power-by-the-hour' functional sales model, for example, the jet-engine industry had a strong imperative to make engines that required frequent overhaul and replacement. When customers receive 'free' engines that they only pay for when they are being used, however, the engine manufacturers quickly recognised a strong incentive to design engines that lasted a lot longer and required less maintenance. Such transitions, in many cases, only become possible thanks to the benefits attributable to digital technologies…

1.2 e-

…in parallel with the product-to-service evolution trend there is a pattern of evolution that sees 'mechanical' technologies evolving towards electronic and digital solutions. The mechanical keypads found on the first mobile phones have evolved to become digital touch-screens; the 35 mm film used to record photographic images has become digital; the physical money traditionally carried in people's pockets, is increasingly becoming 'e-cash'. People used to visit shops and now increasingly shop online. There are literally thousands of examples of such physical-to-virtual transitions [2]. The common factor – that it is easier to move electrons rather than atoms – again delivers inherent environmental benefits as well as being better able to serve customer needs. As such digitalisation looks set to be a trend that will also continue for the foreseeable future.

1.3 Innovation

The rise in the importance of innovation offers up another highly visible evolution trend. This trend is driven by the convergence of a host of other societal trend patterns. Globalisation, the transparency emerging through social media, rising populations, climate change, finite natural resources combine to create, firstly, an imperative to find better ways of doing things, and, secondly, an increasing likelihood that if incumbent organisations fail to meet shifting customer needs, someone else will step in.

'Innovate or die' has been a commonly used aphorism for close to two decades now. More often than not, however, it becomes 'innovate *and* die'. 98% of all innovation attempts end in failure [3]. The world of innovation, in other words, is one that is largely dysfunctional. There are many reasons for this, but two stand above the others. One, is the growing recognition that innovation is not the same as the 'continuous improvement'/'operational excellence' management philosophy that has been dominant since the quality revolution of the 1970s. Rather it is the opposite. Methodologies like Lean and Six Sigma, while extremely potent ways of driving improvement, turn out to drive problem solvers in precisely the wrong directions when it comes to innovation. In Operational Excellence world, for example, 'variation' is bad and therefore needs to be eliminated, but in Innovation World, variation is in many ways the prime enabler of identifying step-change opportunities and solutions.

Second is the definition of the word innovation. Over 90% of authors using the word use or imply a definition that equates innovation to either 'new ideas' or, more commonly, 'new ideas that are launched onto the market'. Neither of these definitions, however, makes any kind of sense from the perspective of enabling better understanding of how to innovate. By either measure, e-service providers like Uber count as innovation, but, at this point in time, the Company has lost and continues to lose vast amounts of money. To the point, many investors are beginning to believe that they will never become cash positive. Any prospective innovator taking organisations like Uber as models for their own projects is only likely to

fall into the same financial black-hole. The only innovation definition that makes sense is one that includes a success metric. For most enterprises this metric will be financial in nature – achieving a net positive ROI for example, or customer value, or profit – while for others it will be measured in other ways – patient life expectancy or quality of life. Whatever the chosen success metrics are, a new idea only becomes an innovation once they are met. The primary importance of using this definition is that it is the only one that enables a possibility of acquiring and sharing repeatable best practice…

1.4 Systematic

…much of the 98% failure rate found in Innovation World comes from the fact that innovating is difficult. It demands that innovators embrace the innate complexities of the world. It demands they are willing to venture into the unknown. And that they are willing to persevere through the many false-starts, insurmountable obstacles and dead-ends, through the maze of mis-information, mis-interpretation, confusion, stress, and sleepless nights. In many ways, the 2% were first and foremost lucky. They prevailed predominantly by trial and error. Perhaps ironically, the digital world has been lucky enough to stumble upon 'methodologies' like Agile and Scrum, and has evolved the concept of the hackathon in order to increase the speed trial-and-error iterations are able to be performed. The irony being that, even though consistent with working in complex environments, the rapid-trial-and-error strategies of many in the digital world have had little or no impact on the overall innovation statistics. 98% of all innovation attempts fail; 98% of e-service innovation attempts fail.

The big idea underpinning 'systematic' centres around the removal of the trial-and-error randomness from the e-service innovation process. In effect it becomes, like its TRIZ forerunner [4], a programme of research to decode and reveal the 'DNA' of the 2% of successful attempts. When dealing with complex systems, as we inevitably are when it comes to innovation, such a task is fraught with difficulties. Not least of the reasons being that it is never possible to 'step in the same river twice'. Just because an innovation team replicates all of the steps of a previously successful innovation project does not guarantee their success. In fact, given the general speed of change in the world, the surrounding context and environment of any previously successful project is inevitably different in today's project. Many prospective innovators, unfortunately, have been taught that 'doing the same tomorrow as you did yesterday and expecting a different outcome' is one of the first signs of madness. Such an aphorism might have made sense in simpler times, but it carries little if any relevance in a complex world. To the extent that the 423 Fortune 500 companies from the original 1950s list that no longer exist could all be said to have fallen precisely into the trap of continuing to do what they'd always done and expecting to get the same money-making results.

'Systematic' and 'complex', in other words, do not traditionally make for good companions. 'For every complex problem there is an answer that is clear, simple and wrong', says another dangerous aphorism. It is an aphorism that might today be extended to say that every complex problem has *thousands* of clear, simple wrong answers. But in making that extension, now that the appropriate research has been conducted, it also becomes possible to say that every complex problem has at least the possibility of a clear, simple right answer. Provided that the first principles of innovation have been incorporated into the simplicity. This, then, has been the basis of the Systematic Innovation research programme [5] over the course of the last two decades: to understand complex systems from a first principles perspective. Which, in the first instance, means examining millions of case studies and looking for

patterns. There being vastly more examples of failed innovation attempts than successful ones, this in turn means looking at failed projects and looking for repeated failure mechanisms.

The results of this analysis – which to date has incorporated over 11 million case studies – is that when innovation attempts go wrong, they go wrong for a very small number of reasons. When it comes to e-service attempt failures, that number, as shown in **Figure 1**, is effectively three:

Which can be elaborated upon as follows:

1. Jumping off the cliff with the wrong parachute – most e-service innovation attempts in effect fail on their first day because they have misunderstood the customer need. They have, in other words, started with the wrong problem. They have listened to a 'Voice of the Customer' that was never there. Or was wrong. Or partial. There are two ironies here. The first is that listening to the customer's Voice has long been an established norm. While it makes sense in Operational Excellence context, sadly, it makes no sense at all in Innovation World. Customers know that they want faster, cheaper, etc., but they usually have no idea at all about what might be possible. This is especially the case when it comes to the emotion-related aspects of a prospective innovation opportunity. Many customers would like to be 'cool' for example, but that is something they are highly unlikely to even covertly specify in the catalogue of requirements that eventually finds its way to the e-service development team. Much of the 'real' customer need is unspoken and unwritten. As if this were not bad enough, the second irony is that while the rapid iteration processes that come with Agile, Scrum, etc. are in theory all about going regularly going back to the customer with prototypes to obtain their feedback, project teams still do not uncover the real innovation opportunities. 'The Wrong Parachute' means in effect that the majority of innovation teams do not know how to find the 'right' problem, and, even if they accidentally did find it, still would not know they'd found it.

2. Failing to solve the Ordeal. One of the key first-principle differences between the 98% of failed innovation attempts and the 2% successful ones is that the 2% almost invariably identified and resolved one or more contradictions. The 98% continued the Operational Excellence derived belief that the only way to deal with trade-offs, compromises, conundrums, paradoxes, chicken-and-egg problems, and whatever other terms get used a synonym for contradiction, is 'optimisation'. Innovators solve contradictions. Contradictions are the 'David-versus-Goliath' challenges that are inevitably attached to any step-change situation. Again, in theory iterative Agile processes, given enough designers

Figure 1.
Three primary sources of e-service innovation attempt failure.

and design iterations, should in theory eventually stumble upon contradiction-solving solutions. In practice, however, because almost no designers have been taught that contradictions can be solved, what happens is that Agile and Scrum devolve into trade-off merry-go-rounds which simply transfer the trade-offs from one design parameter to another, until eventually the team ends up, whack-a-mole like back where they began.

3. Failing to find the Road Back. The third problem concerns execution of the innovation project and what might be seen as a failure of perseverance. This is the part of a project where using the wrong definition of 'innovation' comes into play. It is one thing to find 'the solution' to a customer need, it is quite another to turn it into money. A big part of the innovator's challenge here is that large parts of the digital investor world has become too enamoured of so-called 'unicorns'. The digital world has become quite adept at creating companies that are able to attract billion dollar valuations. But attracting a billion dollar valuation and generating more than a billion dollars of new revenue are most definitely not the same thing. The investor ethos seems to hold the irrational belief that what happened with digital Goliaths like Amazon, Facebook, Baidu, Tencent, Alibaba and Google, will also happen to them. And that the game is merely about keeping the enterprise going long enough that the profits will begin to appear. Time, alas, is not the only factor at play, start-up enterprises, need 'innovation DNA' to find the right customer problems and solutions, but they then need to be able to integrate that way of thinking with Operational Excellence World thinking in order to work out how to make money from those solutions. Innovation and Operational Excellence, per earlier comments, may be polar opposites of one another, but any successful enterprise needs to be able to master both sets of skills and bring the requisite ones together at the right places and times. Very few digital start-ups get to master this integration challenge before the last in the chain of investors decide to call time.

2. What the 2% did – First principles

Mention of 'jumping off cliffs', 'Ordeal's and 'Roads Back' offer a nod to first-principle thinker, Joseph Campbell. Campbell devoted much of his life to studying the world's literature in order to, in a manner analogous to the TRIZ and Systematic Innovation research, decode the reasons why most literature (not coincidentally, around 98%) ends up as pulp, and a small percentage become enduring classics. His primary answer was published as The Hero With A Thousand Faces [6]. Although he did not understand the dynamics of what the business world now recognises as s-curves, Campbell's 'Hero's Journey describes how successful literature always passes through the same stages that will be experienced by innovators as they make the shift from one solution paradigm to the next. **Figure 2** illustrates these generic stages as they relate to the innovator's journey between s-curves [7].

The vertical axis on any S-curve picture may be plotted to show any and all of the attributes of a system that might wish to be improved. From an e-service perspective, the axis might be plotting customer related parameters such as benefits delivered, satisfaction, adoption rates, or, from the innovator's perspective, such business parameters as number of customers, turnover, risk-reduction, profit, or ROI. At more granular service levels, the axis might be plotting performance parameters like speed, accuracy, consistency, privacy, etc. Oftentimes, all of these attributes can be integrated together so that the curve plots 'value'. The horizontal axis is usually plotted as time, or, in more enlightened environments, improvement effort expended.

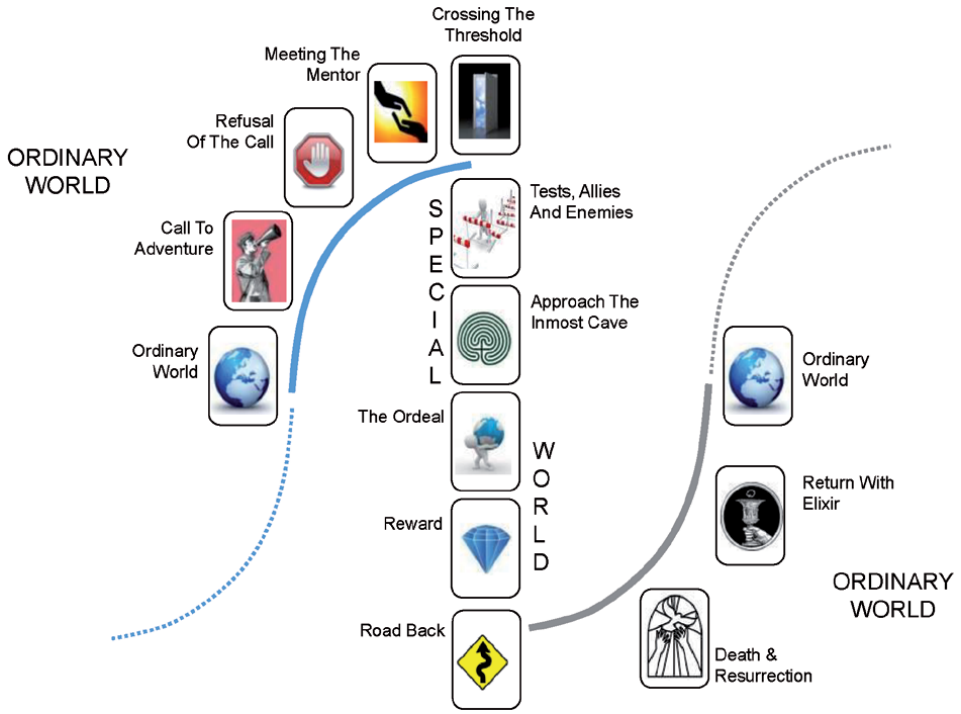

Figure 2.
The Hero's journey As S-curve transition.

Looking at the s-curve itself, the shallow gradient start of the S-curve is usually associated with the inevitable struggle that occurs when a new service paradigm appears. Eventually, assuming a critical mass of 'early-adopter' customers are willing to pay enough for the 'poor' initial manifestations of the solution, this early revenue will pay for the continuing development of the offering. At some point, there will be some form of internally-controlled production-related Eureka moment – a new delivery technology, for example, or a new pricing model – that will allow the curve to follow a much steeper upward trajectory. This 'stride' portion of the curve is the joyous stage of an enterprise when life is easy – easy sales, easy improvements and easy knowledge creation and sharing. But then, sooner rather than later, comes the law of diminishing returns top part of the curve; the 'stuck' portion. This is where contradictions begin to emerge: whatever it is that the service provider is trying to improve, 'something' increasingly comes to prevent the achievement of those improvements. After 'Crossing The Threshold' (i.e. jumping off the cliff), the brave innovator is exected to endure a series of tests, allies and enemies before, eventually reaching a pont where they have no choice but to confront The Ordeal – i.e. the contradiction. Assuming they prevail and achieve 'The Reward', the beginning of a new S-curve begins to emerge. Then, assuming the 'right' new solution is appropriate, comes the Road Back – the transition from novel service idea to a service offering that is (commercially) successful.

2.1 The ordeal

Having revealed the universal nature of the inter-s-curve journey, the original TRIZ researchers shifted their attention to the contradiction part of the story, and began mapping all of the attributes of solutions that customers wanted to improve, and all of the other attributes that emerged to impede those improvements.

The resulting list of parameters was very finite. In a technical context, the latest Contradiction mapping tool identifies just fifty relevant attributes [8]. When the Systematic Innovation research extended the same contradiction attribute search into the world of business, the eventual list comprised forty-five parameters [9]. In the IT world, the list is currently twenty-one parameters [10]. The e-Service world, then, effectively becomes a combination of the latter two parameter lists. Because the primary research underpinning all three tools begins from empirical grounds, there is always the likelihood that more parameters will be revealed in the future. The job in this context is to keep looking, and, more specifically, keep looking for exceptions rather than confirmation that the lists might already be complete.

What this research has then gone on to reveal, having identified the existence of pairs of conflicting parameter, are the strategies that the 2% innovators have used to successfully resolve the Ordeal conflicts. Here the most surprising finding is that the list of possible strategies – whether for technical, business or e-service (or, for that matter, architecture, biology, literature, music, and all other domains of human endeavour) - is even more finite. Since the mid-1970s, in fact, the list has remained static at forty [8–10]. This, again, is not to say that this will be the eventual final total, but rather that, at this this point in time, these are the only forty strategies that prospective innovators need to have in their Ordeal-solving armoury. **Figure 3** illustrates an example of the Business version of the contradiction solving tool, showing how conflicting parameters are mapped onto the relevant rows and columns of the Matrix so that users can then be provided with a ranked list of the forty Principles used in the past to resolve similar contradictions.

In some ways, these Matrix tools and the list of forty 'Inventive Principles' form the foundation of 'systematic'. In others, stepping back to look at other first-principle characteristics of the 2%, it also becomes clear that while the principle of contradiction-solving is a necessary component of success, it is by no means sufficient. In order to reach sufficiency, it is necessary to connect three other elements to the Hero's Journey. The next concerns directionality…

Figure 3.
Example mapping of e-service ordeal onto the business contradiction matrix [8].

2.2 If you do not know where you're going…

…any road will take you there. Why do the solutions offered to customers occasionally make jumps? Is digital 'better' than physical? Is service 'better' than product? According to the next big finding of the TRIZ research, they are indeed ultimately better because the top of the new s-curve sits further up the y-axis of **Figure 2** than the top of the previous curve. The y-axis, as discussed earlier, could be any of a host of different parameters. It could also be defined to include *all* of the parameters that customers might be interested in. TRIZ calls this integrated parameter, 'Ideality'. More generally, it is known as 'value'. Whichever label is used, the meaning effectively becomes the same: ideality or value is the sum of all the positive things customers want, divided by the sum of all the negative things they do not. Examination of the 2% of successful innovation attempts through this ideality lens reveals a very clear direction of success: over time, customers expect the positives to increase and the negatives to decrease. Hopefully, this should not be a great surprise to anyone. The directionality concept becomes interesting, however, when the idea of an *ultimate* destination is brought into play. Theoretically at least, the end point might be seen as the point where customers receive all the positives they want and all the negatives have disappeared. The ideal solution, in other words delivers 'free, perfect and now' to all customers. Although simple to say, many organisations have profound difficulty with the statement's underlying implications. Not least of which is, if customers expect 'free', how does the provider make the money required to stay in business? For enterprises operating in the physical world, the answer is that 'free' will likely not happen for a long time. For those operating in the digital space, however, because it is so much easier to change and evolve solutions, it happens much faster. To the extent that e-service organisations like Google and Facebook effectively already operate as 'free, perfect and now' businesses. No doubt there will be deep philosophical arguments about some of the other implications of the 'all-the-benefits-none-of-the-negatives' evolutionary destination as the ideality concept becomes more widely known. One of the implications becoming most visible relate to the moral and ethical aspects of mankind's 'direction': from an e-service perspective, the easiest of the free, perfect and now destination elements to achieve is 'now'. Innovations that provide customers with instant gratification of their perceived needs has resulted in a growing awareness that the increased convenience can too easily arrive at the expense of meaning [11]. Fast food makes for convenient fuel. Fast food ordered on an app makes the job even easier. But, as can be seen in the slow-food movement, and the rise in home-cooking through Covid-19 pandemic triggered lockdowns, the preparation and consumption of food is a highly social and highly meaningful act. Ultimately, if the ideality destination principle is interpreted in its pure form, this kind of convenience-versus-meaning contradiction merely means that we will not achieve a true Ideal Final Result (IFR) solution until it has been solved. This is a topic that will be explored in more detail in Section 3. In the meantime, the discussion here about emotion-related issues and moral and ethical debate takes us to the next cluster of first principles emerging from the study of the 2%…

2.3 If you do not know where you are

…in the same way we need a compass to point innovators in the direction of future success, **Figure 1** suggests that the most common reason for failure in the e-service domain is that the project team does not know where it is starting from. Projects get launched, and the team jumps off a cliff ('Crosses The Threshold' in Hero's Journey terms) with a mistaken understanding of where their customers are.

The heart of the problem here, from a first principle perspective, is that humans have two brains. A fast brain and a slow one [12]. The fast (limbic) brain makes near instant, emotion-based decisions about what a person wants, and the slow (pre-frontal cortex) one rationalises those decisions. The fast brain provides the 'real' reasons a person wants something; the slow brain provides the 'good' reasons. Both of these need to be present if the customer is going to make a decision to hire our novel e-service solution. By far the easiest of the two for providers to deal with are the rationalisable, 'good' reasons. These are all the things that get written into the service offering descriptions and pricing information on the website. All the information, in fact, that the myriad competitors will also have on their website. Which in turn why there are so many e-service price comparison sites. Unfortunately, few if any of these offerings has anything to say about the information the customer's fast brain is looking for. There's a frequently used saying in China: 'when all else is equal, we buy from our friends. When all else is unequal, we still buy from our friends'. Friendship, in other words, very easily trumps the tangible offerings made by most e-service providers. The problem this gives innovators, unfortunately, is that amorphous concepts like 'friendship' are very difficult to measure. The same goes for a host of other emotion-related parameters such as trust, empathy, anxiety or confidence. But just because a parameter is difficult to measure, does not excuse a choice to go and measure something simpler instead. The next important question then becomes, what were the first-principle 'real' reason parameters the 2% focused their attention. The answer is shown in **Figure 4**. On the left hand side are the four parameters that form the 'decision-making' foundations of the limbic brain [13]. On the right-hand side are the six parameters that form the equivalent core of the human moral decision making process [14].

Having recognised the fundamental nature of these ten parameters comes the recognition that a good way to help ensure an e-service innovation attempt ends up in the 2% category is to find ways to measure each of them. This, in fact, has been the rationale and focus of PanSensic since it's inception fifteen years ago [15].

So much for measuring the fast-brain/real-reason information required to inform innovation projects. This might be the more difficult of the two types of measurement required, but it is also safe to say that only a small proportion of innovation attempts get the easier part right either. It may indeed be easier to formulate a specification describing the tangible parameters that will motivate customers to hire a provider's service solution, but unless the search incorporates contradiction-finding, then the heart of a potential innovation opportunity will have been missed. What usually happens here is customers are surveyed to establish what attributes they want, and then, finally, how much they are prepared to pay for them. One of the benefits of shifting to digital services is that it becomes very easy

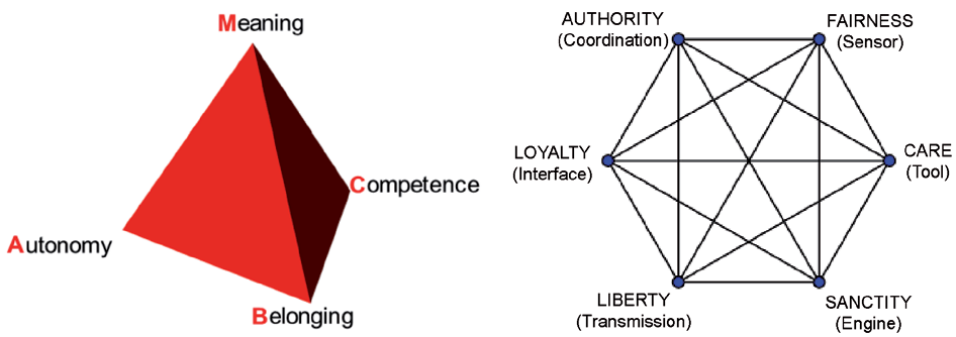

Figure 4.
First-principle human emotion and morality drivers.

to conduct experiments that will help innovators to establish price elasticity. This is something readily observable on many online retail websites in the form of occasional 'personalised' special offers, or, more generally, prices that are made highly dynamic. Dynamic pricing in this sense may be called an innovation, but its an innovation more for the provider than the customer. And, moreover, such models completely fail to identify the main customer innovation opportunities. In complex systems, it is not so much the attributes of a system that drive purchase so much as the relationship *between* those attributes. The moment a provider attempts to deal with such relationships as optimisation opportunities, the innovation opportunity is effectively discarded. Customer might *expect* to have to make trade-offs between, say, price and quality, or efficiency and effectiveness, or long-term versus short-term, but each time providers encourage such behaviour, innovation opportunity is removed. Again the real task here is to look at these kinds of trade-off from a contradiction solving perspective. Customers do not fundamentally wish to choose between quality and price, they want high quality *and* low price. Hence deploying measurement methods that, first, identify these kinds of underlying contradiction, and, second, are able to prioritise them, in effect becomes the only way – from the tangible side of the story – to identify the genuine innovation opportunities. After a decade or so of working on this problem, the most reliable method of revealing contradictions involves two measurements: a) which attributes make customers express positive emotions, and, b) what are they frustrated about? Necessity may be the mother of invention, but frustration, it turns out, is the mother of innovation.

2.4 The road back

Finally, from a first-principles perspective, is the 'failing to find the Road Back' part of the innovation challenge. Solving a customer contradiction might offer innovators their 'Reward' solution, but having a solution is invention not innovation. In Campbell's terms, the innovation team is still in the 'Special World' limbo space between the old and intended new s-curves. Innovation means successfully transitioning out of that Special World back into the real ('Ordinary') world. And, as shown in **Figure 2**, that transition involves a 'Death & Resurrection' stage in the innovator's Journey. What this should effectively say to the innovator is that – fundamentally – something needs to 'die'. This generally means one of three things: 1) the innovator needs to remove themselves from the equation (especially relevant in academic-lead university spin-outs), 2) the service provider needs to 'unlearn' a previous way of doing things, or, most difficult to engineer, and therefore, usually the most challenging, 3) the customer needs to 'unlearn' one or more of their previous habits or behaviours. In being the more challenging of the three, the third option, perhaps not surprisingly, tends to be the one most likely to give the biggest breakthrough. Call that a meta-contradiction.

3. Systematic e-service innovation

Revealing the 'DNA' of the 2% successful e-service innovation attempts offers a step closer to a systematic innovation capability, but a knowledge of How, is not the same as understanding the What of the innovation process itself. Making that transition demands an understanding of the different stages and types of challenge that an innovation project is likely to encounter. The critical factor, here, concerns the levels of complexity present at different stages of a project.

Figure 5 presents a simplified outline of what the archetypal innovator's Journey looks like when plotted onto a Complexity Landscape Model (CLM) [16]. The CLM

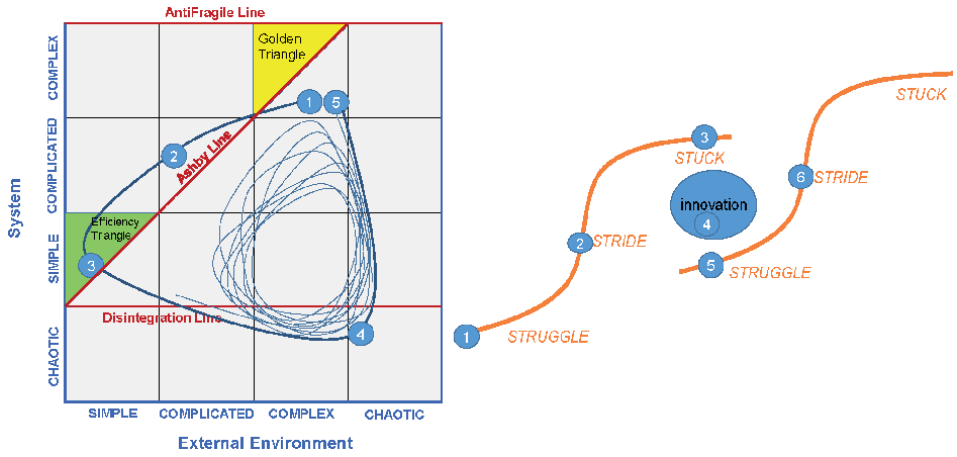

Figure 5.
Complexity landscape model and discontinuous change.

requires innovators to define two complexity states – one relating to their system, and the other to the surrounding environment. On each dimension, there are four distinctly different levels of complexity: Simple, Complicated, Complex and Chaotic. Each of the four demands different ways of making progress. Hence, by plotting a typical Hero's Journey s-curve transition onto the Landscape – as seen in the 1-to-5 stages included in the Figure – will demand multiple different ways and means of progressing from one stage to the next. Importantly, when a project is in Campbell's 'Special World' (Stage 4), almost inevitably there will be a period of Chaos. There are several reasons why this phenomenon is 'inevitable', but from an e-service perspective, the most pertinent is that organisational change only really occurs in the presence of Chaos. Prior to chaos, the human mind tends to continue applying existing rules and protocols. Only when chaos arrives does it become clear that those rules and protocols no longer apply. Innovation in this sense is about breaking rules. Something that the last forty years of Operational Excellence has taught successive generations of business leader to avoid. Operational excellence, in other words, has been about getting to Stage 3 by making sure employees follow ever more rigorous, ever simpler rules in order to maximise efficiency. Here's another example of 'best practice' leading to unexpected organisational fragility, and, thus another meta-contradiction.

In reality, the 1–5 loop is an 'idealised' road map. In that, given the fact that the majority of the time, a project is likely to be progressed in and environment that is Complex or Chaotic, there can be no such thing as the 'right' answer, and more likely than not, so such thing as the 'right' problem either. Which is to say that the only effective means of making progress involves use of cyclical processes. Processes that, in effect, mean that a project will likely take several circuits around the 1–5 loop.

If this is beginning to sound rather vague and un-systematic, hopefully the next section will demonstrate that, by utilising a process built around the first-principles introduced in the previous section, it is possible to accommodate enormous amounts of uncertainty and variation and nevertheless still be confident that a project will fundamentally continue to advance in the right direction.

3.1 Cobra+

Every e-service problem is inherently complex and so from a CLM perspective, smart innovators are well advised to build processes and protocols that acknowledge

this complexity. Project resilience in this context often means operating as much as possible above the CLM 'Ashby Line', which means, per Ashby's Law, that 'only variety can absorb variety' [17], it is better to have excess capability in the project system than that required to deal with the level of complexity present in the surrounding environment. The best place of all to be on the CLM is the 'Golden Triangle' [18]. The COBRA+ process was designed with this scenario in mind. It too ensures problem solvers tackle the issues they are trying to address back at the first principles level. **Figure 6** describes the basic steps of the process.

The process is also template-based in order to swiftly enable problem solvers to work through a logical complexity-embracing sequence of steps without a long learning curve [19]. The overall process forms a cycle, and as such, allows a problem solver to undertake as many iterations as might be necessary to achieve an 'appropriate' solution.

The detailed tests for what might be classed as 'appropriate' are contained within the process, but essentially focus on achieving 'solutions' that a team is happy enough about to consider exposing to prospective customers to receive their feedback. Having obtained such feedback, more likely than not, a team is likely to find themselves passing around the COBRA+ sequence again. And again. One of the biggest difficulties, indeed, when dealing with this kind of customer-change complexity is knowing when to stop. The closest thing to a heuristic that exists to date is that the most likely (2%) winners will be the ones most capable of working through the cycle more swiftly and effectively than their competitors.

Which then leads to a final discussion around the meaning of the word 'effectively'. Systematic here needs to mean something better than trial and error iteration. The overall evolution trajectory towards an eventual 'Ideal Final Result' outcome is one way of helping to assure this happens. The next comes from recognising that each loop around the COBRA+ process forces project teams to identify and find solutions to at least one Contradiction. The final, and perhaps most

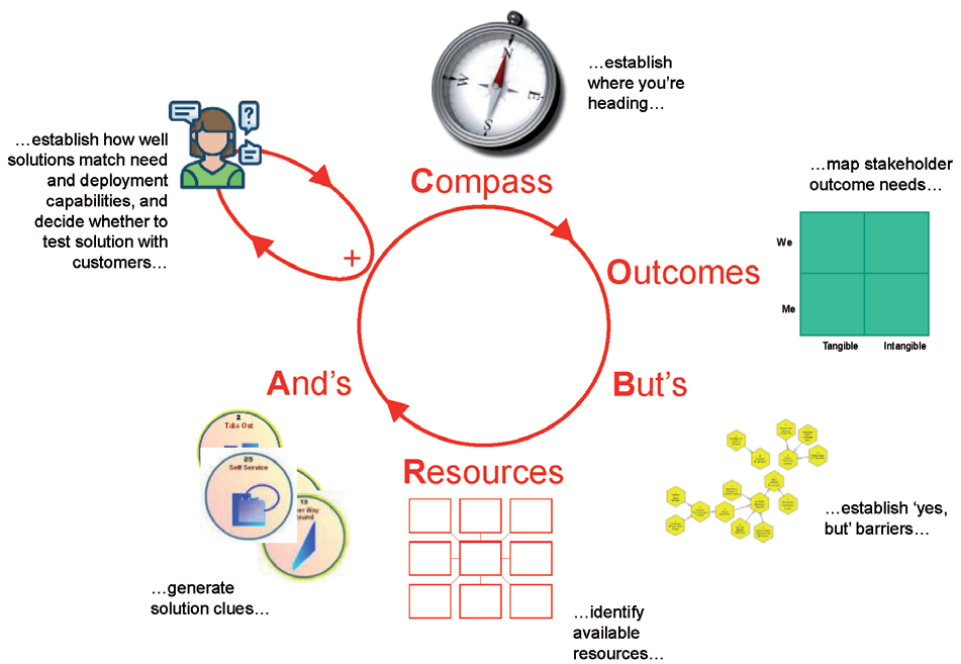

Figure 6.
COBRA+ process.

important one emerges via another piece of long-term research. This time looking at the meta-level evolution of industries with the aim of revealing repeatable patterns of success. Which, thanks to the contradiction-solving DNA effectively means looking for patterns of contradictions and their resolution. This is in effect another strand of the TRIZ research philosophy. Where – probably more by luck than judgement – it was found that by removing the 98% noise of coming from failed innovation attempts, what would normally looked like a host of random evolution trajectories, actually became a series of very clear step-change patterns. Patterns that, once innovators are aware of them, effectively provide a road-map to reliable and repeatable success, irrespective of prevailing societal and/or market turbulence.

3.2 Patterns of system evolution

As industries make their inexorable transition towards Ideal Final Result 'perfection', the journey involves a succession of discontinuous s-curve jumps. As one customer solution matures and hits its 'stuck' plateau, eventually along will come an innovator with a contradiction-solving solution to start a new s-curve. Almost invariably, the start of this new s-curve will present customers with a solution that is 'inferior' in many ways to the incumbent solution, but offers some form of advantage to certain niche situations. Preferably these niche situations will be high value customers prepared to pay a premium for the privilege of their niche advantage (think about the first mobile phones for an iconic example of this dynamic in action). If innovators are able to find such customers, the early revenue they produce, will pay for further developments of the solution that will make it progressively more attractive to a wider variety of customers. And by this means, the new solution will gradually begin to climb its s-curve, until such times as it too becomes stuck. If the innovator has chosen their new solution well, the ideality of their new solution will be higher than the peak ideality of the previous incumbent solution – **Figure 7**.

Such is the way of the world of discontinuous innovation: things will tend to get worse before they get better. This is another challenge for Operational Excellence dominated industries – where KPIs that acknowledge things may get worse for a period of time are virtually non-existent. The problem is not so big in the e-service sector, because the rate of s-curve jumps tends to be much higher than in most (non-digital) industries), and investors are more accustomed to the s-curve rollercoaster ride.

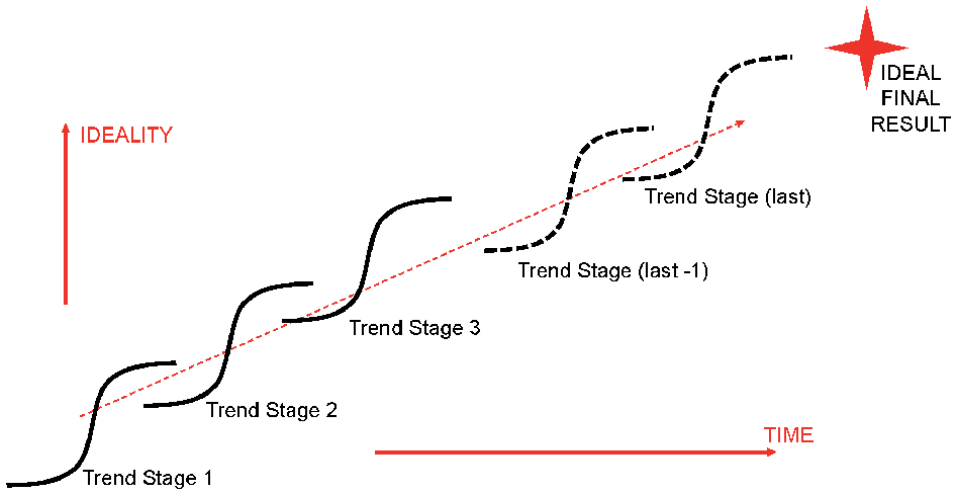

Figure 7.
Evolution trends as roadmaps to the ideal final result.

The relative speed of the e-Service sector jumps, once the noise associated with failed jump attempts is removed so only the successful ones remain, turn out to be one of the best ways to reveal just how clear the road-map to success actually are. **Figure 8** illustrates one of the most vivid and important of these patterns. One that was first revealed in the work of Gilmore & Pine [20], and is now generally know as the 'Customer Expectation' Trend.

Each stage of the Trend in effect represents an s-curve, and the direction of travel occurs from left to right. The e-Service sector in effect emerges thanks to the jump from the second ('Product') stage of the Trend to the third ('Service'). One of the implications of which is that innovators looking for innovation opportunities would do well to look at industries and sectors that are still at the Product stage, and, preferably, are at the mature end of their current s-curve.

This Customer Expectation Trend was one of the first business evolution patterns to be uncovered. To date, the research has now uncovered over thirty other discontinuous evolution Trend patterns [21]. Lack of space here prevents examination of all of them. What follows, however, are what might be thought of as the next four in a 'Top Five' evolution roadmaps for e-Service businesses:

Figure 9 illustrates the 'Segmentation' Trend. It applies both to the internal structures of a business, but mainly, in the e-service context, to the segmentation of customers. The left-to-right trend trajectory effectively tells a story of customization and personalization of services. By the time a service has evolved to the next-to-last 'Segments of One' stage, the business has recognised that every customer is different to every other one, and is able to tune the service to suit each individual customer need. The final stage of the Trend takes things one step further and sees service providers acknowledging that not only is every customer unique, but that they are also unique as their moods shift dynamically. In many ways, this Trend is the polar opposite of the core Operational Excellence drive for standardisation, a standardised solution being the one that traditionally delivers the best profit margin. This standardised *and* customised contradiction is in many ways one that the shift from the physical to the digital has enabled more than anything else...

...and that in turn has been made possible thanks to the next Trend, 'Reducing Human Involvement', illustrated in **Figure 10**.

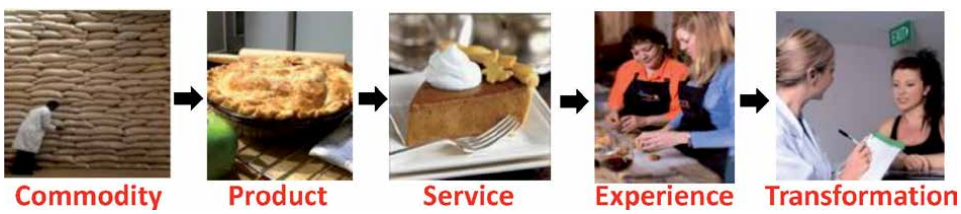

Figure 8.
'Customer expectation' evolution trend.

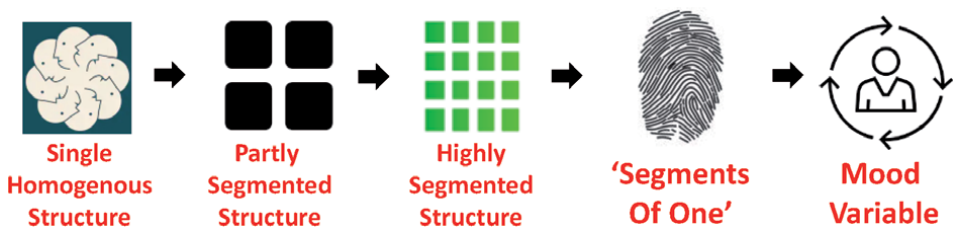

Figure 9.
'Segmentation' evolution trend.

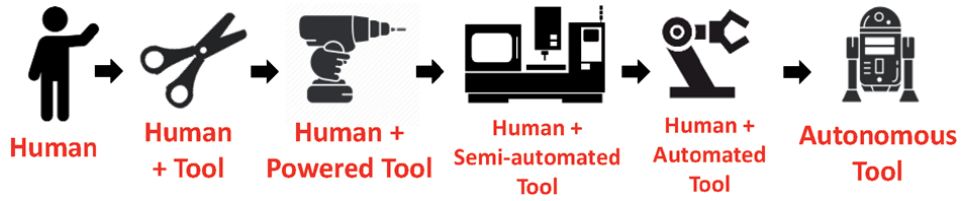

Figure 10.
'Reducing Human Involvement' evolution trend.

The reason customisation of solutions costs providers money is because delivering a customised service means having large numbers of highly capable and therefore expensive, staff. By replacing these staff with intelligent and increasingly emotionally aware digital equivalents, service providers will ultimately achieve the best of both worlds. How quickly this replacement will occur depends to a large extent on how quickly and how effectively the emotion-related first principles described in **Figure 4** can be absorbed into the software. On this front, the immediate good news is that we know what the job to be done is.

As ever, of course, any kind of progress inevitable generates some form of collateral damage. In this case it looks like the collateral damage will come in the form of swathes of service jobs being displaced. A partial answer to this contradiction may be seen in the next Trend. A Trend showing innovators that in addition to the 'things get worse before they get better' characteristic of s-curve jumps things, as a solution evolves along its s-curve there is a clear pattern of increasing-followed-by-decreasing complexity.

During the initial 'increasing-complexity' portion of this curve, the e-service world is likely to see a host of integrated solutions (in which multiple services are combined into 'one-stop-shop', end-to-end offerings) and hybrid solutions in which human service providers are assisted by data-providing digital assistants. It is already established in the insurance industry, for example, that AI algorithms are already capable of making better loss-adjustment decisions and, in a smaller number of cases, fraud-detection decisions than the average employee, but, in order to ensure the emotional needs of claimants are also met, the average employee is still, for the most part, much more capable than even the best 'emotion-equipped' AI.

In the final analysis, however, the decreasing-complexity portion of the **Figure 11** Trend sees the contradictions of these kinds of human-computer hybrid service solutions being solved such that the customer receives all of the benefits they desire from a service without any of the attendant complexity. This is not to say that the complexity has disappeared per se, but rather that it has been subsumed into the algorithms and is therefore hidden from the customer's view.

Fifth in the Top Five e-Service Trends is the Customer Purchase Focus Trend reproduced in **Figure 12**. This Trend works a little differently from the previous four. At least in so far as implications for service providers. The step-changes described in this Trend examine the non-linear shifts in focus of customer attention as their relationship with services evolves. Initially, on the left-hand-side of the Trend, customer purchase decisions are largely based on their need for performance. As these needs become satisfied, performance thresholds will emerge, beyond which, customers will be no happier and no more likely to purchase the service should providers continue to increase them further (many Microsoft solutions crossed these thresholds some time ago – the majority of Word users, for example, do not use 90 + % of the available functionality of the software, and compatibility issues aside, would be quite happy with the capabilities provided in Word 2). When customers perceive they have achieved enough performance, their

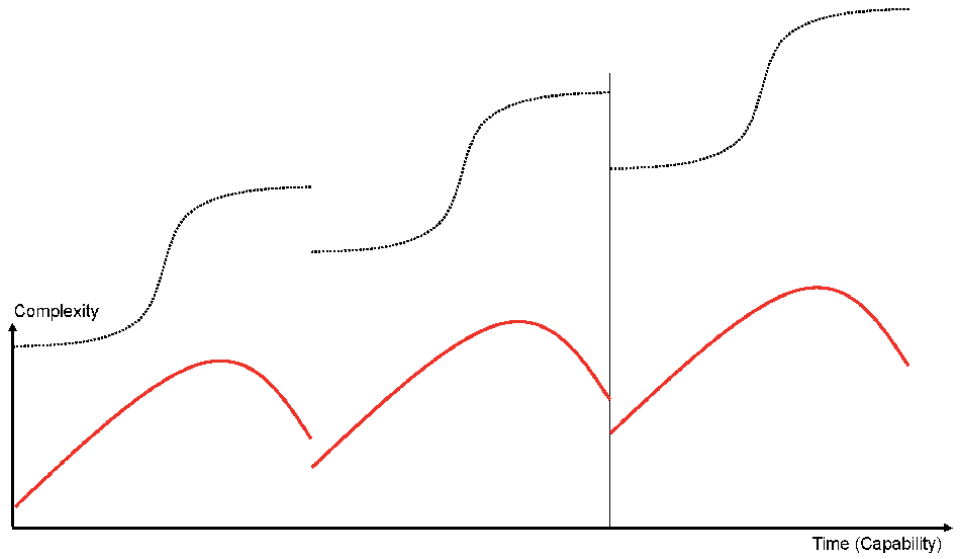

Figure 11.
'Increasing-decreasing complexity' evolution trend.

Figure 12.
'Customer purchase focus' evolution trend.

primary purchase attention shifts to reliability. And then, when they have enough of this, their attention shifts again, this time to convenience. Finally – bad news for providers – when customers have enough performance, reliability and convenience, their purchase decisions are made solely on price. Which effectively means that the service offering has become commoditised.

The job of providers when service offerings approach or reach this final stage is to innovate in such a way that they are able to shift customer attention to new measures of performance. One likely candidate in this regard, to return briefly to **Figure 4** one more time, is that 'meaning' will become a generically applicable new performance delivery opportunity. One that the Covid-19 pandemic, again as discussed earlier, seems likely to play a significant role in bringing to the front of many e-service customers' minds.

4. Into the future

The commonly held advice about making predictions of the future is to avoid having to do it if at all possible. No-one can predict the future beyond the next 400 days [22]. In the turbulent times triggered by the fall of the pandemic domino, this number is becoming lower, and with every additional falling societal domino, is tending to become lower still.

What the TRIZ and Systematic Innovation research has shown, however, is that just because we cannot predict everything about the future does not mean we are not able to predict anything. If nothing else, the Trends of Evolution described in the previous section are a good way of informing innovators that, while it might be difficult/impossible to know *when* discontinuous jumps will happen, *what* those jumps will be is much more predictable. A 'product'-based business will, sooner or later, shift to become a 'service'-based business. Similarly – and crucially for those already working in the service industries – sooner or later any service business will evolve into an 'Experience'-based business. The implications of that most likely ought to form the basis of an e-Experience successor to this book.

First Principles knowledge, meanwhile, is remarkably stable [23]. The laws of physics are essentially just that: laws. As mankind's understanding of these laws evolves, the 'first principles' will evolve too, but their half-life generally speaking is measurable in decades or centuries. More subtle, but the TRIZ-originated innovation-DNA research has also revealed the relative stability of knowledge pertaining to the emergence and resolution of contradictions. Innovation – the successful transition from one S-curve to another – is in effect driven by this contradiction story. Innovation, to all intents and purposes, is contradiction solving. Knowledge pertaining to how contradictions are solved will thus inevitably become one of the critical factors in the e-Service innovation story. If organisations are not managing the contradictions in their e-Service business, they are placing their future on a path with a 98% likelihood of failure.

Author details

Darrell Mann
Systematic Innovation Network, Bideford, UK

*Address all correspondence to: darrell.mann@systematic-innovation.com

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Chapter 3

Social Media Ecosystem and Its Influence on Small Business Strategic Practices

Shirumisha C. Kwayu

Abstract

The plethora of social media applications creates an ecosystem that can assist strategies for small business. However, the abundance of social media applications is attributed as a cause for confusion to business owners and executives making it difficult to conceive strategies for engaging effectively with social media. Following a practice theory, this paper uses an autoethnographic methodology to study how the social media ecosystem influences strategic practices of a small business. The study found that the social media ecosystem is crucial for enacting a strategy of a small business and that changes within the ecosystem influence the whole strategy. In addition, the study shows how context is interwoven with the social media ecosystem to affect the strategy of a small business. The study underscores the importance of strategizing practices for small business to develop agility that is necessary for developing and embedding digital transformation. Practically, the study highlights the significance and the need for developing countries to synchronize their soft infrastructure in order to help small businesses exploit the benefits of globalization during this era of social media.

Keywords: social media ecosystem, autoethnography, practice theory, small business

1. Introduction

The abundance of social media application creates an ecosystem of social media [1] which business organizations can use to enhance their information system (IS) and strategic endeavors [2, 3]. The use of social media in business organizations is in the post adoption stage. For instance, Mahr and Lievens [4] highlighted that 80% of firms listed in Standard and Poor's 500 index used social media. Although large organizations embraced social media, Kiron et al. [5] suggested that both large and small organizations practice social media. In addition, Braojos-Gomez et al. [6] suggest that small firms tend to use and leverage social media for strategic objectives such as marketing because of their low portfolio of financial resources to compete more effectively in the market compared with large business organizations. Although social media can be leveraged for strategic reasons, Kietzmann et al. [7] suggested that executives were struggling to build strategies for engaging effectively with social media. For instance, Omotosho [8] suggests small business entrepreneurs are familiar with major social media platforms and their relevance to their business endeavors but lack of continuity with platforms for business purposes was a factor for converting

the platforms for their personal use. Likewise, Effing and Spil [9] finds that social media strategy within organizations is not yet well developed. The difficulty of developing a strategy is attributed to abundance of social media applications which exist in different forms such as blogs, content communities, or social networking sites (ibid). Kwayu et al. [3] found organizations used different social media platforms for different strategic activities, which explains why there is a co-existence of different social media platforms in organizations. Therefore, while social media platforms support different strategic practices, Hanna et al. [1] suggest that the social media ecosystem creates an understanding of the overall social media strategy. Social media ecosystem is an accumulation of social media applications which emerge as important e-commerce context for organization to engage [10].

Partly out of financial constraints, small businesses turn into social media strategies [6]. Small businesses understand that social media is crucial for the competitiveness of small businesses. The evidence that the practice of social media within organizations is far advanced than its recognition in the literature [11], further underscores the need for scholars to understand the practice of small businesses use of social media and how the social media ecosystem influences strategies of small business.

Considering the above, this paper explores how the social media ecosystem enacts strategy for small business. The paper draws from practice theory which focuses on how people interact with technology in their ongoing activities while enacting structures, which influence emergent and situated use of that technology [12]. Thus, the practice perspective offers us with an understanding of how technology is used and how the use of that technology affects the organization.

Motivated by the concerns above, this paper seeks to answer the following question: how does the social media ecosystem enact strategy for small business?

Accordingly, this research is an autoethnography research that adopts an interpretivist philosophy to gather empirical evidence from personal experience and self-reflection of owning and managing a small online business. In this respect, the paper makes the following contributions. First and foremost, it will help to understand how an ecosystem of social media produces, embeds and enacts strategic activities for a small business. Second, it will help to understand the role of context in organization and assist contextual inclusivity. Third, it will give insights on the digital divide that exists between developed and developing context and the role of social media at either bridging or expanding the divide. Lastly, the paper will be useful for small businesses that want to develop agility, which is required to successfully adopt and implement digital transformation.

The remainder of this paper is structured as follows. First, I discuss the literature on social media, followed by a discussion on practice theory. Then a methodology section follows. Thereafter is the presentation of the findings and a discussion on the implication to literature and practice. Finally, I conclude with limitations and avenues for future research.

2. Social media strategy

Social media is now a mainstream practice within organizations [13]. It is a new form of information technology that allows interaction and interoperability of users [14]. Dabner [15] explains social media as an internet and mobile based application which integrates technology, telecommunication and social interaction to enable the creation and dissemination of words, videos, images and audio. Treem and Leonardi [16] suggest social media is distinct from previous forms of information technology (IT) in terms of affordances. For instance, it allows

simultaneous and instantaneous exchange of information between users which has enabled social media usage to soar within a relatively short period of time. For example, Piskorski [17] highlights that most of popular social media such as Facebook, Twitter, Instagram and YouTube which were made in mid-2000 are now having more than billion users. Thus, with the affordances that social media offers to organizations and the influence that it has; organization are generating a considerable interest in understanding how to implement and develop strategies around social media.

Kwayu et al. [14] argues that social media is a broad term which embodies various forms making it difficult to apprehend. There have been various efforts to classify social media with Kaplan and Haenlein [18] developing six categories of social media which are: blogs, social networking sites, content communities, virtual game worlds, virtual social worlds and collaborative communities. Another attempt to offer understanding on different forms of social media was of Kietzmann et al. [7] which developed seven functional building blocks of categorizing social media platforms. The functional blocks are: Identity, sharing, conversation, presence, relationships, groups and reputations. Although the categorization of social media helps to understand a platform and its effect in organization, it obscures the understanding of the combined effect of social media applications that exist within the organization consequently denying organizations' executives with means of developing the overall social media strategy within organization.

In efforts to understand how social media co-exist in organizations, Piskorski [17] argues that for social media to be successful they have to offer a single social solution. Once it offers more than one solution, it becomes less effective. Given this observation, social media platforms refrain from copying social solutions from other platforms, hence this is the reason why different platforms with non-overlapping social solutions can co-exist in an organization. Like Piskorski [17], Kwayu et al. [3] found different social media platforms engendered different strategic practices within an organization. Although different social media platforms serve different functions within an organization, understanding of social media as an ecosystem helps the organization to pursue overall social media strategy rather than being tactical [1, 10]. Piskorski [17] suggests that an overall strategy needs structural change and helps organization in the long run whereas tactics are limited to a function and they are short-lived. In practice many organizations tend to use a functional approach to strategy [19] which denies organizations with full potential towards a social media strategy. Therefore, this paper intends to help in understanding how the social media ecosystem shapes business strategy.

It is crucial to understand social media strategy in order to understand how the social media ecosystem shapes business strategy. Piskorski [17] defines social media strategy as the idea of using social media for value creation and competitive advantage. Though limited some studies have explored social media strategy. For example, Culnan et al. [20] proposed an outline for implementing social media strategy which includes three elements that are; mindful adoption of social media platforms, building community in social media platforms and creating absorptive capacity for sourcing value from the community in social media. Similarly, Piskorski [17] argues that successful implementation of social media strategy seeks to increase organization's profit by improving interactions between people and making them undertake sets of corporate function for free. In addition, Piskorski [17] builds his argument using Porter [21] generic business strategy which gives organizations two choices of either differentiation or cost leadership. With differentiation an organization will use social media to pursue customers and ensure that they pay more without increasing the cost, while with cost leadership an organization will use social media to reduce their cost without reducing the customers willingness

to pay. Another study that reviewed social media strategy is Effing and Spil [9], who developed a framework which comprises three stages and seven key elements of social media strategy. The first stage is initiation, which comprises targeting audience and channel choice. Most organizations focused on the first stage. Second stage is diffusion which has elements of goals, resources and policies. Whereas the third stage is maturity which involves elements of monitoring and content activities. While these studies provide significant understanding of social media strategy, their major weakness is that they focus on customers. The studies also ignore other issues such as impact of social media on processes, structure and strategy of business organization.

3. Practice theory

As mentioned earlier, practice perspective view how people interact with technology in their ongoing practices to enact structure that shape emergent and situated use of the technology [12]. This implies that practice theory emphases the latent connection of material aspects of social reality [22]. Golsorkhi et al. [22] argues that practice enables a researcher to deal with the most fundamental issues in contemporary social analysis by showing how social action is linked with structure and agency. Furthermore, they suggest practice perspective has potential to explain why and how social action sometimes follows and reproduces routine, rules and norms and sometimes it does not (ibid). The underlying belief of practice theory is that activities of social life are carried out through ordinary acts of life.

Halkier [23] suggests that practice theory is not a coherent theory, but it attempts to synthesize conceptual elements regarding the performing of social action. Thus, practice theory is concerned with performativity, meaning that activities of any kind in human life are continuously carried out and through ordinary life performance organized through multiplicity of shared practice (ibid). Thus, practice theory offers a way to explain why a social phenomenon comes to be the way it is, making it a better way to understand how strategy is enacted.

Within the IS field it is believed that technologies embodied structure with them, and the structures were appropriated when the technology was in use [24]. However, Orlikowski [12] proposed a practice theory which advances the notion of embodied structure with enactment of structure and the notion of appropriation with emergent use of technology. This means that practice theory acknowledges that structure is enacted when technology is used, and consequently when there is recursive use of technology a structures of technology use emerge. Hence, Orlikowski [12] made a distinction between technology in practice (use) and technology as artifacts. The practice theory thus focuses on the use of technology, which makes it useful means of exploring how people organize themselves when interacting with technology. Thus, the practice theory explains organizing phenomena as interweaving of social and material. In this way, and by focusing on activity the practice theory does not distinguish social and material as there is no social without material and no material without social [25]. Therefore, practice theory acknowledges that social activities depends on material arrangement in which the activity is taking place (Ibid). Furthermore, practice theory has been used in the study of social media, for instance Kwayu et al. [2] used practice theory to explore how social media is a tool for competitiveness and its influence on organizational practice and strategy. Likewise, Huang et al. [26] used practice theory to study social media used in a ticketing company in china. The theory was useful to explain the phenomenon of site-shifting and how practices where bundled to produce emerging, dynamic and fluid nature of ambidexterity. Considering this, practice

theory becomes a suitable theory for explaining how the social media ecosystem affects the strategy of a small business.

4. Methods

4.1 Research philosophy and design

This research is an autoethnographic research which follows an interpretivist philosophy. The interpretivist philosophy is suitable for this research as it views knowledge as being socially constructed through language, consciousness and shared meaning [27]. Interpretivist philosophy is in line with autoethnographic research. It's a form of research, writing and method that connects the autobiographical and personal to the cultural and social [28]. Cunliffe [29] insists that autoethnography is not a method but a methodology. This means that autoethnography is more than techniques of data collection and analysis.

Wall [30] suggests that autoethnography draws on personal experience that extends to provide insights on a social behavior making it reflexive and better suited to explain social phenomenon since it acknowledges an inextricable link between personal and the wider context. Thus, autoethnography research provides means of organizing reflection on everyday life as experienced by researchers [31]. Furthermore, autoethnography is suitable for this research because it is enactive as it is concerned with material and physical domain that relates to the researcher domain of research (ibid). Therefore, autoethnography is beneficial for the research as it offers opportunity for making latent and tacit knowledge ordinary. This is because personal experience removes the access boundary of generating knowledge on the interdependencies between researched phenomenon being enacted and researchers. Therefore, despite autoethnography research being in line with interpretivist philosophy it is also in line with practice theory and the research phenomenon of understanding how the social media ecosystem enacts strategy of small business.

4.2 Case description and analysis

This research draws from my personal experience of establishing an online shop on ETSY platform. My shop sells handmade crafts from Africa with the main source being Ghana. My business started in 2018. The business significantly depends on several social media platforms, which create an ecosystem that shape the strategy of my business. I started the shop while in the UK and I continue to manage it from Tanzania. This transition has offered me a good experience of navigating/conducting business between developed and developing countries. My data is a recollection of my personal experience and reflection.

The analysis of my reflection follows a reflexive thematic approach, which is considered a fully qualitative approach [32]. Reflexive approach is centred on deep engagement, commitment and rigor as it emphasizes meaning as contextual or situated, reality or realities as multiple and researcher subjectivity as not just valid but a resource [33]. In addition, Braun et al. [32] suggest in a reflexive analysis a researcher becomes a storyteller, actively engaged in interpreting data through the lens of their own cultural membership, social positioning, theoretical assumptions, ideological commitments and their scholarly knowledge.

The finding of this research is drawn from my personal experience, which can make it hard to generalize the results. Nevertheless, Halkier [23] suggests that it is possible to generalize but with a change on how we view generalizability.

First generalizability should be specific and bound by context rather than taking it as universal. Second, generalizability must attempt to present dynamism, uncertainties, conflicts and complexities that constitute various overlapping context and knowledge production processes (ibid). Thus, generalizability is not supposed to produce stable representations but possibilities and instability [34]. This form of generalizability can be done by positioning as a way of drawing inferences on narratives and discourses to enable representation of dynamics that constitute social construction of things, relationship and performances [23]. Hence this type of analysis is suitable to analyze practice which is performative of social action making it a suitable method for understanding how social media ecosystem enacts strategy for small businesses like mine.

5. Findings

The findings are presented in a narrative form. This is because they are from my personal experience and reflection. My narration is structured to first provide a background including outlining the objective of my business. Second it outlines the products of my business. Third, it explains the use of social media applications. Finally, I conclude with my reflection on the influence of the social media ecosystem on my business.

In the last quarter of 2018, I started an online shop on Etsy. I had planned to start earlier but I delayed perhaps due to procrastination. The idea of starting an online shop originated from conversations with my extremely practical sister. She was selling handicrafts on Saturday markets. I thought it took a lot of energy from her hence I suggested that she should explore a way of selling online. Being practical, she immediately started to sell online. Her online business picked up. As it did, she gradually stopped going to the Saturday markets. She found more time to spend with her daughter. As her online business kept rising, I shared strategies from theoretical understanding of the information system (IS), but I never practiced anything. It was until I saw the benefits and gains she was getting that I was personally prompted to start my own online digital shop. My objective was to get income and build capital. I had gained insight and considerable understanding of business from her experience. She also linked me with people who she had met through social media. I manage to source items following her example. My business strategy is a digital business strategy, which is a fusion of IT and business strategy [35]. Thus, for me, the IT strategy is the business strategy. The digital business strategy was informed and influenced by my research in IS.

In Etsy, I sell handmade products from Ghana, Zimbabwe and Tanzania. The products include different types of handwoven baskets such as baby bassinets, laundry baskets, handbags, buckets and wall hanging basket decors.

My business significantly relies on different social media applications, which enable different functions for my business. From the outset I knew that I would need to use different social media applications because I knew one social media application could not do everything. Also, I wanted to get the synergy by using different social media applications in combinatorial fashion. In my business I use WhatsApp to communicate with local artisans. For marketing and promotion, I use Pinterest, Facebook and Instagram. For Logistic and tracking I use ParcelsApp. Whereas, for financial operations I use Wave, PayPal and internet banking applications. Wave enables people to send money to some African countries and the recipient receives their money on their mobile wallet such as MTN. There are other applications which send money to Africa, but their cost structure is different. Wave deals with exchange rate but other applications such as World Remit charge

a percentage which can reduce or take off the profit margin of the business. These applications work as an ecosystem, a change in function of one application changes the whole structure and strategy of the business. For example, in December 2019 Wave was unable to send money to Tanzania. With that inability, it was hard to pay for products from Tanzania and consequently I thought to change my operation strategy. For example, I thought instead of shipping from Tanzania to ship from neighboring countries (Kenya or Rwanda) but this would increase the costs, which could affect my competitiveness or make it impossible to sell. My competitiveness to sell depends on my process design and the context that is created by the social media ecosystem. Similarly, when the Covid-19 Pandemic started it was difficult to ship due to flight cancelation, only DHL could ship but it was too expensive and this prompted me to cancel operations in other countries apart from Ghana, where DHL shipping was reasonable. The business process is a two-way highway - one is money/cash and information flow from the consumer to me (merchant) to supplier (producer/artisan) and the second way is the product from the producer to the consumer. The portfolio/context of my social media applications (ecosystem) needs to support this process in a perfective way. In other words, a change in context changes my business process, efficiency and strategy.

When my business started to grow, I wanted to sell on other platforms such as Facebook and Amazon. In Facebook to integrate any app one needs to have more than 2000 followers, I had to do so and managed to integrate my Etsy shop with my Facebook page. Nevertheless, after doing so I realized that it was not effective. It was difficult to sell products on Facebook which has lots of potential buyers. The affordance of Facebook Shop Page does not facilitate quick sales in that potential buyers may not see the products as visible as it could be. Considering that, I tried to register for Facebook Marketplace only to find out that it is limited to America. I tried to sell on Instagram, which is also connected to Facebook, but I was also not able since it only allows big selected brands from the US. After failing to do so I managed to register on Amazon UK, which also offers the opportunity to sell in Europe. I was not able to sell lots of products perhaps because I am new, and my pictures are not very sophisticated. Hence, I tried to register on Amazon.com. However, Amazon did not allow me because of my nationality. This is an example of how I strategize, by trial and error. Through it I have learnt different barriers as well as enacting ways to process and strategize my business.

In reflecting my own experience as briefly described above, I have come to appreciate the importance of what I call 'soft infrastructure'. Unfortunately, 'soft infrastructure' is an ill way of referring provision of human services from more common recognized hard infrastructure [36, 37]. Thus, it is difficult to define soft infrastructure because its intangible, hard to measure and often described in a subjective and qualitative way that may not be easily understood (ibid). Therefore, by soft infrastructure, I mean intangible facilities that enable successful operation of my business. This includes things like bank details, identity information, postal address, national and international policies, and software applications. For instance, sometimes we can be on the same platforms but due to differences in identity such as nationality or location, size can be limited. This is due to the way those platforms are structured. For instance, a small business can fail to register because it cannot fill a required field that is not oriented to their context. Sometimes, network issues and even cost for maintaining platforms is a factor hindering small business from exploiting social media platforms [8]. Different contexts, for example countries have different institutions which have different arrangements and agreements. Thus, although social media platforms are global, access to some services from these platforms can be constrained due to different institutional arrangements and agreements. Thus, the ecosystem of application can enable or constrain a

business strategy for a small business. My business has been successful because of the information and technology developments which are occurring in Africa. Most of these developments in information and technology are recent, perhaps less than two decades. For example, most local artisans do not have bank accounts, but they do have mobile wallets. Thus, the money I transfer goes straight to their mobile wallets in the cell phones. This sort of transaction I cannot do with my UK bank. For example, I cannot transfer cash from my UK bank account straight to the mobile wallet in Africa. I can only do that via social applications such as Wave to a mobile wallet in Africa. If it is sent straight from my UK bank account, the only way is to go to another bank account in Africa. This would have been an impediment since it is often the case that my local artisans in different countries in Africa do not hold bank accounts, yet they all have mobile wallets. Technological progress makes it easier to send to mobile wallets because the money is received instantly and with the notification on both phones. Further confirmation and acknowledgement of receipt is done through WhatsApp. Thus, the ecosystem of social media creates a context that facilitates business. Lastly, my business has thus been successfully due to access to soft infrastructures in the developed world as well as some of the developments that are taking place in Africa. Thus, my business strategy operates in overlapping contexts of the developed and developing world.

6. Discussion

The above findings show that each social media platform plays a role as identified by Kwayu et al. [3] and Piskorski [17]. In addition, they show that although each platform plays a role they collectively function as a system. This highlights Omotosho [8] argument that small businesses are failing to use social media platforms due to lack of continuity with platforms for business purposes. Thus, it underscores the importance of understanding social media ecosystem and its role in forming continuity with platforms for business purposes. Changes in one platform can affect how the whole ecosystem works. This is a significant finding as it shows how an ecosystem enacts a strategy for a small business. It further signifies the synergetic effect of co-existing social media platforms in an organization. This extends Hanna et al. [1] research on ecosystems by explaining why people use different social media platforms in simultaneity.

Second, these findings show how contexts overlap and interact with each other thus creating a narrow path for small business to enacts its strategy. For example, there are different types of social applications that transfer money abroad, however they function differently. As explained above, some apps transfer money but they charge a percentage which can reduce or take off the profit margin hence making the business meaningless. Therefore, although there is an abundance of social media applications, the choice is limited due to the multiplicity of overlapping contexts such as business context and geopolitical context. All of these factors affect business in their totality. Walsham [38] suggests the use of IT in sub-Saharan Africa is recent and its associated with mobile phones and social media. This explains why I have to use a combination of internet banking (UK) and social application (Wave) to send money to Africa mobile wallet (M-Pesa). Thus, not one social media can navigate different contexts on its own. It is a link of different social applications that creates an ecosystem that enables to carry out business financial functions. Thus, this paper contributes to literature on context and ICT4D (information communication technology for development) research by showing how the digital divide exists between developed and developing context [39]. This insight is helpful to assist digital inclusivity especially for less developed countries which are left behind with widening

inequality that is created by digital companies such as GAFA (Google, Amazon, Facebook and Apple). Furthermore, the digital inequality (i.e. rural – urban, developing and developed) is exacerbated by neglect of research on social media and its influence on small business even within context of developed world [40].

Third, the findings show the importance of social and material arrangements in supporting small business strategies. As much as a single platform embodies a structure that can enable or limit a function, an ecosystem of social media platforms enacts a structure which creates an emergent strategy. For example, if Facebook opens its marketplace to other countries, this will influence our strategy because it will afford us with a new market from Facebook. Thus, any change in social or material arrangement as explained in the finding enacts an emergent strategy. Hence, this study enhances our understanding of Orlikowski [12] proposition that enactment and emergence are complementary to embeddedness and appropriation of technology structure. It enhances this understanding by showing where embodied structure plays a role and at what point enactment of structure becomes dominant.

In practice, the findings in this paper have the following significance.

Through highlighting the importance of soft infrastructure, this study shows the importance of synchronizing development of soft infrastructure. The misalignment of soft infrastructure between the developed and developing world exacerbates the digital divide that exists between the two. Synchronization of soft infrastructure will enable small businesses to grow and be able to access global markets with seamless effort. This will be successful if stakeholders and policymakers create conducive environment for use of social media for business activities among entrepreneurs and small businesses [8]. The policy holders and stakeholders will be in a better position to do this if they take a holistic view of understanding the social media ecosystem.

Second, this paper underscores the importance of strategizing practice for small business. Strategizing is a dynamic, iterative, interactive and continuous social process [41]. Social media platforms are dynamic, and they change continuously, thus small businesses need to constantly practice strategizing processes as business strategy is enacted continuously depending on changes that are happening in the social media ecosystem. Thus, what is right or what functions today might not be the same tomorrow. Therefore, small businesses that want to develop agility, which is required to successfully adopt and implement digital transformation need to have a continuous strategizing practice.

7. Conclusion

This study has provided a fresh insight on how the social media ecosystem influences a strategy of small business and how the ecosystem performative is interspersed with context. The study is subjective to my view and personal experience with the sole objective of understanding how the ecosystem of social media influences business. This is because being a situated actor and a researcher engenders a strong feeling of attachment and responsibility for the research subject. Therefore, although this is limited to my personal experience future research can bring objectivity in the same phenomenon by deploying other research methods such as surveys. Furthermore, this research implies Africa as a developing world, future research can explore other emerging markets such as Asia and South American countries. Inferences from other areas will provide deeper insights that will help our understanding of globalization and its influence on small businesses especially during this era of social media.

Author details

Shirumisha C. Kwayu
Bumaco Limited, Tanzania

*Address all correspondence to: skwayu1990@gmail.com

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Section 2

E-service Concepts

Chapter 4

Concept of a Management System for the Formation of Adult Language Skills on the Example of English

Aliaksei Dadykin

Abstract

The relevance of the research topic is determined by the need to create a new technology for applying the most effective methods of forming speech skills of foreign language proficiency in adults. The research is interdisciplinary and is located at the intersection of psychology, pedagogy, linguistics, information technology and systems analysis. The goal is to implement a visual approach in an electronic educational environment to accelerate the acquisition of a new language by adults. The peculiarity of the approach is the logical relationship of the entire language system, time-saving learning of the material and the dynamics of the use of language structures. The proposed training management system is a distributed system for managing the formation (acquisition) language skills of adults. In the course of the system's operation, a detailed statistical analysis of the results is carried out, dynamic learning curves of each student are displayed, coefficient tables are justified and indicators of the formation of speech comprehension skills by ear are specified, and speaking levels are determined from the initial to the threshold level of spontaneous speaking. The conceptual solution of such a system has been obtained, and its use will lead to a synergistic effect in the learning process and, as a result, the accelerated creation of a new language zone in the student's mind. The system provides a process of controlled formation of speech skills to a threshold level that allows you to move from learning a language to improving it in the process of using it. Continuous evaluation of the level of competence of the learner leads to the formation of logarithmic learning curve and compensates for the prerequisites of the degradation of a learning curve in the direction of loss of expected competence, which opens up a new area of search in building learning management systems.

Keywords: continuous evaluation, learning curve, learning management system, synergistic effect, visual approach

1. Introduction

English dominates the world as the language of science, international communication, and information technology. The need for ubiquitous English language teaching continues unabated, and over time, everything gets stronger. Education

systems being one of the most conservative systems of society do not keep up with scientific and technological progress and social changes do not have the capabilities and resources to solve the problems of quickly preparing a large number of adults for language, social and industrial activities. In addition, the coronavirus epidemic has befallen the whole world has aggravated all social problems many times over. We live in a time when the main state structures simply do not cope well with the duties assigned to them:

> health care systems fail to perform their functions and medical staff are forced to show real heroism to rescue people;
> education systems are not able to train people in professional and language skills in a sufficiently short time as a result of which the migration crisis turns into a catastrophe and this is becoming especially relevant now during the pandemic.

The transition to remote learning is a forced measure, but the distance education currently practiced cannot show decent results primarily due to the tendency to use the same approaches for both classroom and distance learning. The main task today is the transition from distance education to full-fledged e-education. However, we cannot use traditional educational technologies that will not bring the desired effect, but will only undermine faith in new approaches. Therefore, it is necessary to develop such teaching methods that will most fully meet the emerging educational needs and will form the basis of electronic educational systems.

Existing learning management systems (LMS) are mainly aimed at managing standard educational processes for the transfer of theoretical knowledge to the education system and are not suitable for monitoring and managing the acquisition of primary language and labor skills. In addition, they usually have a rather complex interface both on the client side and on the part of the administrator and the creator of the training content. These features almost completely exclude the possibility of using LMS as a tool for self-study at home, for example, in a typical situation of migrants and refugees. And filling such a training system with content for different

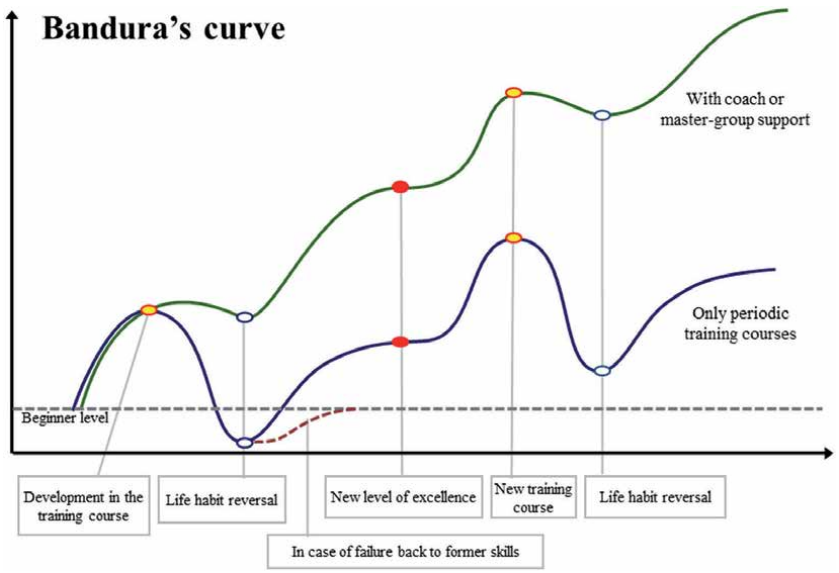

Figure 1.
Comparison of learning curves for retraining.

countries, languages, activities and professions is a task of great complexity, which requires too much time and resources to solve.

Therefore, it is necessary to create a new generation of tools that provide not only the structuring and transfer of knowledge from teacher to student, but also quantitative and qualitative management of the level of skills and competencies of the student and the parameters of his real progress along the learning curve. This is especially important in the field of adult education and retraining. As it was shown in the works of Bandura [1], learning occurs in the process of interaction of the influence of the external environment, human behavior and the properties of his personality. At the same time, the presence of previous experience leads to the fact instead of the usual logarithmic growth, the learning curve acquires characteristic curves with several minima the so-called "barrier to overcome" (**Figure 1**).

The use of modern information and communication technologies (ICTs) together with the use of effective models of skills acquisition will reduce and even completely eliminate the impact of such barriers and, accordingly, accelerate learning and increase its success. System analysis and visual modeling tools will help ensure such integration. At the moment, there are no technical limitations for creating a new generation of systems, and only the complexity of combining knowledge, theories and technologies from completely different branches of science, industry and education in one project does not allow us to combine the existing technical solutions that will be proposed in this project in a new way.

2. Prerequisites for creating a system for acquiring language skills

The ability to communicate in a foreign language is most quickly achieved through progressive mastery of labor skills while simultaneously developing the entire language system, which very accurately and in a timely manner implements the speech skills of a new language necessary for the student in his daily activities. This is the only way to quickly form thinking in a foreign language, in which the presentation of thoughts takes place in accordance with the norms of the new language system acquired for its expression in everyday speech. Modern research is interdisciplinary and is located at the intersection of systems analysis, ICT, psychology, linguistics and activity theory.

The relevance of the topic is determined by the need to create a new detailed technology for the formation of speech skills in the electronic management system for teaching a foreign language to adults. In the third decade of the XXI century, both metdological and technological prerequisites have matured for the realization of this goal. Technologies and tools created under their influence are directly influenced by a changing culture, and their further use is a way of accumulating and transmitting social knowledge.

Technologies using Big Data, artificial intelligence, machine learning, speech recognition and synthesis systems, as well as augmented or virtual reality create the technological basis that forms the basis for creating new LMS. In turn, the Korzybsky structural differential, the theory of activity of Leontiev and his followers, the system of interval repetitions based on the ideas of Ebbinghaus, the theory of formation of Bandura skills and the Structural-Visual Method (SVM) form the core of the Electronic language Acquisition Management System (e-AMS).

2.1 Typical systems for teaching a foreign language

There are a huge number of offers on the market to solve the problem of managing foreign language teaching. These are general-type LMS, programs and

applications for learning languages, both for individual aspects of the language and for the entire language as a system. In the course of research, a large number of such programs, applications and services were studied and tested. Let's focus only on the general features of entire classes of programs and services, mentioning only the most typical examples.

LMS of general type, such as Moodle, Docebo, Edmodo, Schoology and many others, are created mainly for the organization of the educational process within the framework of the classical path of knowledge acquisition. They are designed to facilitate and simplify the activities of the teacher, methodologist, and management of the educational institution and contain a large number of properties, functions, and tools. They are difficult to set up and master and are designed for use within large organizations (schools, universities, large firms). They perform their functions well, but it is extremely problematic to adapt them to manage the individual process of obtaining a specific skill.

Specialized programs due to the low methodological competence of programmers in most cases are created for the study of words. The use of interval repetition methods in such programs and services as Memrise, Mnemosyne, Anki, Supermemo, etc. allows you to quickly memorize poorly structured information, which provokes users to spend a lot of time on rather unproductive activities for memorizing the translation of words out of context and structure. This is also the sin of most services and social networks for language classes such as Duolingo, Busuu, LinguaLeo, etc.

The closest prototype is programs for complex language learning such as Rosetta Stone, Tell Me More, Babbel, etc. They offer tools for developing most language skills and are designed more for self-directed language learning. These programs do a good job with their functions, due to the direct, untranslated method laid down in their basis. But they have their own limitations and shortcomings that slow down progress and force people to quit classes. The main one is the same direct method, which reduces exercises to repeated repetition without understanding the logic of the language.

The situation is aggravated by the complexity and congestion of the interface, the non-obvious methods of training and the rather high cost of such programs. Such programs are created by programmers for people who are good at computers and are poorly adapted for use by ordinary people who are not familiar with computer technology. In addition, the presence or absence of a native language in the interface and content of the program does not guarantee the absence of translation, thinking and comprehension of the material in the native language, especially for people who have already had many years of experience in translation training.

To achieve direct understanding and completely untranslated thinking is possible only by combining the ideal balancing of the complexity and pace of training with the abilities and capabilities of the student by controlling the learning curve, which is one of the most important tasks of the controlled formation of language skills. As the review showed, at the moment there are no programs that allow you to block thinking in your native language and guarantee quick acquisition of direct thinking skills in another. This goal is not only not implemented, but it is not even put.

2.2 Features of language skills formation in e-AMS

New generations of teachers and students have, as before to wonder how to make the process of mastering the language quality and time-saving, what method to use in teaching. As sad practice shows, mechanical mastery of the language,

unfortunately, does not provide any quality or effectiveness of the results, i.e. the ability to complete communication. This result is more natural than accidental: the focus of traditional communication techniques on practical purposes is actually unjustified, since the formal speech approach does not provide real conditions for the formation of psychophysiological mechanisms that ensure the competent use of the language.

2.2.1 Approach to measuring speech skills in a foreign language

The mechanism of speaking any language is set genetically, and it can not be simply changed. As the outstanding Russian scientist academician Shcherba said "We can banish the native language from textbooks and classes, but we cannot banish it from the student's head" [2]. **Figure 2** shows a simplified diagram of the interaction of speakers of different languages within the same subject area. For example, if the work on a joint project in the IT sphere is carried out by specialists from different countries, their linguistic interaction should be considered not in the field of the entire language space, but only in the part that relates to their professional activities. Similarly, it makes no sense to train refugees for a long time in all the intricacies of a new language, it is necessary to give them the skills of a new profession as soon as possible and to ensure full communication within this subject area.

The main form of communication is the transmission of the necessary meaning through dialogue. The minimum possible fragment of the dialogue (**Figure 3**) is an elementary Question, the simplest Answer and the Delay between them. In case of a conversation between partners speaking different languages an additional delay Δ is inevitably added to the process of their dialogue related to the internal translation of the information received from the language of the question to its presentation in their minds in their native language. The same process occurs in the opposite direction when forming the answer.

Considering the same processes from the point of view of training or rather the formation of language skills in a foreign language, we can safely say that either the teacher or any training system should strive to compensate as quickly as possible for this internal delay $\Delta \rightarrow 0$. Then the language zone of the new language will be formed in the consciousness of the learner, or in other words the curve of learning a foreign language will reach the point of "spontaneous speaking". That is, the

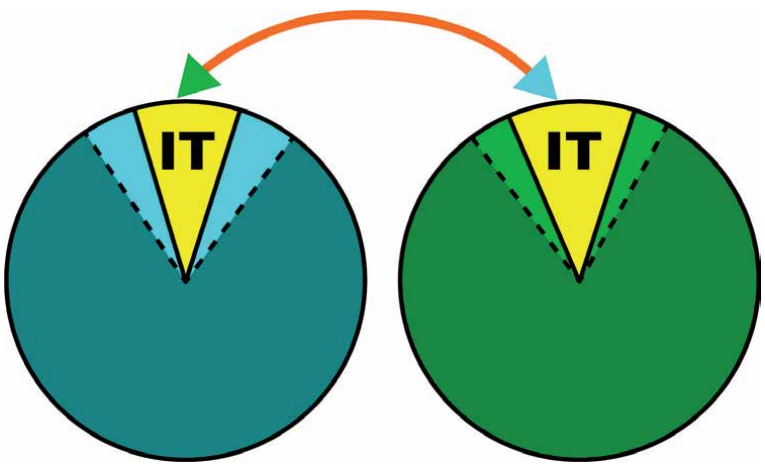

Figure 2.
Interaction between native speakers of different languages within the same subject area.

Figure 3.
Fragment of dialogue between native speakers of different languages.

construction of the ideal process of learning a foreign language is reduced to the creation of such learning tools guarantee the complete elimination of the delay $\Delta = 0$ in the shortest possible time.

It takes at least 100 hours to master the skill of spontaneous speech. This means that we are not talking about continuous speaking, but about completing 30-minute tasks daily, taking into account interval repetitions twice a day (in the morning and in the evening). Such a schedule should be created by the joint efforts of an adult student and a teacher at least in the first 40 days of the language skills development process. The habit developed during this time will allow the student to reach the level of spontaneous speech, depending on his abilities, after about 3–6 months of continuous training, while making extensive use of the structural-visual method. Implementing this approach will not disrupt the continuity of learning.

2.2.2 Structural-visual method in linguistics

For most people instead of a speech mechanism a translation mechanism works introduced by the school approach to language learning, which is physiologically a different process, the opposite of language. To start the speech mechanism, you need to create a database of sound images, speech-motor images and direct connections of these images with meanings.

The translation mechanism prevents the creation of such links and leads to the formation of links between the signs of one and another language. Therefore, after school experience even in non-translation courses on the communicative method or when using programs like "Rosetta stone" most students choose their usual translation strategy. At the same time, acts of thinking and understanding are performed in the native language, and externally language actions (listening, speaking, and communication) in the target language.

Teachers do not yet have the tools to identify, measure, and change the type of mental process, and to find out what process is actually going on. And it is almost impossible to explain these subtleties to the student in order to obtain self-esteem, especially since these processes are unconscious and do not lend themselves to conscious regulation. The relations between processes in reality, sensory and motor processes in the psyche and language are extremely difficult to explain and poorly understood, and have long been the subject of disputes and disagreements between various sciences and scientific directions. Therefore, consciously explaining to the student what, how and why he needs to do is not a solution to the problem. As a result, the habit of the student, developed earlier in the course of a long experience of studying at school or other institutions, still takes over.

Psycholinguistic studies have shown that the use of grammatical rules for planning and controlling utterances slows down speech activity [3], since the same areas of the brain and mental processes that are needed for understanding or producing speech are involved in operating with the rules.

The Structural-Visual Method, which replaces complex text rules with corresponding visual structures in the form of drawings, diagrams and diagrams, allows us to get out of this contradiction. The application of SVM in linguistics consists in the use of graphical means to demonstrate the structure of an English sentence and how it is constructed in various forms with extensive use of color for encoding meanings.

Replacing verbal Rules with Visual Models (VMs) allows you to make significant improvements to any training method. Instead of hindering language activity, SVM allows you to consciously manage the training of professional skills and very accurately control the process of forming language skills. This removes the acquisition-learning contradiction and turns the grammar monitor into a grammar scaffold. Visual models allow you to quickly launch the speech mechanism and provide not only a comprehensible input, but also a comprehensible output, which in Krashen's theory rightly seemed inefficient [4].

SVM reveals the mechanisms of practical use of both visualizations of the first kind, which include visual dictionaries and virtual classes, and visualizations of the second kind, which are embodied in Dynamic Grammar, as well as Visual Models based on it [5] and map-tables for different levels of foreign language acquisition.

Leontiev defined visualizations of the second kind as "the external support of internal actions" [3]. Such tools for describing the grammar of a foreign language should be available in every linguistic class, and then only a thoughtful look is enough to understand the structure of the language. The subsequent training of professional skills will allow you to consolidate and transform the consistently formed fundamental grammatical skills into solid skills of speaking a new language in the form of a conscious statement or dialogue. In their significance, Visual Models and Dynamic Grammar are comparable to the periodic table of chemical elements, which hangs on the wall in any classroom where chemistry classes are held.

Figure 4 shows the stages of development of elementary action [6] on the example of the verb Do, where the black arrow indicates the direction of development of the elementary process and the flow of time. The figures below the arrow indicate what is happening in reality, and above the arrow is in the mind. Moreover, the dynamics of the development of an action can be clearly traced from the idea to its completion and is quite accessible to any adult student.

Figure 4.
Dynamics of change of the verb DO.

The extended dynamics (**Figure 5**) is created by highly qualified linguists and is difficult for students to understand in the first stages of training. In the future, each visual grammatical construction is transformed into a Visual Model of the appropriate level with such assumptions, when the illustrative material is correlated with a specific task of mastering professional material, with specific educational actions. Then the teachers know exactly what the introduction of visibility is necessary for in each particular case, and submit Visual Models in combination with map tables in the form in which they can best perform the corresponding professional task.

Without basic grammatical skills, the same communicative approach turns into simple memorization of spoken phrases. Visual structures of English sentence construction allow for conscious practice, that is, independent planning of the utterance and control of its correctness. It is proposed to focus primarily on mastering the system of English tenses and automation skills, and to postpone the variety of communicative situations for subsequent practice. If you work out the basic construction on a limited number of vocabulary to full automatism, then their use in the future will not cause difficulties and will not require conscious control by the rules. Language acquisition is much faster when there are ready-made algorithms with which the language "works" than when you try to independently derive these algorithms from the speech stream and communicative situations.

A simple video lesson using Visual Models of the English Language for beginners can be viewed at the link Video 1. More detailed information about SVM is provided in [7].

In combination with Visual Models [8, 9], lingvomaps are used (**Figure 6**) and card tables that provide a mode of accelerated formation of grammatical skills. According to the Krashen's input hypothesis of the understandable input material, which is in good agreement with Vygotsky's theory of the Zone of proximal development (the methodological principle of potency) [10], the development of skills occurs when performing exercises that are one step more complex than the current learned level. Increasing the current level can be achieved by increasing the speed and accuracy of the material of the same level of complexity (advanced training), or the introduction of new material (new knowledge-competence-skills).

Since the learning curves (acquisition of knowledge) and learning skills (acquisition of skills) have significantly different forms and numerical parameters, unjustified transfer of methodological techniques from one field of application to another leads to unreasonably slow progress or its complete absence. The choice of the optimal mode of teaching skills in the field of grammatical skills is complicated by the lack of a mathematical description of the regularities of this process, almost complete lack

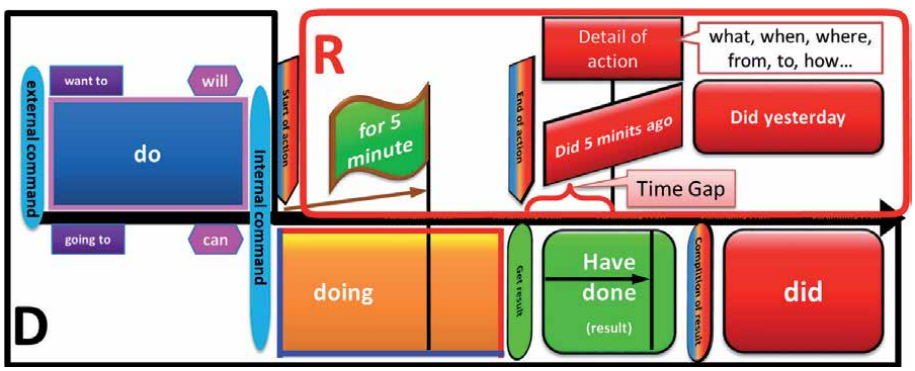

Figure 5.
Extended dynamics of change of the verb DO.

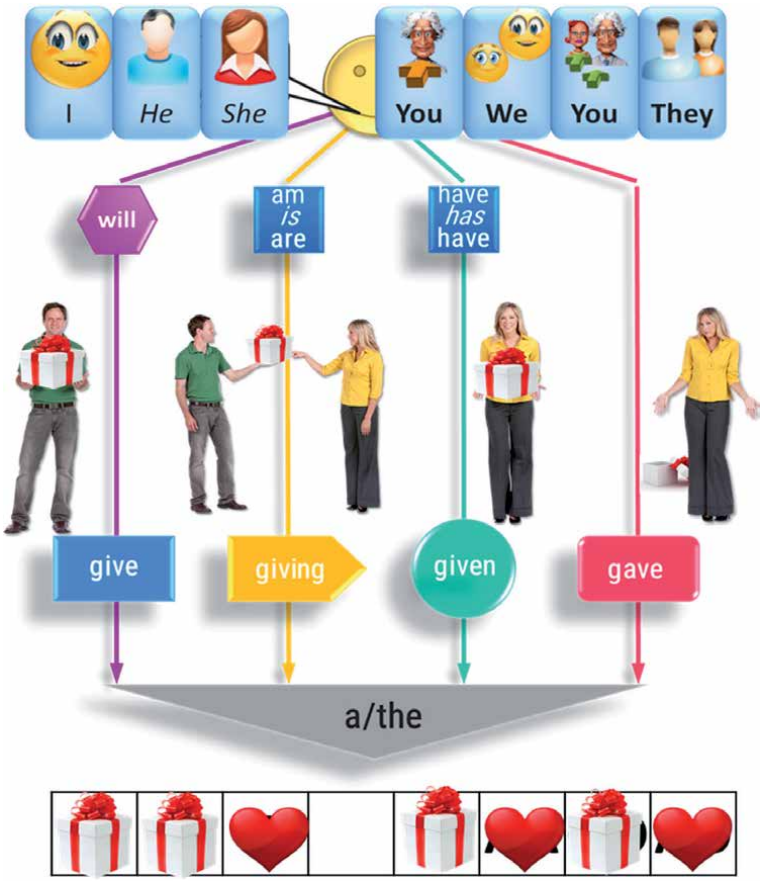

Figure 6.
Lingvomap.

of accurate data and available means of obtaining them. This is due to the extreme complexity and multilevel structure of the language, which is a fractal system with a huge number of interrelated variables, mathematically not strict and ambiguous.

Dynamic Grammar can be used as an independent tool that allows you to bring "correct speaking" into everyday speech activity, but its most effective seems to be to use it as part of interactive speech simulators as part of an electronic acquiring management system (e-AMS).

2.2.3 Language competence management

Forgetting information is fast enough, but electronic Acquiring Management System will ensure the formation of a logarithmic dependence of the learning curve, will avoid the "barrier to overcome" and prevent the transition of training in the mode of retraining (**Figure 7**).

The proposed e-AMS is primarily aimed at developing listening and speaking skills, which are fundamental [11–13] and account for about 75% of the total required competencies (**Figure 8**). As we can see, written speech accounts for less than 10% of the total language competence, so it is not taken into account in our system. In addition, there are several variants of perfectly functioning Internet systems that are specifically designed for learning grammar in writing and can easily be added to e-AMS.

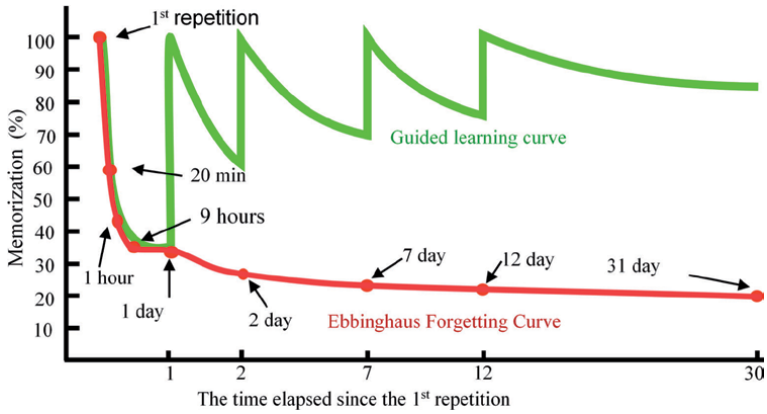

Figure 7.
Comparison of guided and unguided learning processes.

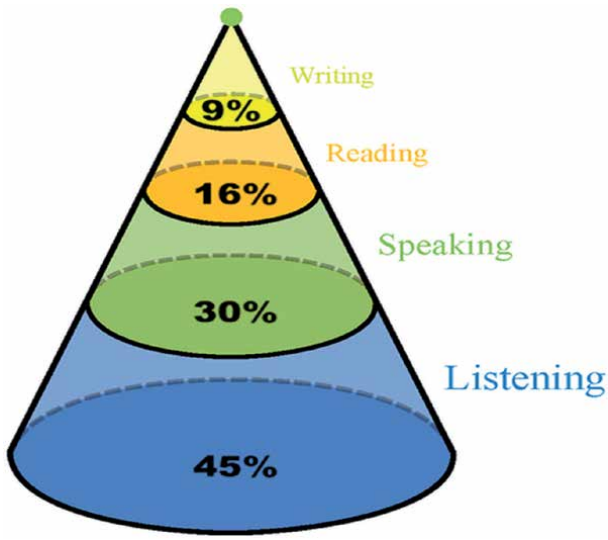

Figure 8.
Distribution of language competences.

In fact, the description of the process of obtaining the necessary result i.e. achieving the level of "spontaneous speaking" is reduced to a mathematical dependence:

$$Rez = \mathrm{F}_{\mathrm{minmax}}\left(Li, Sp, \mathrm{Re}, Wr\right) \approx 350\,\mathrm{hours},$$

where: Li – listening, Sp – speaking, Re – reading, Wr – writing.

Moreover, particular importance attaches to the correlation between R_{Li+Sp}, $\mathrm{R}_{Li+\mathrm{Re}}$ and R_{Li+Wr}, because the process of forming language skills is not determined by simple listening, but works only if the learner strives to imitate the sounds of new speech as accurately as possible and understands the structure of the language at an accessible level.

Therefore, regular lessons (**Figure 9**) in e-AMS of 25–30 minutes each should consist of:

pre-recorded introductory part (3–5 minutes) in which the teacher explains the meaning of the lesson, and only in this part of the lesson explanations in the student's native language are allowed, if the visualization mechanisms are not enough to convey the meaning;
main part (about 20 minutes) can be spent in a virtual classroom for the chosen profession, this part of the lesson uses the main components of SVM, which are Visual Models and Visual Dictionary;
final part (5–7 minutes) is a grammatical training based on maps-tables, fixing the language skills at the appropriate level.

Successful conscious training requires two modes: linear demonstration of patterns to implement them, and random training to fully automate the skill. The first mode shows the linear change of one parameter with fixed other variables. When using the second mode, you can combine linear and random changes to these parameters to create unpredictable situations that require real thinking using language to complete the task.

A video example that briefly explains the meaning of such lessons is provided at the link Video 2.

Currently, the first prototypes of interactive trainers using visual models are created. To implement the full functioning of the e-AMS, 3–7 standard simulators are required at each of the increasing levels of language proficiency in accordance with the program of formation of professional skills of the student. The total number of trainers is about 25.

It should be well understood that the main contradiction that prevents the creation of effective tools for rapid mastery of another language is the logical closure between the language as a tool for managing activities and the language as a subject of activity. The essence of this problem is that if the student does not know how to make a proposal that conveys the desired meaning, then he will not be able to do it. But if he knows the rule of how to do it, then he still can not do it, since the area of the brain responsible for speaking is busy thinking about this rule.

However, one of the most effective ways to teach a language is to learn through the simultaneous formation of professional skills. The proposed approach allows you to form a speech zone based on the study of not individual words and grammar, but the use of typical situations, working dialogues, short sentences, phrases, speech patterns, and even slang. The general view of the process of forming a new speech zone is shown in **Figure 10**.

Teaching materials should be presented in about 90 video tutorials and about 60 training exercises. The corresponding Common European Framework of Reference (CEFR) [14] test system is quite suitable as a control test for the transition from one level to another with one reservation the system must be adapted to the planned

Figure 9.
Schematic drawing of a typical lesson structure in e-AMS.

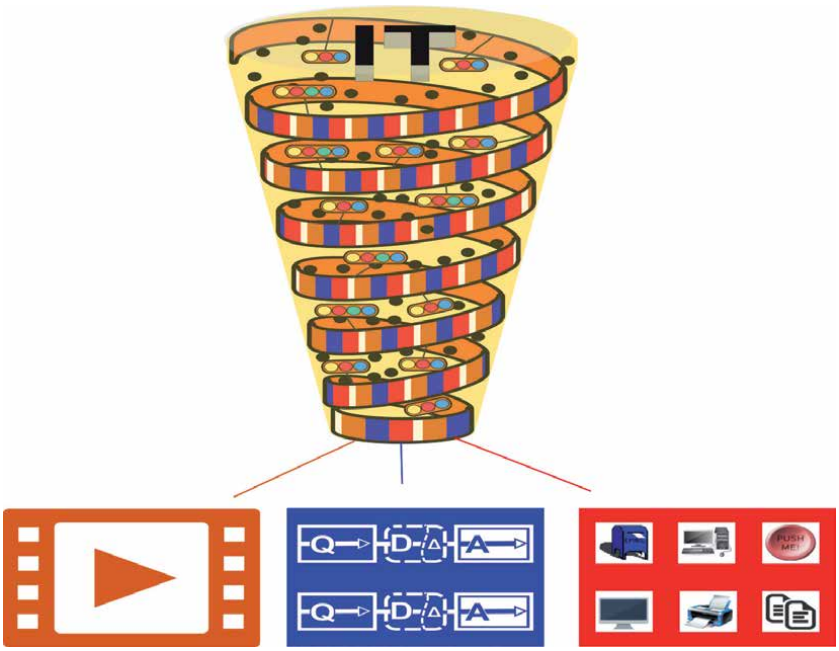

Figure 10.
General view of the process of forming a new speech zone using e-AMS.

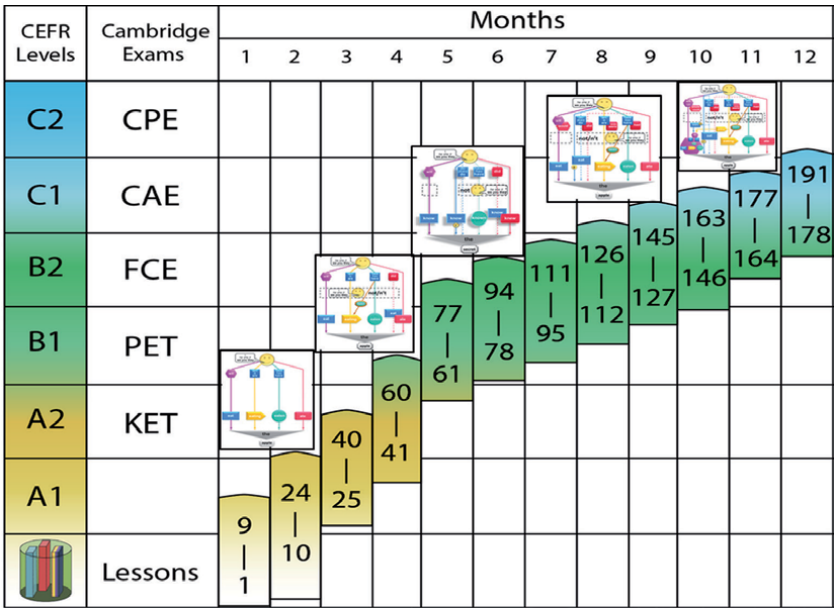

Figure 11.
Approximate order of using Visual Models according to the learning curve.

professional activity of the student and implemented in two stages at each level (**Figure 11**).

Thus, the development of a new language is a transition to a new way of thinking, causing speech production in accordance with the grammatical schemes and semantic connections of the system of the studied language It is here that the gnoseological roots of SVM are found, which is used in the proposed e-AMS.

3. Electronic system for acquiring language skills

The conceptual solution is based on the use of mechanisms of system analysis and unification of scientific concepts of representatives of the Soviet school and scientists of Western countries against the background of the technological leap of the second decade of the 21st century. E-AMS allows you to manage the process of forming professional and language skills of adults and combines:

methodological principles justified in the works of Bandura and Galperin [15];
Structural-Visual Method that accelerates the achievement of linguistic competencies both at the initial stage of learning a foreign language and at the stage of "barrier to overcome";
using the achievements of the IT sector as a tool for ensuring the implementation of training goals with continuous monitoring of the current state and obtaining a guaranteed learning result in a finite number of steps.

3.1 Structure e-AMS

The prototype being created is a distributed system for managing the acquisition of professional and language skills by adults. The main components of the system [16] (**Figure 12**) are: Interactive Speech Trainers with Visual Models (IST with VM), a Content Management System (CMS), a Speech Recognition and Modeling System (SRS), a System for Continuous Evaluation (CES) of the level of language skills and a Virtual Assistant (VA).

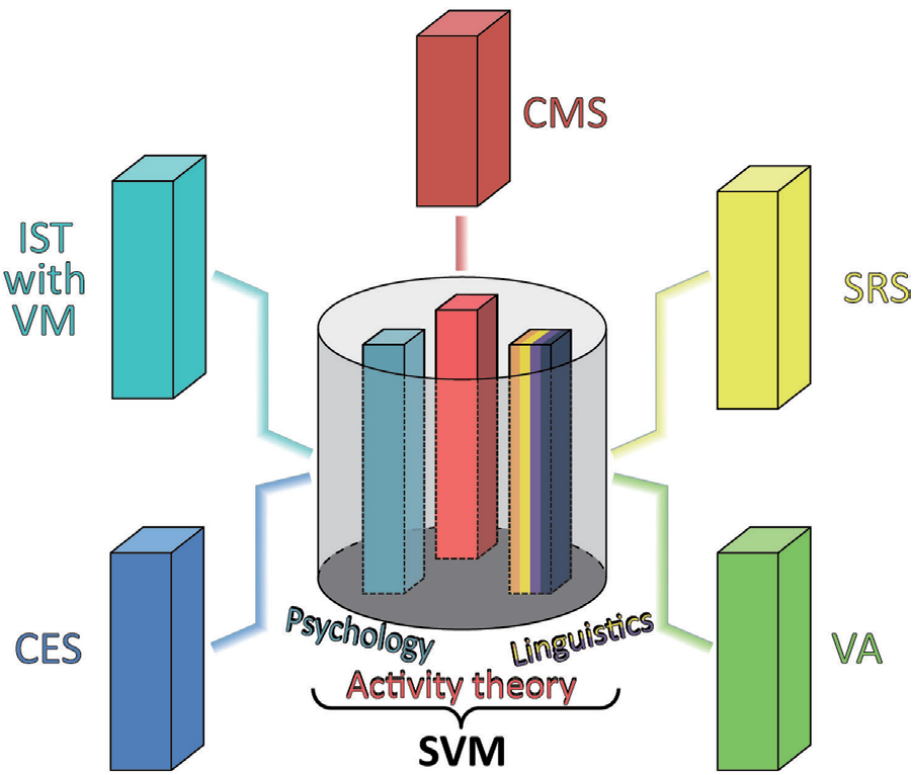

Figure 12.
Generalized structure of e-AMS.

This training system has the properties:

unity of the main goal of learning outcomes for all its elements;
high stability of the entire system and the independent value of each element;
correlation between the elements of the system, providing positive feedback in the process of formation of professional and language skills;
continuous evaluation of the level of competence of the student, which ensures the formation of a logarithmic dependence of the learning curve and compensates for the prerequisites for the degradation of the learning curve in the direction of loss of expected competence;
ability to evaluate and compare the results of similar educational systems and technologies, as well as their individual components;
cross-platform in relation to operating systems and programming languages, and invariance in relation to the student's native language and the foreign language being studied.

Interactive Speech Trainers are a new generation of chat bots that use artificial intelligence mechanisms to configure each student in the system, and Visual Models are in the form of augmented reality elements. This combination will allow you to fully immerse yourself in the process of forming skills and guarantees the maximum concentration of the student's attention.

Content Management System is designed to ensure the formation of educational material based on the most frequent words and semantic structures from the Corpus of the English language, subsequently modified by the subject area of the acquired professional skill. The current frequency is automatically determined using the Google Ngram Viewer resource.

In the course of work of the **Continuous Evaluation System**, a detailed statistical analysis of the results is carried out, the dynamic learning curves of each adult student are derived, the coefficient tables are justified and the indicators of the speed of formation of speech skills are clarified, the levels of speaking from initial to spontaneous are evaluated in accordance with the CEFR scale [14]. Not the curriculum, and the level of professional skills and language proficiency in the current time will be the determining to move forward on the learning curve.

Special methods of using a **Virtual Assistant** will allow you to organize the process of training language skills in such a way that the inclusion of the translation mechanism could not happen physiologically. The system will feed the material at such a speed that the exercise can only be performed without translation. Another option is also possible, which is used now, when the target speed of simple exercises is set such that it is almost impossible to perform them in a transferable way in the allotted time.

In addition, the VA must perform the function of a media aggregator, which provides the ability to connect to various services and find interesting professional content (virtual classes, photos, audio, and video) according to various criteria with reference to the level of current language proficiency of an adult student.

E-AMS continuously operates at three levels:

moderator-programmer who is one of the development team;
teacher who updates content, processes general learning statistics at different levels, and in complex cases decides on the teacher's work through interactive platforms "face-to-face" with the student;
the most important level is the level of an adult student who consciously "transfers" his own consciousness to the control circuit of the educational process.

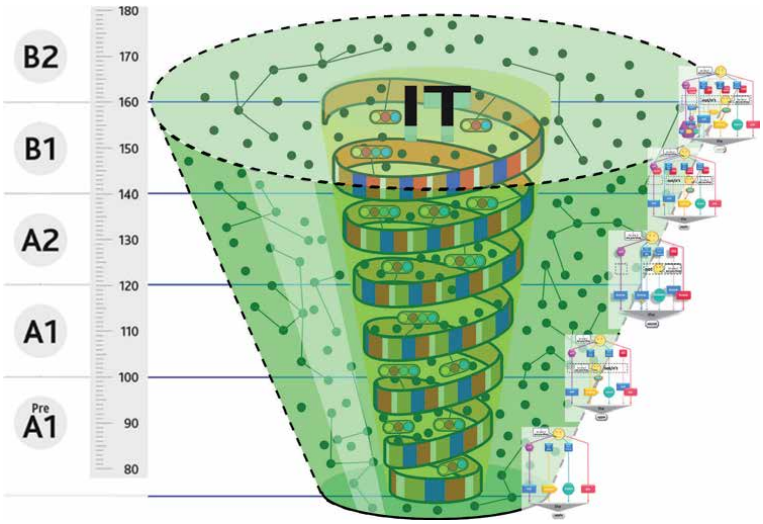

Figure 13.
Visual Representation of e-AMS.

Of interest is the Visual Representation of e-AMS (**Figure 13**), which is an attempt to display all of the above in one figure. In fact, this is a visual representation of the theory of interiorization, or the creation of an indicative basis for mental activity according to Halperin, implemented in the adult learning process using e-AMS.

3.2 System architecture

Currently, the development of the main components of e-AMS is carried out in four interrelated areas:

- further improvement of the visual approach that models the structure of the mastered activity based on an interactive visual dictionary and visual models;
- creation of a set of interactive speech simulators with elements of augmented reality, video lessons and training exercises corresponding to different levels of students' competence;
- development of a content management system, formation of repositories of educational materials for video tutorials and mechanisms for managing the synthesis of educational exercises;
- setting up a system of continuous evaluation and management of the learning process in real time.

The last two directions of development of e-AMS are connected exclusively with Big Data. The language system is not limitless and in fact is quite observable, but its full use presents numerous opportunities for combining, which until recently exceeded all possible system conditions, and only now the use of Big Data technology can successfully solve these problems.

In addition, a system of continuous evaluation and learning management provides the configuration of the entire system at the levels of:

- interface of speech simulators, where all the achievements in the field of gamification, socialization and cooperation should be fully provided for the translation of the educational process into a modern, intensive and effective format;

continuous measurement and control of the learning process of each individual point of a learning curve or retraining in real time, which provides an individual approach to individual skill training, as the rate of exercise is not defined by an external statement or interface training program and abilities and competence level of each individual student.

Figure 14 shows the system architecture for the first three main parts of the e-AMS: IST with VM, CMS, and SRS [17].

Implementation of the platform. The Platform will be implemented using the C# and JavaScript APIs. Since the advent of the HTML5 standard, there have been new opportunities to develop robust and efficient APIs that support voice processing, and this powerful, widely accepted standard includes interaction with various media, protocols, and programming languages [18]. The HTML5 page can handle voice and speech recognition recorded directly from devices, possibly available on the user's hardware. In addition, WebGL programs consist of control code written in JavaScript and special effects code (shader code) rendering in HTML, use the development element to draw WebGL graphics for visual programming with the introduction of programmable visual effects (for example, elements of augmented reality in the form of VM) and interact with the web page using scripts.

The **web server** contains a client-side API for transmitting the received data from the database (DB) server to the graphical interface for the client and connecting from the web server to the database using data access layers. These layers contain a connection manager and business layers containing a set of objects (classes) that return data as a set of data for use by web services and JavaScript and WebGel using Google services for speech modeling and speech recognition.

Database design. These are relational data tables that contain information about the lessons, as well as all information about the results of the lessons for each student for further extraction into the system. The results about any student and the lessons conducted with them will be stored in the DB, and dynamic learning curves will be formed on their basis.

Information Request and Display Module (IRDM). In this module, images representing action verbs in sentences are displayed as action and VM images. This

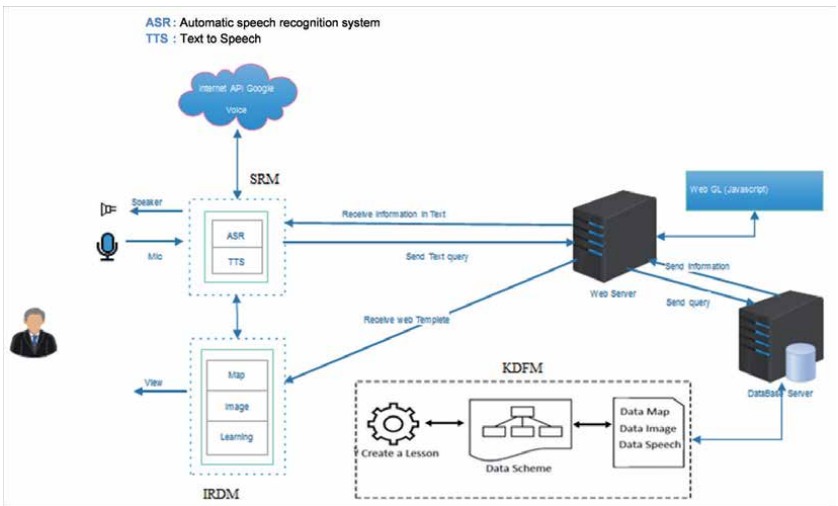

Figure 14.
System Architecture.

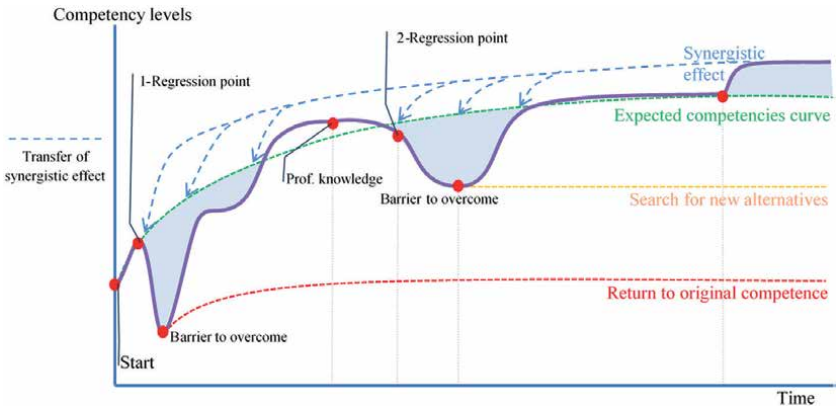

Figure 15.
The learning curve with the transfer of synergistic effect.

module allows the teacher to control the program parameters via the keyboard and computer screen, and this information is sent to the web server: once the information is processed the selected data is displayed to the teacher as the content of the next lesson.

Knowledge Data Formation Module (KDFM). The module consists of a DB that contains all the relational tables and is used to describe and represent the area of knowledge defined by the topic of the classes. The DB contains stored procedures that provide a way to create lesson content at the teacher's request depending on the selected level of complexity.

Speech recognition module (SRM). This module allows the student to interact in our platform using voice. The system returns the information to the SRM for conversion to speech using Text-to-Speech (TTS). The user speaks into the microphone, and this information is converted into text in the Automatic Speech Recognition (ASR) system. In the web server the java script functions check the correctness of the displayed text in the IRDM from this input data. Finally, the feedback of speaking will be permanently stored in the DB to evaluate and improve the transmitted meaning and pronunciation at the same time.

The introduction of modern ICTs into the structure of the foreign language LMS, along with the use of effective learning models, allows to speed up this process and increases its success by transferring the synergistic effect to all stages of the formation of language skills, especially to the "barriers to overcome" to accelerate the return to the expected competence curve (**Figure 15**). This approach opens up a new scientific direction in the construction of LMS.

4. Conclusions

E-AMS is a unique science-intensive high-tech product. Its use will lead to a synergistic effect in the learning process and, as a result, the accelerated creation of a new language zone in the minds of adult learners. The system provides a process of controlled formation of professional and speech skills, which allows you to move from language learning to its improvement in the process of use. It is created on a modular basis, so each element of the system can be effectively developed and used separately. At the same time, the effect of sharing all elements of the system and integrating additional developments can significantly exceed the capabilities of existing analogues and help solve very important social problems.

In the European Union as part of the Horizon 2020 program, a preliminary assessment of the material and time resources for the creation of a border system combined with the necessary infrastructure for the implementation of the task of training professional personnel and language adaptation of refugees and migrants was carried out. Such expenses amount to approximately 5 million euros, which should be allocated over 2 years, provided that the necessary work is carried out in parallel between 5–6 institutions or organizations.

Within the framework of the current Horizon Europe program, the amount of resources allocated will certainly be increased since apparently the EU leadership does not have a constructive understanding of how to turn the existing migration crisis from a state of humanitarian disaster into a process of managed migration. The consistent appearance of even individual components of e-AMS will contribute to improving the quality of the educational process in the field of foreign language acquisition and expanding international relations.

The work is in its initial stage and researchers from Ukraine, Lebanon, the United States, Japan, and Belarus are involved in the project to some extent. It should be emphasized that it does not contradict the existing system of assessment of language competencies in Europe, but rather contributes to increasing their importance. The role and place of e-AMS in the Cambridge exam system and the assessment systems they have developed is shown on the right side of **Figure 16**.

I would like to note that the documents prepared by the Council of Europe on the basis of the recommendations of Cambridge and other educational institutions of the United Europe, talk in detail about multi-stage levels of language proficiency, but they do not say anything about how to achieve this in the minds of adult

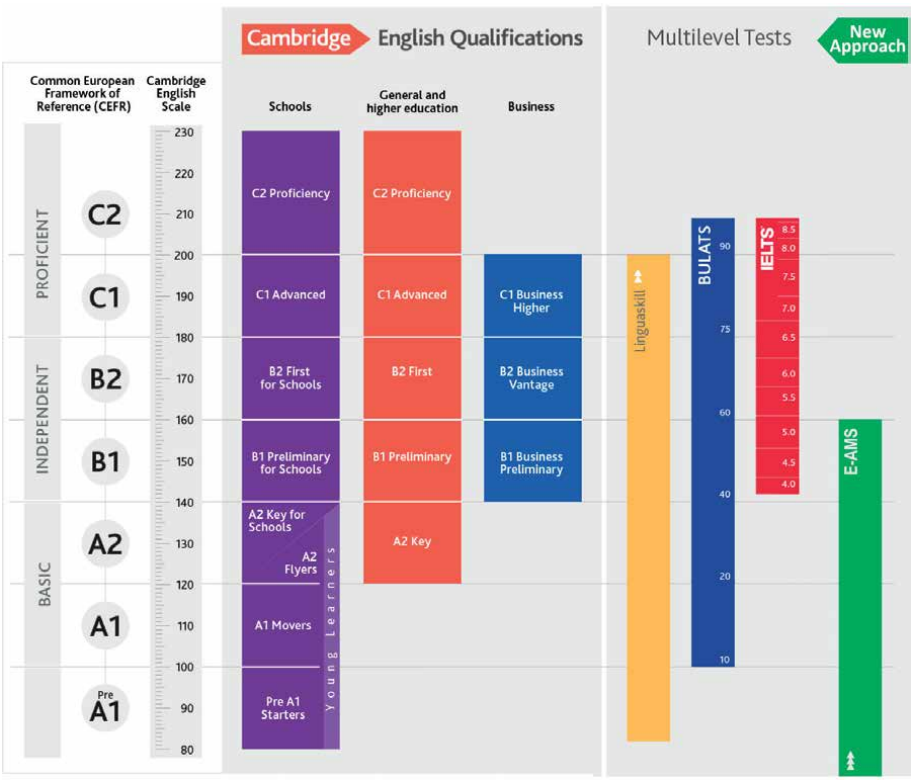

Figure 16.
CEFR and the new approach.

students. It seems that these organizations have a poor understanding of how to do this in relation to adult learners in a fairly short time and on a mass scale.

That is why the problem of refugees and migrants sometimes becomes a disaster in the developed countries of Europe and the United States of America. One of the main reasons why developed countries refuse to accept them is, first of all, a lack of understanding of how to solve the problem of training a large number of adults with their subsequent employment. Therefore, both in Europe and in the United States, instead of destroying walls like the Berlin Wall, they plan and create walls between states, spending huge sums on this, exceeding the cost of creating high-level educational systems by thousands of times (**Figure 17**). Maybe now with the arrival of the new White House administration, the situation will change?

The implementation of such a project is particularly important for refugees and migrants. In a relatively short time, they will be able to get not only all the necessary information about their new profession, but also to acquire stable language skills of the new homeland. Moreover, the learning process will take place remotely, without the work of a teacher directly in the classroom face-to-face with students, and the classes themselves can be held at any point where there is an Internet connection. The resulting solutions and tools will actively contribute to the efforts of state administrations to manage the integration of migrants at the national and local levels. They will also facilitate communication with migrants and their access to services such as vocational and language training, employment, education and social security in host communities.

Expanding the influence of SVM in educational institutions in different countries and especially the widespread introduction of components in the market of electronic educational services will change the trends that have existed for decades and eliminate existing gaps in the ratings of even developed world powers. For example, such a technologically advanced country as Japan, according to the EF EPI Rating [19], is only on the 55th place in the world, which is significantly lower not only, say, Italy (30) or Spain (34), but even Belarus (40). Despite the existence of the project IT-country (**Figure 18**), the implementation of a full e-AMS in Belarus is not planned in view of the utter disinterest of the educational structures to change the current situation for decades, are encouraged to seek independent decisions within the system startups or search for like-minded people abroad.

Figure 17.
The Wall and e-AMS costs.

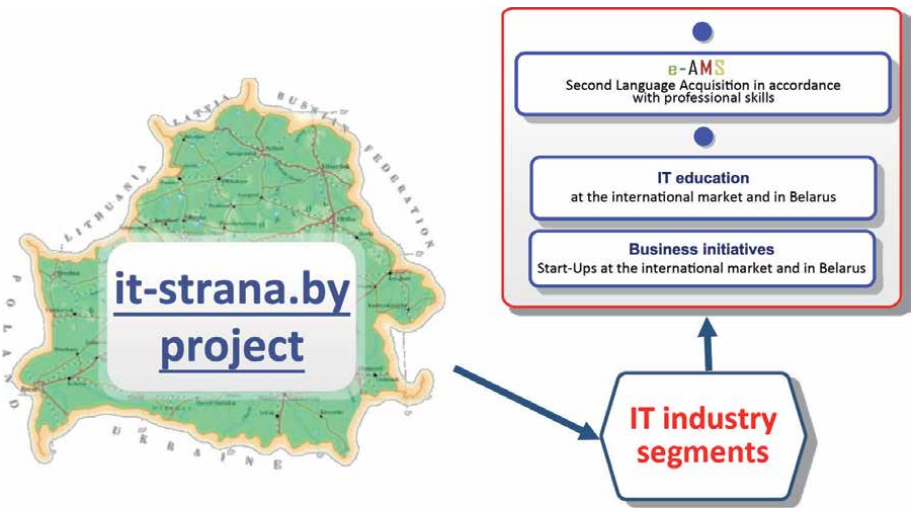

Figure 18.
IT Country Project.

Progress is impossible to stop, however sometimes it is the education system because of the extreme conservatism and focus of their activities primarily on the implementation of government social orders do not contribute to the innovative development of society. An alternative to this is electronic learning systems can quickly implement and put into practice the most advanced technological innovations.

The proposed e-AMS provides the formation of the speech zone of the acquired language in the mind of the learner due to a sharp increase in the effectiveness of exercises by transforming grammatical information from verbal to graphic form. In addition, continuous assessment of the level of competence of the student leads to the formation of a logarithmic dependence of the learning curve and compensates for the prerequisites for its degradation, providing a synergistic effect in the learning process. As the core of the system, it is planned to use the Structural-Visual Method to create non-Verbal means of teaching foreign languages based on modern technologies, teaching new labor skills and new social interaction.

The main result to date can be considered a conceptual solution to the problem of simultaneous interaction of the language system and ICT tools that ensure the sustainable formation of foreign language thinking of adults in the process of developing professional and language skills presented at the system level.

Acknowledgements

I would like to express my gratitude to Anatoly Osipov, Vice-Rector for Scientific Work of the Belarusian State University of Informatics and Radioelectronics (Belarus), for financial support in publishing this chapter.

I would like to express my special gratitude to my co-authors: inventor of visual models Vitaly Dibrova (Studio of Languages, Ukraine) for the provided video materials; Professor Tomokazu Nakayama (Jissen Women's University, Tokyo, Japan) and Professor Boyd Bradbury (Minnesota State University Moorhead, USA) for their sincere support of the idea of creating e-AMS; Professor Igor Schagaev (IT-ACS Ltd., London, UK), whose scientific ideas inspired me to develop e-AMS and write this chapter.

I also thank my graduate students: Imad Tahini (Lebanon) for creating a working prototype that demonstrates the interaction of the three main parts of e-AMS and Artsyom Marzalyuk (Belarus) for creating the drawings in this chapter.

Video materials

All video materials referenced in the text are available at: https://bit.ly/3ooKHC1

Author details

Aliaksei Dadykin
Belarusian State University of Informatics and Radioelectronics, Minsk, Belarus,

*Address all correspondence to: alex_05_07@rambler.ru

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Chapter 5

Accessibility Experience Design (AxD): A Bi-directional Accessibility Perspective for e-Business Services

Aghaegbuna Obinna U. Ozumba and Chineme Ozumba

Abstract

This chapter proposes the idea of accessibility experience design for e-business services, as a bi-directional accessibility perspective for e-business growth in market share. The study is based on the needs for social justice, inclusion, and access on one hand, and business profit on the other. e-Business services have continued to grow with advancement of web and mobile business applications, which give better access to customers and influence the public. Awareness of the need for universal accessibility, to the services which are progressively being offered online, has also increased. Recently, accessibility policies and regulations have become more visible. However, even with the current COVID-19 situation and the shift to online mode, e-business services still lag in web and document accessibility. The resultant loss of access to the sub-population of impaired people results in missed business and market expansion opportunities. Therefore, this chapter explores the current drivers of accessibility practices, adoption by e-business services, and their market implications. The bi-directional accessibility perspective is proposed through the notion of accessibility experience design. The chapter is based on secondary research, which is complimented with demographic analysis of existing population data sets.

Keywords: a11y, accessibility, design, disability, document, e-business, impairment, ux, user experience, web

1. Introduction

Our research interest here is the apparent lack of access to the population sub-group of people living with disabilities and the economy they possess, due to the currently sub-optimal provision of accessibility in e-business services. The study is centered around the link between concepts of social justice, inclusion, and access on one hand, and concepts of market share and business profit on the other. It is based on the view we put forward here, that the sub-population of people living with disabilities is substantially and continually increased by those who are progressing in various aspects of impairment, and that they possess the capacity to make economic decisions and effective demand of business services, including e-business services.

People living with disabilities have certain conditions, and due to the lack of enablement by their circumstances/environment, they are unable to function fully and independently in life. It should be viewed as an outcome of the complex relationship between the impaired person and their environmental factors which essentially result in the situation of disability in human functionality [1–3]. It could be obvious or hidden, temporary, progressive, permanent, continuous, or situational, etc. [1]. There are various types and degrees of impairment. It generally refers to the senses and motor ability, such as sight, hearing, touch/feeling, mobility, and cognition [1, 4]. These types and their respective degrees of impairment, place limitations on how well individuals can use conventional systems of information and communication. Such systems arguably include physical products, the internet, digitized information such as apps, websites, electronic documents, and other digital media such as video, audio, graphics, and animation. There is therefore arguable need to provide accessibility to such nature of information for people with relevant disabilities.

Accessibility in digital information refers to the provision of ways and means through which people with various disabilities can access digitized information. It is the application of the principles of universal accessibility (UA), as expressed by the UN convention on the rights of persons with disabilities [5], UN disability and development report [6], UN DESA-UNESCO forum on disability and development [7]; and whose general approach and methodology is provided in the International Standard Organization (ISO) ISO/IEC GUIDE 71: 2014 [8]. Digital accessibility is provided for in the ISO 30071-1 standards [9]. There is the Web Content Accessibility Guidelines 2.0 (WCAG20) by the World Wide Web Consortium (W3C), which is universally adopted [10], with the four principles emphasizing that content must be perceivable, operable, understandable, and robust for current and future technologies [11]. As highlighted in the e-Accessibility policy toolkit, the approach should be to balance relevant factors, in providing access to full participation and independent living to all. The factors include "utility, usability, accessibility, desirability, affordability, viability and compatibility" [12].

Apps, Web and electronic document accessibility, are areas of concern for e-business services, being the medium through which, electronic services are offered to the public, by companies offering e-business services [13, 14]. e-Business is the use of information and communication technologies, with electronic means, in the digital realm, to transact information in the supply and value chains of business, as opposed to the traditional, manual, physical human interface and agency-based models [15, 16]. e-Business services are applied in various aspects of life including general e-commerce, supply chain management, customer relationship management, business intelligence, enterprise application, etc. [16, 17]. Most, if not all, currently available e-businesses, offer services to a wide range of customers, including the population sub-group of disabled people. This chapter deals with accessibility for the web, electronic document, and digital media, through which e-businesses package and deliver their services.

The provision of relevant types of accessibility for impaired people is viewed as an ideal goal and necessity. There are other initiatives such as the Web Accessibility Initiative [18], WAI-ARIA, the Accessible Rich Internet Applications suite of web standards [19], and A11Y Project [20]. In some cases, digital accessibility is regulated and enforced. For example, there is the European accessibility act of 2019 [21]. There are relevant laws in various countries, from Asia to Europe and the Americas [22–24]. In the context of the United States of America (USA), there is the Section 508 of the US Rehabilitation Act of 1973, as amended, with the Information and Communication Technology (ICT) Standards and Guidelines, under enforcement in USA agencies [25]. There is also the Americans with Disabilities Act of 1990

(ADA) with the ADA Standards for Accessible Design (1991 Standards), and the 2010 ADA Standards for Accessible Design [26].

The need and awareness for accessibility, the global conventions and policies, and regional and national laws, should constitute substantial legal, social, and economic motivations for the speedy adoption of accessibility standards globally. However, the visible level and rate of adoption is still low, and absent in some cases. For example, the WebAIM case study of top 1million websites in February 2020, found that 98.1% of home pages exhibited automatically detectable WCAG2 failures [27].

Apparently, the general view of accessibility has not evolved into that of a business opportunity, which will be inherently motivating to the business community, and therefore drive more adoption. In the USA for example, the total number of ADA lawsuits in 2019 was 11, 053, while the state of California recorded 1885 lawsuits in 2019 [28]. Furthermore, 4, 759 lawsuits were filed in federal courts within the first half of 2020 [29]. Considering the trend of lawsuits, there is a need for more motivation towards the speedy adoption of accessible design. The reported legal trends will only support the current trend of minimal adoption, and at the level of minimum requirements. Our argument in this chapter is that e-businesses need a perspective that sees the provision of accessibility, as a means to gain access to the sub-population of people living with disability. The concept of Bi-directional Accessibility in e-business services, if adopted, would achieve substantial improvement in the approach to accessibility, which will increase adoption, especially in e-business service delivery.

1.1 The concept of Bi-directional accessibility for e-business services

Bi-directional accessibility can be thought of as a philosophical view of accessibility which says that when a barrier between two parties is removed, access is achieved, not only for one party, but for the two. Using the analogy of a physical space with secure access: When the door is opened, it gives access to the person without to enter the room, while giving access to the person within, to exit the room into the space from where the other person enters the room. Using the analogy of the internet service: When someone uses a computing device such as a tablet computer to access a website, the unique internet protocol (IP) address of the device is registered with the service provider. The act of accessing the website automatically makes it possible for the website administrator to determine the IP address of the device, which can be used to trace it. The idea of bi-directional accessibility is currently applied in internet services. A key example is where websites offer free resources, which require visitors to enter contact details such as email address. Some websites will send a link to the free resource, to the email address as a validating measure. Currently, due to regulations on the use of personal information [30], visitors would be made to agree to privacy policies, before accessing some of these free resources online. By accessing the free resource, the visitor willingly gives the website administrator their email address and agrees to receiving information from them such as promotions and newsletters. This simple transaction gives many web-based businesses access to an ever-growing customer base. In practice, many such visitors evolve into customers in their database, which is an increase in market share. The Bi-directional accessibility perspective says that if e-business services make accessibility a priority and implement it fully, they will gain access to the market share that is made up by people with various disabilities. Essentially it provides a combined view of accessibility, where the inclusivity factor is balanced with the business case. Adopting this view will make businesses more proactive in the provision of accessibility in their digital space, as opposed to being compelled by

the threat of lawsuits. Businesses will then go beyond providing basic accessibility, to providing what we have classified as 'Accessibility Experience Design' (AxD), in the design of their e-business services. However, this notion may not be enough to drive more adoption of UA in e-business services. To promote this paradigm shift, the business case needs to be made and a deeper understanding needs to be built.

1.2 The case for bi-directional accessibility for e-business services

The case for accessibility is emphasized by the global charters and standards which have been referred to earlier. Furthermore, there are historical precedents supporting the case for accessibility. Such precedents include the conventions, regulations, and ordinances that are available at the global, regional, and country levels. There are also accessibility standards from W3C.

Regardless of these developments, the concept of e-Business Accessibility seems not to have taken root with the right perspective, as businesses which have internet presence have all not become universally accessible. Also, efforts to make internet presence accessible, seem to be driven by concerns about possible legal liabilities. The apparent notion seems to be that of providing access to people with limitations/impairments, as opposed to creating an avenue through which both service provider and client can access each other. The mutuality of the benefits of Web and electronic document accessibility is not emphasized in the business case for the provision of accessibility by e-business services.

An important issue is the 2020 Covid-19 global lockdowns, which have continued into 2021. It has resulted in a massive shift to provision, or supplementation of services through electronic channels. Although it would be a welcome development for many people with disabilities because it should present ease of access, this is not the case. Many websites, apps and e-documents are still inaccessible to people with disabilities. The people most affected are those with vision, hearing, motor, and cognitive disabilities. However, the result of this limited access to e- business services by people with disabilities, also means that those businesses have limited access to the wealth base controlled by such people.

This is a pertinent issue since businesses are set up for profit. It follows then, that a paradigm shift is needed from mere provision of access to disabled people, to creating mutual access between businesses and the sub-population group of disabled people. This philosophy is what we refer to as Bi-directional Accessibility for e-business services, the business case for accessibility. Arguably, it is applicable to other areas of life where there is need to improve the extent of transactional relationships. There is a need to view accessibility holistically, beyond the issue of social justice. There is a need for a wider and more balanced view, which includes the perspective of accessibility as a meaningful business expansion tool, for accessing a substantial section of the market.

For this paradigm to be adopted from a business profit perspective, the business case needs to be substantiated by providing data, from where relevant conjectures can be drawn. Hence a research design was set up on the derived aim of the study:

To identify and substantiate the relevant market population factors which justify the need for bi-directional accessibility for e-business services and build a basic understanding of its application.

2. Research design for the study

Due to the nature of the study as dictated by the stated aim, a mix of quantitative and qualitative data was needed. Additional research was carried out through

a pragmatic process, using a rather abductive reasoning approach [31, 32], through a multi-staged, mixed method approach [33, 34]. The research involved a review of purposively selected research documents and reports, demographic analysis of existing population data, and scenario and user analyses. Review of literature has been used to identify the drivers or market factors, in the preceding background to the study. Relevant population research output was analyzed, while existing population data set was used to perform additional demographic analysis. Through this multi-layered approach, the demographic dynamics of the disabled sub-population groups and their market implications, are determined and used as basis for scenario building [35, 36], and analysis of the user experience of disabled persons. The research design exploits the strengths of Survey strategy, literature review [37, 38], Design research, empathy probe and persona analysis [39, 40], and user experience research [41, 42].

For manageability, the study was scoped down to the geographical region of the USA as a country. However, comparison with non-US data is used to introduce the themes under which results are presented. A purposive sampling approach was adopted for the study, for relevant sources of data, which are grouped under, fact sheets, research publications, design manuals, and the US census data set. A sample size of 12 data sources was used for the study. A systematic literature survey using Google Scholar and the plain Google search engine were used to identify and select key research. Data was extracted and interrogated through content analysis of fact sheets and research publications, and descriptive statistical analysis of the US census data set. **Table 1** shows details of the data sources.

The hybrid methodology provides a framework for highlighting the potential strength of the disabled sub-population. It sheds light on the negative customer

Source	Source Details
Fact Sheets	WHO [43] Disability and Health Key Facts
Fact sheets	Center for Disease Control [44] fact sheet on disability
Fact Sheets	UN Department of Economic and Social Affairs factsheet on persons with disabilities
Research Output	Okoro et al. [45] - Prevalence of Disabilities and Health Care Access by Disability Status and Type Among Adults
Research Output	Yin et al. [49] - A Hidden Market: The Purchasing Power of Working-Age Adults with Disabilities
Research Output	Duffin [50] - U.S. population by generation
Research Output	World Data Lab [51] – The silver-economy-richer-older
US Census Data Set	US Census data set on persons with disabilities
Research Output	Williams and Brownlow [48] UK 2019 Click-Away Pound Report
Research Output	World Data Lab research of 2020
Research Output	Ozumba [53] Cognitive Impairment Spectrum
Working paper	Ozumba [54] Working paper on empathizing with people who work from home
Design Manual	Microsoft [52] Inclusive, a Microsoft design toolkit

Table 1.
Details of the study sample of data sources.

experience and loss of business opportunities, and the possible gains of applying bidirectional accessibility. Results are presented hereunder.

3. Results of the study

Results are presented by layering disability statistics in an integrative manner with discussions following, covering the study aim. This approach provides for robust analysis and cross validation of results, as relevant facts are presented and discussed to build the evidence.

3.1 Demographic dynamics of disabled persons by age

Firstly, from a global view, the first population statistic to discuss is the WHO 2020 fact sheet on disability. It shows that there are about 1 billion people or 15% of the world's population who live with disabilities. The numbers are also increasing due to population growth, advances in medicine and healthcare, and the aging process [43]. Considering the global statistics, it is arguable that a substantial portion of every nation's population would be increasingly disabled.

Secondly, in the case of the USA, using the Center for Disease Control (CDC) fact sheet on disability [44], based on [45], the global statistic translates into 26% or 1 in 4 adults in USA having a disability. The fact sheet and original research report also show that, 2 in 5 adults aged 65 and above, have a disability [44, 45]. While a quarter of the adult population segment has disabilities in the USA, it is noteworthy that the ratio increases appreciably for retirees, pensioners, and senior citizens. This group would progress in impairment as they get older, thereby needing more accessibility.

Thirdly, analysis of 2019 data from the United States Census Bureau's (USCB) 1-year estimates, indicates that 41 million people or 12.7% of the US population have a disability [46]. While there seems to be a gap between [44–46], the census figures here refer to documented and non-hospitalized cases. Notwithstanding, there is a baseline of at least 41 million disabled persons who need access to independent living, including access to e-business services. The stated 12.7% of the population constitutes an appreciable market share that could be exploited. Furthermore, **Figure 1** derived from USCB data supports the phenomenon of a positive correlation between disabilities and aging.

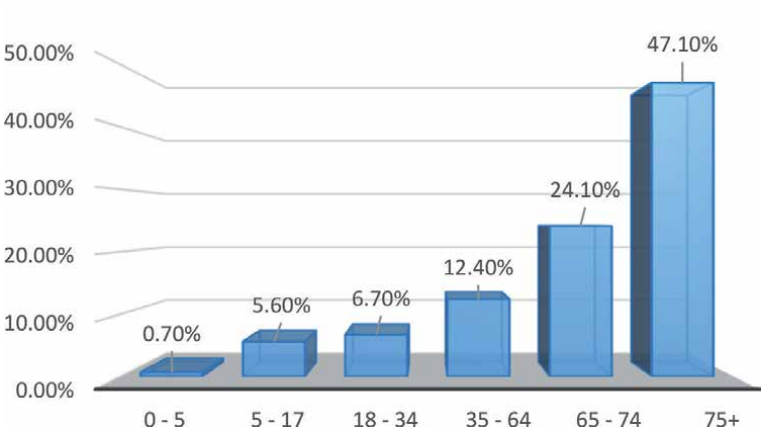

Figure 1.
Percentage of US population with a disability by age (derived from [46]).

Figure 1 shows that the proportion of people with disabilities increases with age. There is also the phenomenon of 'sudden leap' in the rate of increase at some stages, which occurs in the age ranges of 5–17, 35–64, and above 75. Perhaps the most significant trend is that by 75 years and above, about half of the population have a disability. This trend supports [44, 45]. Chronic medical conditions and aging process are major drivers of disability in the US. Chronic conditions increase with age. Since the percentage of people with a disability increases with age, it follows that a substantial portion of those in the range of 35–64 have disabilities, and they will progressively join the group of 65–74 and above 75. The collective volume of this population segment would be made up of people who are still working and those who are retired. In each case they would control substantial amounts of funds to make economic decisions, which could benefit e-business services.

3.2 Demographic dynamics of disabled persons in relation to financial capacity and market implications

To discuss the market implications, we start with another external (non-US) view by reviewing UK, a comparative economy to USA. The UN-DESA factsheet on persons with disabilities shows that 75% of the companies on the Financial Times Stock Exchange (FTSE) 100 Index, miss out on more that $147 million in revenue. The loss is due to their lack of basic levels of web accessibility. Their e-business services are largely inaccessible [47]. To further support our argument, the UK 2019 Click-Away Pound Report, shows that 69% of website visitors with disabilities, will leave a website, once they experience inaccessibility. In their telecom sector, about 92% of persons with access needs, will not contact the website owners about their experience. As such it may seem that there are no accessibility problems on a website, while the people who click away, move on to more accessible sites and spend their money [48]. Such is the nature of direct loss of market share and business opportunity, due to lack of accessibility. Within the US context, it is important to note that 15% of the economic decision makers (those aged 18 years and above) have a disability. See **Figure 2**.

If they do not have access to desired e-services, it translates to missing out on 15% of 18–34, 35–64, 65–74, and above 75 age ranges, and the funds they control. Furthermore, among this 15%, the greater proportion is made up of people who will access the internet on their own, apart from those who have self-care and independent living difficulties. See **Figure 3**.

Results of the "Hidden Market" research by [49], shows that the total disposable income for working-age people (18–64) with disabilities in the US, is about

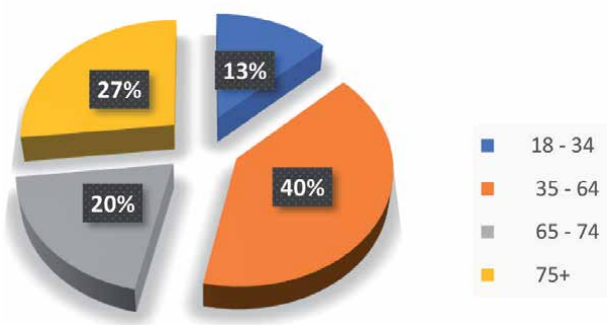

Figure 2.
Economic decision makers with a disability by age group (derived from [46]).

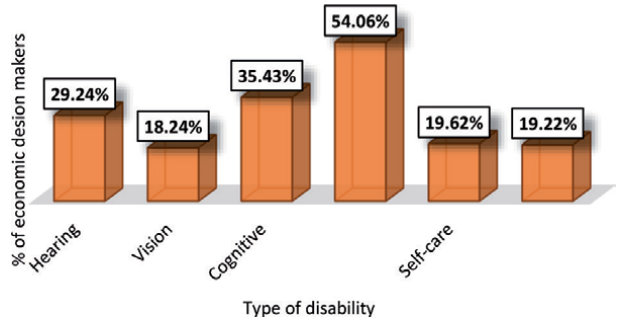

Figure 3.
Economic decision makers with disability by type (derived from [46]).

$490 billion. Though it is only 7.2% of the disposable income of people without disabilities ($6,787 billion), it remains substantial. It is closer to the total disposable income of other market segments including African Americans ($501 billion) and Hispanics ($582 billion) [49]. This comparison highlights the appreciable nature of the disabled persons' market share.

At a deeper level, research by [50], shows that by 2030, the last of the baby boomer generation would be older than 65 years. With a population of 69.56 million, baby boomers constitute the second largest population group in the US. Due to the positive aging–disability correlation, as they transit to 65 years and above, their rate of disability will increase, thereby increasing the total proportion of people with disabilities. Baby boomers fall within the population sub-group known as 'Silver Economy', those aged 60 and above [50].

Research by World Data Lab in 2020, shows that within the US, the sliver economy population, currently have a spending power of $3.4 trillion. Their wealth control is expected to grow to $4.4 trillion in the next 10 years [51]. The silver economy falls within the age group that experiences rapid increases in the rate at which disabilities progress, as shown in **Figure 1**. They have greater financial control and greater occurrence of disability at the same time. It means that they have more accessibility needs, more spending power, and more capacity to make economic decisions quickly. Furthermore, the implications of the current COVID-19 lockdowns and restrictions for this population sub-group will keep them appreciably indoors, for health reasons. They will need to access more services online than before. Moreover, most services have gone 'e' since the COVID-19 pandemic, making it imperative that more people will need accessible e-services. Since members of the silver economy control a substantial financial base, and are at home, they will have appreciable need for online purchasing and client services. This makes accessibility experience design imperative for accessing the market they represent.

3.3 User experience analysis and its implications for business opportunity

With the analysis and discussion thus far, there is an appreciable population of disabled persons who control substantial amount of the money within the US economy. To explore their user experience, it is important to highlight an outlying population, which is not usually addressed in accessibility studies. We refer to the population working remotely and online. They are better understood through their experience, and the types of access needs they have.

3.3.1 The outlying group who work online, remotely, and from home

Greater percentage of this group are classified as able-bodied people without impairment. As such there is little, if any, sensitivity towards them in accessibility discourse. However, user research shows that they experience different types of impairment. Disability used to be defined only as a limiting condition which a person moves around with. Currently disability is defined more as a complex thing involving any pre-condition and the features of a person's environment, hence it is dependent on context [52]. The temporal and situational disability occurrence in the US, accounts for up to 21 million impaired persons yearly [52]. The Microsoft accessibility persona spectrum highlights that injuries and illnesses create temporary impairment. However, the situational impairment could arise due to anything within the environment which the person responds to. It could be due to a factor the person must accommodate to perform a task, or a situation between two persons. This type of impairment happens to people who are normally classified as non-disabled, turning them into disabled persons within a specific time interval, context, and situation. Essentially, just as with a permanent disability, the person who is situationally disabled, remains a disabled/impaired person for as long as the disabling situation and contextual features remain. The implication is that an appreciable amount of the able-bodied working population will experience some type of accessibility need at various intervals. Though more dynamic, that is an additional market share to exploit for business opportunities.

Therefore, universal design is encouraged in contemporary IT design. Designing for the worst-case scenario, or for the permanently disabled will essentially accommodate all other cases [52].

In addition, the more subtle aspect of disability is cognitive impairment, especially temporary and situational cognitive impairment. According to [53] it ranges from permanent to situational. See **Figure 4**. Here we highlight situational impairment, in Ref. to those working online remotely, especially those working from home. While the extremes have been presented here, there are other psychological levels that fall between the three key points presented under situational disability. All the possible cases can arise while working remotely from home, thereby creating situational needs for accessibility.

The user experience implications are that the situationally disabled person who needs access to a web site or an app, needs it immediately, and in that situation.

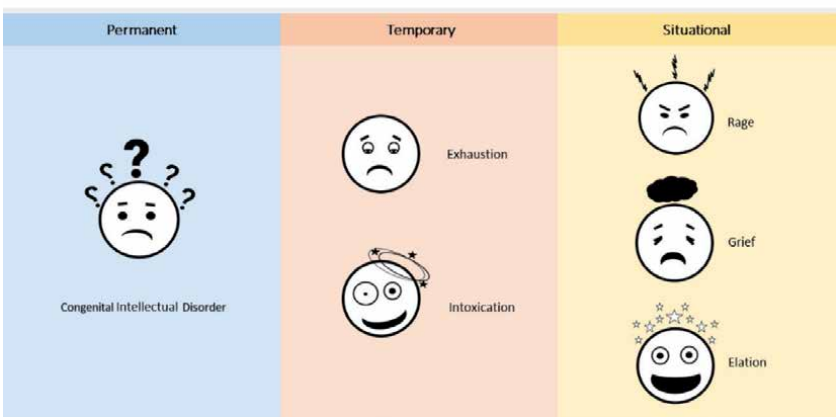

Figure 4.
Persona spectrum for cognitive disability [53].

Usually, it is to perform a task that is needful within the same disabling situation. Therefore, they would move across e-services quickly to find the one that serves their purpose.

Furthermore, the user experience implications are substantiated by recent user research showing, that cognitive load is a major frustration for a lot of people working from home. They experience the need to multi-task and manage the friction between the home and the encroaching office environment [54]. The COVID-19 pandemic has driven up the adoption of work from home mode, which has prospects of increasing permanently [55]. Before the pandemic, about 80% of employees in the US wanted to work from home for some of their work time [56]. However, research also shows that those who work from home experience various levels of stress, which arguably, lead to increase in cognitive load [57]. Therefore, while most persons in the working population do not have any known impairments, the phenomenon of situational disability would create access needs for them, which could result in loss of opportunities for the e-businesses, which they are not able to access.

3.3.2 Scenario analysis of a typical disabled user and an e-business owner

Here we introduce and analyze the user experience scenarios, probing into the disabled persona and deriving empathy, to fully contextualize the business implications. Three scenarios are simulated for this purpose.

Scenario 1 refers to the physical business service scenario for a typical person with visual disability. It is the normal setting where human interface is used, which inherently addresses the issue of accessibility, with simple practice of customer relationship skills. Probing into the personas, the business representative (REP) will welcome and help the prospective customer to make the decision to buy. In this case, it is basically natural and there is little danger of losing a business opportunity due to lack of accessibility on the part of the business owner. Unfortunately, business owners could move their services online with the wrong assumption because the person with disability sought out the business in this normal case. It is possible to erroneously expect that all types of customers will maintain loyalty regardless of the level of accessibility on their website.

Scenario 2 is about the situation where the e-business is inaccessible. The business has moved online with an assumption based on a different scenario. Thus, the prospective customer with disability feels excluded and unwelcome. However, being desperate for the service, he does not wait, and does not bother to complain, but moves on to find an accessible alternative, while making a point of duty to tell his network. On the side of the business, accessibility is not prioritized. The budget is devoted to optimizing SEO and increasing advert campaigns, with more focus on persons without disability. The outcome at best would be that the conversion rate on the website remains the same while the bounce rate remains the same also. This would be due to the business competing only for the same market share, without accessing 'the hidden market'.

Scenario 3 is about the case where the e-business service provider recognizes the 'hidden market' of persons with disabilities and prioritizes accessibility experience design, to target them. In so doing their e-busines services become more accessible to other groups of customers, including those with temporary and situational disabilities. Targeting the population of persons with disabilities would have a relatively competitive cost to the other priorities for driving sales. Research shows that the persona of disability will generate more loyalty for accessible sites, just as they would easily avoid inaccessible sites. Another important note is that while they would not complain to the business service provider, they will spread the news

through their network. Hence while the inaccessible e-business service may not be alerted to the problems of their website, many potential customers will know in a short while. It could result in a case of undetected loss of business opportunities.

From the three scenarios, Scenario 3 is successful because it mimics the natural process in scenario 1, albeit in the digital realm.

4. Conclusions

This book chapter discussed the importance of the sub-group of persons living with disabilities, from the more holistic perspective of bi-directional accessibility. It provides better motivation for e-businesses to embrace what we have described as Accessibility experience design, taking user experience to an inclusive level. The study was motivated by the lingering sub-optimal adoption of accessibility practice among e-businesses, despite the existence of drivers. The case for balancing the social and moral requirements for accessibility, with the need for business profit, through the bi-directional accessibility perspective, was established. The case was made for targeting the population of persons with disabilities as a market share, offering them e-business services with accessibility as a package, and therefore accessing the economy they control. To substantiate the argument, there was a need to explore the different types of disabilities, to determine the various types and the proportion of the population which fall under each category. It was necessary to understand in broad and specific terms the strength of the population, who they are, understand the world they live in and therefore empathize with them.

Through the bespoke methodology for the study, appreciable insight has been derived on the dynamics of disabilities and the market implications. This chapter arguably adds a lot of value to the accessibility discourse, introducing new thinking such as AxD and bi-directional accessibility for business services, and introducing new research on accessibility such as [53, 54]. The case for bi-directional accessibility has been articulated and substantiated through analysis of existing reports, and statistical analysis of census data set. Qualitative data from user research was used to construct and analyze the scenarios and realities of the key people concerned, making it possible to empathize with them. Arguably, the information in this chapter should assist relevant people to make the right advocacy and proposal for investment in accessibility. It provides a basis to motivate for the adoption of bi-directional accessibility among e-businesses. The concept of experience design has existed for some time, and many prefixes have been added to it, such as UxD, CxD, etc. However, the notion of AxD, accessibility experience design, invokes a mental model which places accessibility above mere compliance.

Author details

Aghaegbuna Obinna U. Ozumba[1*] and Chineme Ozumba[2]

1 School of Construction Economics and Management, University of the Witwatersrand, Johannesburg, South Africa

2 Access2UX LLC, New Jersey, USA

*Address all correspondence to: obinna.ozumba@wits.ac.za

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Chapter 6

A Conceptual Model for Deploying E-Service in SMEs through Capability Building: A Comparative Case Study

Zuhara Chavez, Jannicke Baalsrud Hauge, Monica Bellgran and Alvis Sokolovs

Abstract

This paper proposes a conceptual implementation model for small and medium enterprises (SMEs) to follow as part of their digital transformation. The conceptual model can be translated into a practical step-by-step guide for SMEs to apply during their digital transformation. The model is based on gradually developing industrial capabilities that can influence production processes performance. We employed a comparative case study approach to capture the lessons learned by SMEs in their journey to develop and implement a production digitalization system for deviation management and performance improvement. The model was validated in the cases of study capturing the actual SMEs' needs. Managerial capabilities of production processes such as monitoring and control demonstrate to influence the performance positively. The proposed model aims for a full digital transformation by following a gradual approach to being resource-efficient and integrating their business needs. This paper is an extension of work originally presented in APMS 2020, IFIP AICT 592.

Keywords: Managerial Capabilities, SME, Sustainable Production, Digitalization, Manufacturing Industry

1. Introduction

The main motivation of Industry 4.0 (I4.0) is the connection and integration of manufacturing and service systems to provide effectiveness, adaptability, cooperation, coordination, and efficiency [1, 2]. The concept is based on the emergence of new technologies that enable production to operate in a flexible, efficient, and greenway with high quality at low cost [3, 4]. Such technologies should advance the transmission of information throughout the entire system, and thereby enable better control and operations to be adapted in real-time according to varying demand [5]. The concept is widely spread around the world, given that incorporating emerging technical advancements can improve the industry's ability to deal with global challenges [4]. Studies on I4.0 models that include organizational, business, and technological advancements focus mostly on Multinational Enterprises (MNEs) [6].

Only a few studies specifically focus on supporting SMEs' advancement and shift towards "Smart Manufacturing (SM)" or "I4.0" [7, 8]. SME's perspective has not necessarily been taken into account in terms of outlining the appropriate I4.0 guidelines and industry policies [6, 9] even though they form the backbone of the European Economy.

The technological solutions are often defined as nine elements referred to as "foundational technology advances" i.e. big data and analytics, simulation, autonomous robots, internet of things, cyber-physical systems (CPS), cloud computing, virtual reality, machine-to-machine communication, and cybersecurity [14]. A common practice for researchers and practitioners tends to be treating the technological solutions as standalone elements [5, 10–13]. However, to achieve a successful transformation, I4.0 as a whole should be well understood and a clear road map is to be generated and implemented [9]. Research indicated that larger companies can achieve the higher maturity levels in technology for the I4.0 concept quicker than SMEs given that they can invest more resources i.e. money, time, and technical expertise. On the opposite, an advantage of SMEs against big companies is the lower complexity of their business and manufacturing processes, which translates into smoother and faster implementations [10]. I4.0 projects driven by SMEs often remain cost-driven initiatives [5, 11] and to this day there is no evidence of real business model transformation [5]. Empirical cases in research are frequently centered around presenting single applications, emphasizing the low-cost factor as a main advantage and strength of their application [3, 12–17]. The implementation of the I4.0 concept implies a major challenge which is resilience and robustness of the production system, which is the ability to absorb manufacturing disturbances without failing or breaking and be able to adapt to major variations and gradually return to its original state or "normal" state and level of performance [18, 19]. When trying to connect production processes disturbances and deviations to I4.0, the terms are assessed in works that address resilience and robustness [18, 20, 21], they often focus on (a) analyzing the variation and its adjustability, (b) analyzing variation in terms of disturbances' propagation and their effects which leads to (c) concentrating on the characteristics necessary to build resilience. The term deviation relates to quality and design and it is stated merely as a variation in the physical product specification.

The new technological advancements enable a new array of production process capabilities, which according to [22] can be grouped into four areas: monitoring, control, optimization, and autonomy. These capabilities and technical resources available to achieve the performance targets relate closely. Given the four capabilities, little is understood about how SMEs can develop each one of them to achieve the ultimate goal of autonomy and in what way they can influence the production performance.

SMEs struggle to cope with external market uncertainties and changes, and often taking the next step in increasing or adjusting their business is constrained by lack of expertise and resources [11, 23], yet they need to remain competitive to survive. For that reason, the focus needs to be on understanding the adoption of new technologies as a support for improving deviation handling and developing SMEs' managerial capabilities with a long-term approach.

To contribute to knowledge building within the area, this chapter is centered on the main research question — how can SMEs conduct a digital transformation that supports and aligns with deviation handling for production system performance improvement? A conceptual model that connects the mentioned elements and illustrates the digitalization deployment for SMEs, which to the best of our knowledge is lacking will be validated in the results.

2. Development of production processes under the Industry 4.0 paradigm

I4.0 is expected to generate a great number of benefits such as improved innovation capability, easy monitoring, and diagnosis of system multifunction, increased self-awareness and maintenance capabilities of systems, high productivity with environmentally friendly products, improved flexibility with decreased costs, unbiased, real-time, and knowledge-based decision making [24]. Likewise, emerging technologies are designed to support the processes behind those benefits [25]. Even though they may be applicable in diverse industries, those technologies can generally not be adopted as independent components, they require high management involvement and support to succeed. It is also important to understand the settings of technologies being adopted, the extend of the technology adoption, whether incremental or radical [26, 27], and the environment that will be improved by those technologies i.e. system, process, or activity. SMEs in particular, may not be aware and understand the capabilities required from management to implement such technologies.

Absorbing manufacturing disruptions and adapting is a crucial characteristic to reach with the support of the I4.0 concept and component implementations. In [18, 28] highlight the fact that robustness and resilience may not necessarily concur, but together provide production systems with a sustainable competitive advantage. Previous research [29, 30] has shown that for achieving sustainable production it is crucial to measure performance efficiently, which demands more automatic collection and management of data.

Research on the propagation of disturbances makes a clear distinction between resilience and a robust system [18]. According to [21], resilience is a competitive approach, and robustness is one of the characteristics of resilience. One common aspect presented in the mentioned studies is the variation analysis in the production processes and operations. They agree upon controlling and stabilizing variation to reduce disturbances and deviations. Nevertheless, the range is closed to product variation, which is far from the goal of full integration with the I4.0 transformation. Six characteristics to achieve resilience in I4.0 are identified by [21], these are flexibility, diversity, connectivity, knowledge, redundancy, and robustness. Yet, models and guidelines on how this can be achieved in practice are lacking.

In an analytical framework presented in [5] managerial capabilities [22] are connected with the concept of I4.0, and new technological advancements are represented as means of implementation. Their analytical framework specifies the importance of classifying I4.0 elements in terms of the desired performance objective i.e. flexibility, cost reduction, delivery time reduction, improved productivity, improved quality, and the corresponding managerial capacity that needs to exist. It depicts a close link between the performance objectives, the levels of managerial capability, and the technical resources required for achieving them.

Recognizing the different aspects of digitalization i.e. technical, managerial, and operational will make SMEs more aware of their organizational dimensions like finance, product, process, and people. In return, this acknowledgment will lead to informed decision-making [26], more accurate judgments, and results in coordination with production operations, plans, and supply chains. SME managers must understand the different ways of approaching I4.0. Reflecting on the own company's positioning supports the understanding of how to acquire benefits from this new paradigm [11].

3. A model for digitalization deployment in SMEs

3.1 Research methodology

The research methodology followed in our study consists of three main steps: 1. development of the model, 2. validation of the model integrated into the development of a production digitalization system, and 3. assessment for potential model improvements.

3.2 Development of the model

To build up knowledge on the area we started performing a critical literature review on SMEs digital transformation, frameworks and methods, digital technologies and applications, linked to managerial aspects, performance, and deviation management. Research indicates that analytical models for managerial capabilities exist [7, 10, 24] but still there is a practical approach missing in terms of what structure or sequence to apply and guidance on how to integrate specific performance objectives. For our theoretical model, we adopted the framework proposed by [5] as a foundation, due to the components it envisions i.e. capabilities, means of implementation, and operational performance objectives.

According to [22] intelligence and connectivity enable an entirely new set of product functions and capabilities, which can be grouped into four areas: monitoring, control, optimization, and autonomy. The four capabilities defined initially are linked together, where each capability builds on the next one. For instance, monitoring capabilities are the base for product control, optimization, and autonomy. In that sense, a company will not be able to control and optimize without first having a monitoring system in place. Such a model does not include concrete metrics on the operational performance objectives that SMEs can utilize to track improvement through the development of the capabilities. Our contribution includes the overall equipment effectiveness "OEE" as the initial metric to integrate. The model consists of three main levels 1. Managerial capabilities, 2. Means of implementation and 3. Operational performance objectives. The capabilities are arranged in a proposed deployment order from left to right. Each level and its elements are represented in **Figure 1**.

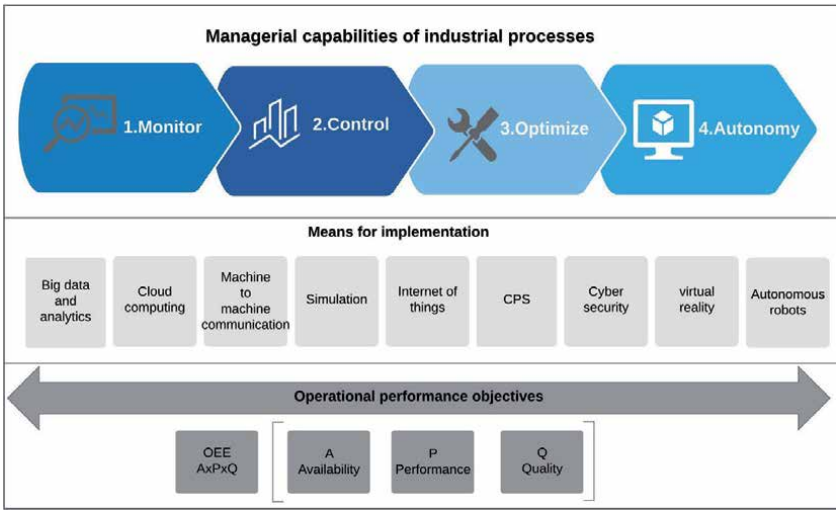

Figure 1.
Capability deployment model in SMEs industrial processes based on [5].

According to our research, SMEs are sometimes lacking formal systems to control and measure their performance. That is the reason why we considered the operational performance to be initially measured by the three elements of OEE as key performance indicator "KPI" i.e. availability, performance, and quality. To the best of our knowledge, most SMEs (independent of industry and production strategy), have an initial understanding of the three elements of OEE. Although the OEE data is not always analyzed, the data itself is often generated. Our model aims to change the common reactive practice among SMEs, by proposing a gradual long-term approach that builds on developing managerial capabilities in the production processes.

The introduction of OEE is envisioned as an initial step of the working procedure for SMEs, it is expected to progressively connect to production disturbances improvement and likewise generate positive effects in performance.

3.3 Model validation: practical application on building the managerial capabilities

For validation of the model, we utilized a comparative multiple-study case research approach. This approach was adopted given that case study research is a comprehensive method that incorporates multiple sources of data to provide detailed accounts of complex research phenomena in real-life contexts [31, 32]. The cases in our study are SMEs that decided to take the challenge of internally co-develop a production digitalization system as part of their digital transformation. The context is unique given the innovative approach the company cases have taken i.e. designing and implementing instead of purchasing and implementing an existing system or digital solution. Our data collection consisted of multiple sources such as interviews, observation, notes from physical meetings, and records from disturbances logging. We performed both semi-structured and unstructured interviews along the whole development process. The multiple sources of data with alignment to the results and having multiple researchers (referred to as advisors in the digital system development), who worked in the data analysis guarantee triangulation. Triangulation of data sources, data types, or researchers is a primary strategy that can be used and would support the principle in case study research that the phenomena be viewed and explored from multiple perspectives [32, 33]. The interviews included plant manager, production manager, developers, and operators at both Case A and Case B; this guarantees the elimination of single informant bias.

3.3.1 Practical industrial cases

The cases selected as testbeds for the model are a Swedish SME and a Latvian SME, for confidentiality purposes they will be called case A and case B. Case A has more than 75 years of experience in manufacturing fasteners and industrial components for the automotive and engineering industries. Case B has around 15 years of experience in manufacturing similar components for the Latvian industry and has been considered the largest conical pin manufacturer in Europe. Both cases share experience in manufacturing and belong to the same German-owned corporate group. Their production processes include high-speed cutting, centerless grinding, length turning, tumbling, cylindrical grinding, and centerless grinding. Their production strategy comprises processes from prototyping to serial production.

In 2019, to improve their disturbance handling and become more autonomous, the companies started to join efforts on their digital transformation by collaborating in the development and implementation of a low-cost and tailor-made digital tool, which they call "production process digitalization system". The project was

interlinked with a research team (advisors) and a couple of students (developers). Before starting this journey both companies had the same Enterprise resource planning system (ERP) in place, representing the only digital solution implemented in their production sites. The system was mostly utilized for production planning purposes. The two cases shared the need for monitoring their production processes more efficiently and integrating real-time data in their ERP-system. Features such as production order completion level, equipment status, and equipment performance were examples of desired information to improve both decision-making and disturbance handling.

3.3.2 The deployment process of the production digitalization system

The development of the digital tool required collaboration at all times since replication of the digital tool was expected. **Figure 2** illustrates the main processes and milestones in the development of the digital tool. The period is indicated to provide a perspective on the length of the project phases. The development can be segmented into four main phases, each one of them with different milestones and processes for each case. At each milestone, both case companies discussed the activities required to guarantee compatibility and feasibility.

The physical development of the digital tool started with building a local network around a system including a programmable logic controller "PLC" and a human-machine interface "HMI" with attached sensors. The local network then was connected to a server that process the data i.e. "means for implementation". The first physical sensors installation was performed in case A and then replicated in case B (parallel work in phase 3, **Figure 2**). In both cases, data related to OEE was not fully digital, therefore digitizing the data (transferring from manual to digital) was a major initial step to build on the control capability. This digitizing step made it possible to monitor real-time data and helped the operators to start interacting with the system. **Figure 3** is a visual representation of the elements that the prototype tool covers in connection to the capabilities deployment model in **Figure 1**. **Table 1** includes a description of the practical implications of the implemented elements in the cases as illustrated in **Figure 3**.

It is important to emphasize that manual data was a prerequisite to get an overview and an understanding of the environment to develop the tool structure. In this context, "tool structure" refers to the software design and the type of data to collect and display that is relevant for decision-making. Designing the dashboard was part of the collaborative work and conducted parallel to the activities presented in

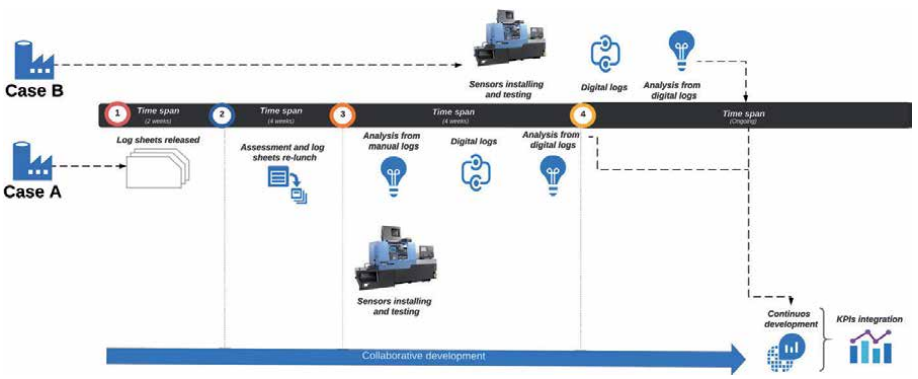

Figure 2.
Digital tool development processes and milestones at case A and case B.

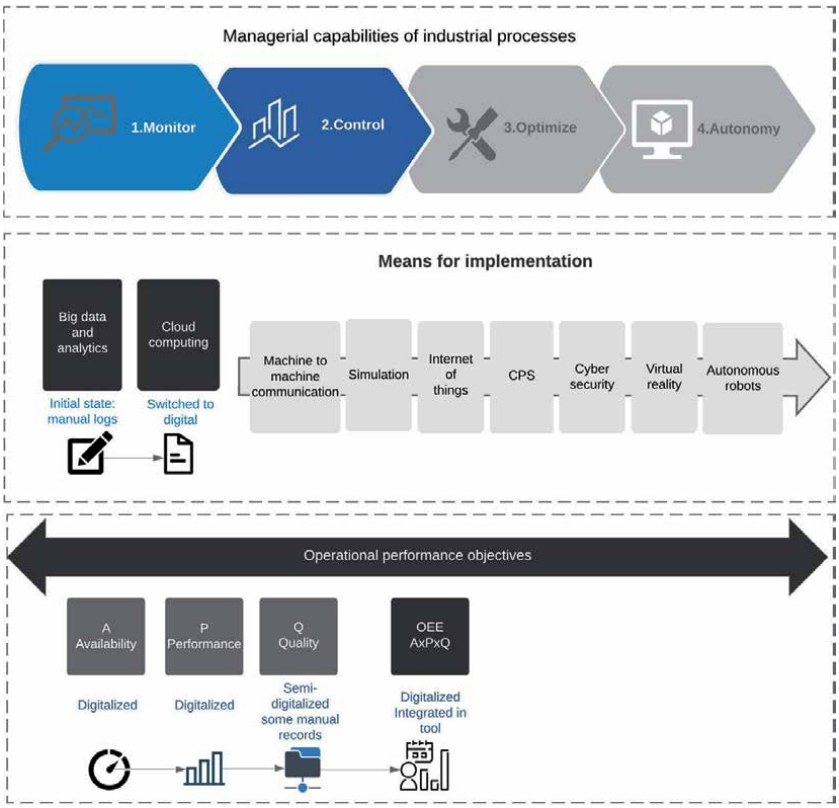

Figure 3.
A demonstration of the deployment of the capability model: from industrial case A.

Figure 2. **Figure 4** shows a representation of the original dashboard. The dashboard comprised the following "basic" elements for display in the initial prototype of the production digitalization system:

- Machine number.
- Machine status: A color code indicates status as either a. green indicating normal running machine, b. red indicating stop (planned or unplanned) or c. gray indicating no active production order at the moment.
- Order number.
- Sep-up time: Total time expend on performing set up.
- Quantity: Amount of pieces produced in the displayed time and the total amount in the production order.
- Total time: Amount of time that the machine has been running/producing the indicated production order.
- OEE in terms of Availability (A), Performance efficiency (P), and Quality (Q).

Feedback from the implementation of the tool was collected during the testing phase from operators and managers in both case studies; dashboard upgrading is

Element		Practical details
Managerial capabilities	Monitoring	The starting point of capabilities deployment. Recording of production data, data collection first manually then transitioned to sensors. In about 8 weeks, company case A could migrate to automatic logs.
	Control	Definition of production targets. Utilization of the recorded data. The analysis needed to define improvement thresholds. Introduction of OEE for tracking performance improvement.
	Optimization	Improving by monitoring data, system models, simulation systems, production systems, and resources. The cases have not deployed it at the moment.
	Autonomy	Shifting from reactive behavior to proactive response. The system can learn from the inputs and its behavior and can adapt itself. The cases have not deployed it at the moment.
Operational performance objectives	A: Availability %	Data became available digitally from the machines by installing sensors. Focus on downtime (configurable). The initial data was collected manually by the machine operators.
	P: Performance efficiency %	Data became available digitally from the machines by installing sensors. Focus on cycle times, to reduce discrepancies (configurable). The initial data was collected manually, pre-existing records were in the ERP system but not fully updated.
	Q: Quality	Data is both available from manual records and digitally, depending on the machine. Some quality measures are digitalized but not part of this calculation.

Table 1.
Practical details of the conceptual model elements.

part of the continuous improvement work, together with the KPIs integration. The projection is to have the dashboard accessible online from anywhere so managers and the planning department can access real-time information via their own electronic devices, and for everyone on the production, floor to be aware of the production status at all times. It is expected by the case companies that production disturbances will have a faster resolution since there will be a clear visualization indicating when something is out of control.

The first capability relies heavily on data generation, and the subsequent capabilities are built from it. The importance of data needing to be free from waste and errors is easier to grasp when there is an understanding of the capabilities connection. Also, for a system that is required to be resilient and robust, trustworthy data is vital. We omitted details on the actual OEE calculations, as the focus is to illustrate the initial steps on how to build managerial capabilities with the support from digitalization in manufacturing. Separate work will later assess details on the calculation and integration of OEE in the digital system.

3.4 Assessment for potential model improvement

The model proposed in **Figure 1** was assessed by analyzing the theoretical characteristics and aims against the practical work in the validation stage. The data collected from the cases on the deployment process showed congruency with the theoretical principles and provided some lessons learned that could support and improve the deployment of the model in other SMEs. The summary of the analysis is presented in

Figure 4.
An example of the original production digitalization system prototype dashboard.

the analytical generalization in the next section. Further work for model improvement involves investigating the integration of other metrics in the performance objectives and assessing sequence and prioritization of the "means for implementation".

4. Inspiration for SMEs on starting their digital transformation: recommendations

Our research focused on the SMEs' need for support to cope with the challenge of remaining competitive in increasingly changing markets. Through the model validation in the real cases, we verified that adopting managerial capabilities of industrial processes supported by digitalization not only provides a competitive advantage to SMEs but also can assist in enhancing the production system performance. The digitalization topic is in a novel field, therefore creating a model that applies to a broad range of manufacturing environments is hard to achieve. Nevertheless, an outcome of the lessons learned from the study cases in this research is the analytical generalization:

- Technologies as means of implementation. The conceptual model calls for a defined sequential deployment journey of the four managerial capabilities. However, it can be inferred that the development and deployment of means of implementation may not follow a compulsory sequence; particularly for the last five blocks: internet of things, CPS, cybersecurity, virtual reality, and autonomous robots (**Figure 1**). The company strategy and business needs may determine the deployment order. For instance, the implementation path for the practical cases in this paper may look different at later capabilities i.e. optimize and autonomy, and even if they agree to replicate the technologies deployment, their progress journey is expected to differ.

- I4.0 elements adaptation. Innovative tailor-made digital solutions could be a safe way for SMEs to progress on their managerial capabilities. The key lays in incorporating the company needs into a digital system that integrates the generated data for processing and analysis purposes to support accurate and quicker decision-making (**Figure 3**).

- Monitor capability with data-hierarchy as the foundation. Given that monitoring highly relies on data, it is necessary to assess what elements are required on the different levels of data processing to ensure generation, transmission, storage, and analysis of data are free of waste and errors. This will contribute to the success of further capabilities deployment.

- OEE as a foundation for a performance improvement system. OEE allows setting realistic thresholds in production to monitor against. This metric is based on production data that most of the SMEs are interested to track and in most cases already generating i.e. availability, performance, and quality. Integrating this metric in digital tools can be an initial step towards performance improvement, giving a good enough overview of any manufacturing site. **Figure 4** presents an example of a visual representation of the system dashboard, which is utilized for monitoring but also controlling production processes performance at all times.

- Resilience and robustness coexisting in I4.0 for SMEs. Robustness is a priority when discussing disturbance and deviation handling. With the introduction of digital tools, SMEs can little by little develop their production systems to have the desired abilities.

5. Conclusion and future work

This study presented a conceptual model for the deployment of digitalization in SMEs, built on the development of four managerial capabilities of a production process. Through real industry cases, a conceptual model was developed, testing the applicability at early stages.

The model suggests a deployment sequence that connects directly to the elements of I4.0 and provides a practical vision on digitalization supporting performance improvement at the factory level by using OEE as the initial metric for the measurement of performance objectives. The industry cases allowed the model validation and the definition of future research to improve the model. This study exemplifies how SMEs with restricted resources can initiate their digital transformation process.

Our research has some limitations. First, given the early stage of the case companies' digitalization journey, only two practical capabilities have been tested. Second, the validation only included two case studies, where the results are described with a qualitative approach and quantitative results are not included. It can be hard to evaluate the real benefits achieved by SMEs developing the capabilities. Therefore, future work will be dedicated to following the evolution of the case companies in achieving the model's higher capabilities (specifically third and forth), where the priority is to focus on KPIs integration and data-hierarchy. As discussed previously, the resilience and robustness characteristics should be further investigated with a practical approach. It is imperative to build new knowledge that shows I4.0 real advantages for SMEs and ensure the small player's progress on their digitalization journey based on good theoretical foundations.

Acknowledgements

The authors gratefully acknowledge the collaboration and support from the two case companies and the funding agency. This work is part of the project ASPIRE

"Automation solutions for production deviation management", funded by Sweden's Government Agency for Innovation VINNOVA (Programme Produktion2030).

Conflict of interest

"The authors declare no conflict of interest."

Author details

Zuhara Chavez[1*], Jannicke Baalsrud Hauge[1], Monica Bellgran[1] and Alvis Sokolovs[2]

1 KTH Royal Institute of Technology, Södertälje, Sweden

2 Faculty of Engineering, Vidzeme University of Applied Sciences, Valmiera, Latvia

*Address all correspondence to: zuhar@kth.se

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Section 3

E-service Quality and Development

Chapter 7

Comparative Study on Public Electronic Employment Services: Austria, Spain, Estonia, Romania

Ani Matei and Dincă Dragoș Valentin

Abstract

Jobs around the world are affected by the current health crisis. European Commission, governments are concerned with finding measures to ensure the protection of employees. As such, on October 21, 2020 the European Commission issued an inaugural set of obligations with a social impact under the EU SURE Instrument of the European Union. Amounting to EUR 17 billion, instrument intended to help protect jobs and keep up employment. Under this framework, this chapter analyzes public employment services in four European countries to identify the extent to which they have adapted to the global pandemic situation. Measures to protect jobs and support workers in identifying new jobs are a permanent concern for most countries. Additionally, we are witnessing an accelerated digitalization of overall public services, public employment services too. The way in which employment services are organized, the degree of digitalization does not necessarily infer the conclusion that workers' protection is ensured but only that the premises for the health crisis mitigation effects are provided.

Keywords: electronic services, job search, job loss, public institutions

1. Introduction

THE UNIVERSAL DECLARATION OF HUMAN RIGHTS, art. 23, sets forth that everyone has the right to work, to free choice of employment, to just and favorable conditions of work, as well as to protection against unemployment. European states guarantee the right of every person to freely choose their profession and job under the national law. The national legal framework aims at preventing unemployment, promoting employment or re-employment, supporting people belonging to disadvantaged groups in finding work, ensuring equal opportunities on the labor market, giving incentives to employers and stimulating the unemployed to find a job.

According to Eurostat[1], employment fell by 2.8% in the euro area and by 2.6% in the EU in the second quarter of 2020 compared to the previous quarter, the largest decline since 1995. Lockdown measures in 2020 severely affected industries such as tourism, transportation which triggered the disappearance of many jobs.

[1] https://ec.europa.eu/eurostat/documents/2995521/10545332/2-14082020-AP-EN.pdf/7f30c3cf-b2c9-98ad-3451-17fed0230b57, accesat 11.11.2020

Meanwhile, however, there are many jobs available at European level. At this moment, on the portal ec.europa.eu/eures/ alone there are available 1,613,794 job offers in Europe, from which 14.975 in Romania, 54,416 in Austria, 1,478 in Estonia, 32,686 in Spain[2].

Under this framework, a number of measures have been taken at both European and national level, aimed at: maintaining current jobs, providing financial support for employers and employees, stepping up support efforts to identify new jobs for persons whose jobs have been eliminated; actions of orientation, counseling, mediation on the labor market are being provided. For the latter category of measures, the public employment services of each European state are used, public services that act mainly on two levels: job search and job loss.

The efficiency, speed and degree of digitalization of these public employment services are key in the process of limiting the effects on the labor market of this health crisis that humanity is going through. According to The World of Public Employment Services [1], public employment services generally plan and implement many of the active policies used on the labor market to help workers find jobs and companies fill vacancies, facilitate labor market adjustments and cushion the impact of economic transitions.

The labor force, the labor market, employment have been the topic of numerous researches, analytical studies, from multiple perspectives: studies from the perspective of equal opportunities [2], migrants, refugees [3, 4], of people, of vulnerable groups [5], employment standards [6] or skills required for employment. Employment services have been the topic of research and analysis either from the perspective of reform [7], of management principles applicable [8] or management form [9].

The digital transformation of our economy changes the way we work [10] and the public services dealing with this matter.

There are national public services in Europe and a European employment service: EURES, a network set up in 1994 and it provides services to the EU, Norway, Iceland, Liechtenstein, Switzerland and the United Kingdom. The network consists of coordination offices (both European and national) and public employment services assigned to each EU country, each with its own specific responsibilities. In Austria, there are many information points for anyone looking for a job - whether it's a career change or a resumption of work subsequent to job loss. The Spanish National Employment System consists of the State Public Employment Service (SEPE) and the Public Employment Services of the Autonomous Communities. In Estonia there is the Estonian Unemployment Insurance Fund, a quasi-governmental organization, a legal entity under public law that provides, among other, the human resources needed for employment activities support. In Romania, the employment service is under the state's umbrella, there is a national employment agency with territorial branches

2. Methodology

For a good grasp of the extent to which public employment services regarding job loss and job search are able to contribute to mitigation of the current phenomena generated by the health and economic crisis, we reviewed the institutional, procedural and legislative framework and their digitalization degree across four European countries. The institutional actors, the legal framework, the specific

[2] https://ec.europa.eu/eures/eures-searchengine/page/main?lang=ro#/jvStatistics

procedures were identified and analyzed with the comparative method. The analysis process for conducting the study was iterative and interactive, and the results of the analysis derive from the processing and interpretation of data available from public sources: the legal framework and websites of institutions with responsibilities in the field of employment in the four countries considered.

The study provides evidence of the degree of digitalization of employment services in four countries, in a comparative approach. The limitations of the research are that in order to access the information needed, the electronic form templates and online procedures, it is often required to log in - with user/password, which must be confirmed in advance by entering credentials generated by the electronic signature of the mobile phone, or by using the electronic identification card - "citizen Card ID".

3. Legal framework on public employment services

In Austria, the Employment Law regulates the legal framework for job seekers. The Consolidated Federal Law: The Comprehensive Law for the Unemployment Insurance Law of 1977, BGBI. I No. 92/2000 is the got to resource in case of job loss.

In Spain, job search is a process that is subject to extensive regulation: Royal Legislative Decree no. 2/23 October 2015, approving the revised text of the Law on the status of workers; Royal Legislative Decree no. 8/30 October 2015, approving the revised text of the General Law on Social Security; Law no. 14/1994 on Employment Offices; Law no. 4/2000 on the rights and freedoms of aliens in Spain and their social integration; Royal Decree-Law no. 10/16 June 2010, on urgent measures for labor market reform; Royal Decree no. 1722/21 December 2007, by which Law no. 56/16 of December 2003, on employment, is amended as regards the bodies, coordination and evaluation instruments of the National Employment System. Similarly, job loss is heavily regulated: The Royal Decree no. 2720/18 December 1998, adopting Article 15 of the Staff Regulations in the field of fixed-term contracts; Organic law no. 3/22 March 2007, for the effective equality of women and men; Law no. 3/6 July 2012, on urgent measures for labor market reform; Royal Decree no. 1484/29 October 2012, on the financial contributions to be paid by enterprises that make collective redundancies affecting workers aged 50 or over. Law no. 1/28 February 2014 on the protection of part-time workers and other urgent measures in the economic and social order; Law no. 12/9 July 2001 on urgent measures to reform the labor market in order to increase employment and improve its quality; Law no. 43/29 December 2006, for the improvement of economic growth and employment; Royal Decree no. 1483/29 October 2012, approving the Regulation of procedures for collective redundancies, suspension of contracts and reduction of the working hours; Royal Decree-Law no. 5/15 March 2013 on measures to promote the continuity of the active at work life for older workers and to promote active aging; Royal Legislative Decree no. 2/23 October 2015, approving the revised text of the Law on the status of workers; Decree no. 1424/27 December 2002, on the regulation for the communication of the content of employment contracts and of basic copies to be submitted with public employment services and the use of telematic means in connection therewith; Order TAS /770/14 March 2003, updated by Order ESS/1727/17 September 2013 by which the Royal Decree no. 1424/2002, which regulates the communication of the content of employment contracts and their basic copies to the Public Employment Services and the use of telematic means connected to them.

In Estonia, the Labor Market Services Law of 2005, the Employment Contracts Law of 2009, the Public Services Law of 2012, the Employee Health and Safety Law

of 1999 are available for job search. In terms of job loss is worth mentioning: The Law on Classification of Occupations of 2008; Law on Classification of Economic Activities in Estonia in 2008.

In Romania, Law no. 76/2002 on the unemployment insurance system and employment stimulation sets forth the framework for job loss and job search.

4. Institutional framework on public employment services

In Austria, the form of government is the democratic federal republic, which has a parliamentary regime and consists of nine states, brought together in the specific organizational framework of a federation. This is essential and can be seen in the provision of employment services that depend on the authorities of the federal states. In this regard, the Federal Government has outlined the general guidelines to be followed by each federal state. The Austrian Public Employment Service (AMS) distributes a flow of jobs on the Internet through the eJob-Room, which offers both permanent and seasonal jobs. In addition, AMS provides interactive training on job application, testing job search knowledge while providing a lot of information, advice, and examples of cover letters, resumes etc. **https://www.ams.at/**. Unemployed people and people facing job loss have the opportunity to apply to the Public Employment Service (AMS). This is possible in all federal states and large cities. As soon as a person registers with AMS, professional advice is provided by a personal supervisor.

In Spain, the National Employment System consists of the State Public Employment Service (SEPE) and the Public Employment Services of the Autonomous Communities. In its turn, the State Public Service for Employment (SEPE) is an autonomous body subordinated to the Ministry of Labor, Migration and Social Security and is composed of: *central services; 52 provincial directorates; an extensive network of "face-to-face" offices distributed in the 52 provinces of the Spanish state.* The public service also manages the procedures for granting employment benefits. All legal entities have the obligation to issue an "enterprise certificate" (. liquidation note) to the worker within a maximum of 10 business days upon termination of the employment contract, confirming the termination of the employment relationship and which he must communicate to the Social Security Service and the State Public Employment Service (SEPE).

In Estonia there is the Estonian Unemployment Insurance Fund (Eesti Töötukassa - https://www.tootukassa.ee/eng/content/about-tootukassa), a quasi-governmental organization, a legal person governed by public law that operates independently of the government, according to its mission and operational rules set forth by law. Töötukassa is chaired by a tripartite Supervisory Board: government, employers 'representatives and employees' representatives. The mission of the Estonian Unemployment Insurance Fund is to manage the provisions on social insurance related to unemployment and to organize labor market services that help the unemployed find new jobs. Until 1 May 2009, the responsibility for this mission was provided by the Labor Market Council.

In Romania, the National Agency for Employment, subordinated to the Ministry of Labor and Social Protection, is in charge of managing job loss and job search. The agency has got 42 territorial structures under its subordination, distributed throughout the country, one for each county. The National Agency for Employment implements policies and strategies on employment and vocational training for job seekers and aims to stimulate and increase employment, stimulate employment of young graduates of educational institutions in a coherent process of transition from

the educational system to the labor market, preventing unemployment, facilitating the free movement of workers in the Member States of the European Union and in the states signatories of the Agreement on the European Economic Area, and in other countries with which Romania has concluded treaties, agreements or conventions.

5. Procedural framework for public employment services

In Austria, job search is mainly conducted on the internet. Vacancies can be found all over Austria or around the world via the **eJob-Room** online platform. It provides many functions that make it easy to search and manage documents to submit a job application, and it is also available as an application for the mobile, accessible from the *Apple App Store, Google Play Store, Windows Phone App, Windows 8 App (Tablet)*. Services are available for jobseekers, companies, statistics and organization data. The AMS e-job is also the largest apprenticeship exchange place in Austria. In addition, a robot is available for assistance in expanding job searches to vacancies advertised on company websites. For job loss, the announcement on the AMS platform is made online, but does not automatically lead to obtaining unemployment benefits. Unemployment benefits, must be applied for in order to get such an allowance as this involves a different procedure. Accessing the **oesterreich.gv.at.** platform, people can receive advice/counseling.

SEPE in Spain has a website, **www.sepe.es**, where you can access employment services and various information. This virtual space brings together links to other portals of interest for employment such as the website of the National Employment System (public portal *Empléate*), the website of the Public Employment Service of the Autonomous Community or that of a European Public Employment Service. In addition, online links are provided to entities such as the Ministry of Employment and Social Security or the State Foundation for Vocational Training.

The unique employment portal "*Empléate*", similar to the *eJob*-Room in Austria, contains information about jobs for both individuals and legal entities and offers increased visibility of job offers. The platform hosts useful information to guide and make available to citizens and businesses the tools that facilitate the search for a job or the start of an entrepreneurial activity through a completely digital strategy. The portal brings together, in a single access point, all the existing job offers on public and private portals, through a meta-engine, with the aim of boosting supply and demand and giving greater transparency to the labor market.

Regarding the loss of employment, the communication of the "enterprise certificate" (in the liquidation note) to SEPE is done digitally via the system available for sending telematic certificates for legal entities Certific@2 (mandatory for legal entities with more than ten employees) and the RED system of the General Treasury of Social Security.

It should be noted that most legal entities operating in Spain are inter-connected to the General Treasury of the Social Security via the RED system. This allows legal entities to automatically push data to the State Public Employment Service (SEPE) and to know the worker's contributions faithfully, efficiently and in real time. Another possibility to obtain the "enterprise certificate" by the employee who has ceased the employment relationship with the employer is to request it online, on the website of the State Public Service for Employment (SEPE). To do so, the person concerned must hold an *electronic national identity* document or a *digital certificate*.

In Estonia, in order to be registered as unemployed or as a job seeker, a person will personally submit the application and the documents required to a local

office of the Estonian Unemployment Insurance Fund. The application can also be submitted electronically, using a program that allows the identification of the person submitting the application: https://www.tootukassa.ee/eng/tkauth/login. The application must contain the name and surname, the personal identification code or, if unavailable, then the date of birth, residential address and other contact details of the person. Moreover, the application for registration as unemployed includes information on the circumstances that led to unemployment.

The Estonian Unemployment Insurance Fund shall take a decision on the registration or non-registration of a person as unemployed or as a jobseeker on the second working day following the submission of the application. The unemployed have to: participate in and comply with the preparation of an individual action plan; they need to appear in person at the Estonian Unemployment Insurance Fund for a visit at a given time at least once over a thirty-day period; they need to be ready to accept a suitable job and start work promptly or seek employment and inform the Estonian Unemployment Insurance Fund about the job search process.

As a registered unemployed person, at the time of finding a job or if there is any other reason triggering the cancelation of the unemployed status, the person concerned has the obligation to notify the Unemployment Insurance Fund immediately. If, during 12 months, a person loses his/her registration as unemployed because he/she refuses to cooperate and to follow the individual action plan, if the person fails to appear three times or at least once in 30 days or refuses to comply with the individual action plan or to accept the appropriate job offer for the third time in a row, then the person concerned is no longer entitled to register as unemployed for the next 90 days since the last termination of the unemployment status.

The largest job search portal in Estonia is the www.cv.ee, portal containing information in Estonian, English and Russian. Also, another site accessed to look for a job is the European Job Mobility Portal (https://ec.europa.eu/eures/public/jobseekers-dashboard).

In Estonia, an employee works on a part-time or full-time contract. Telework is regulated by Estonian law. Employment contracts must be registered by all employers, natural or legal persons, in the Register of Employment Contracts, at the latest when the employee starts working. The registration is made at the Fiscal and Customs Council, by directly submitting the contract with one of the local offices of the Fiscal and Customs Council - https://www.emta.ee/eng/offices, or by electronic registration at https://maasikas.emta.ee/v1/login?authst=FxTDYkcrL3.

The work place address is indicated by the Estonian Data System (more information is available on the Estonian Land Board geoportal - https://geoportaal.maaamet.ee/eng/). The address can also be entered manually, if the address cannot be found in ADS, following the path: e-Tax/e-Customs, click on the "*Enter address manually*" link opens the view where you can enter the address by parts (county, municipality, etc.) and enter the missing part of the address in the "Address specification" field.

Employers may correct in the electronic environment the data erroneously entered in the Register of Employment Contracts within three months from the date of commencement, suspension or termination of employment. After the expiry of this period, the data entered can be corrected only by going to a local office of the Fiscal and Customs Council.

In Romania, vacancies are available both on the website of the national agency for employment ANOFM, at centralized national level, and also at territorial level in each agency, for the area assigned. The unemployed is a person who meets cumulatively the following conditions:

- is looking for a job and belongs to the age range of at least 16 years up until the retirement conditions are met;

- the state of health and the physical and mental capacities of the candidate make him/her fit to work;

- does not have a job, does not earn any income or the candidate earns from activities authorized by law an income lower than the value of the reference social indicator of unemployment insurance and employment stimulation, in force;

- is available to start work over the next period, if a job is found.

The person shall register with the employment agency in the territorial area of his domicile/residence or with another employment service provider in order to get a job. Unemployment registration requires an application and supporting documents that are submitted in hard copy with the territorial institution in the applicant's area of residence. The registration of the job seeker is done by the civil servant of the territorial subdivision where he applied for registration, by filling in the person's file. The vacancies identified are offered to jobseekers according to their qualification, skills, abilities and professional experience. The record of jobseekers is kept during the year in the Register of jobseekers, in Jobless, at territorial and national level. During the period in which he is unemployed, a person must follow an individual plan of information, mediation, counseling, and training, services that can be performed by public institutions or authorized private providers. Mediation services can be attended online.

Therefore, in all the countries analyzed there is a specific legislative framework at national level. Responsibilities belong to national or territorial public institutions, except in Estonia where there are autonomous institutions. All countries have developed electronic information and online registration services for jobseekers (**Table 1**).

	Austria	**Spain**	**Estonia**	**Romania**
National legal framework	X	X	X	X
Public institutions at national level	x	x	—	x
Public institutions at territorial level	x	x	—	x
Autonomous institutions	—	—	X	—
Jobs available online	X	X	X	X
Electronic information services	X	X	X	X
Online registration as unemployed	X	X	X	—
Online registration as a job seeker	X	X	X	X
Online professional guidance and counseling	X	X	X	—
Mediation on the online labor market	—	—	X	X

Table 1.
Comparison of the institutional, legislative and procedural framework for employment services in the four countries analyzed.

6. Conclusions

The analysis carried out in this chapter aimed to identify good practices on digitalization in terms of job loss and job finding in four European countries. The study provides a description of the legislative, institutional and procedural framework, and analyzes how each of them is digitalized, as well as the way citizens can access information. It is found that there is a high degree of sophistication, materialized by easy access to information, the forms required for public employment services, as well as the degree of computerization of each service.

In general, we can see that the principle of having a single e-point of contact for citizens and companies in the field of job loss and employment has been widely implemented. The information is introduced in the public administration services database via the respective public portal or via a management platform and it helps save time and administrative resources. Beneficiaries no longer need to know how their jurisdiction is organized within the authority in question, compared to the previous situation. Once the citizen has accessed the virtual office, the initiated procedures are automatically distributed to the responsible authorities within the administration.

In Austria, the computerization process began with the E-Government Law, published in the Official Federal Gazette No. BGBl. I 10/2004-part I. The e-government strategy of the Austrian federal government has taken a comprehensive approach to all e-government procedures in electronic form. These include government-to-citizens (G2C) transactions, as well as internal transactions between public authorities (G2G). Public services are also available in the mobile application version, including the electronic signature to access or finish various applications.

For Spain, there is a strong transformation at all administrative levels (national, regional and local), in the transition process from "hard copy" to "e-government". However, the true institutionalization was legitimized by the adoption of the so-called "e-government law", Law no. 11/2007 on *electronic access of citizens to public services*. This law enshrined in the Spanish legal framework the concept of e-government launched by the Commission Communication of 26 September 2003 to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions, *The role of e-government in the future of Europe* (COM (2003) 567 final].

In Spain, the General Access Point (GAP) represents a platform for all Spanish citizens, business and public administrations. *Among its main advantages it's worth noting* that: a) it guides the citizen in his relationship with the public administration, providing him with the information and services needed; b) it provides assistance to enterprises and entrepreneurial clients in order to facilitate the remote set-up of enterprises in a centralized way; c) it provides access to the *Catalog of administrative procedures* on the platform, as well as of other public administrations; d) it encourages citizens to use electronic processing by simplifying access to electronic services through a citizen-oriented classification.

The review conducted in Estonia leads to the conclusion that e-government is an important issue in the modernization of public administration. However, achieving its true purpose, to provide better services, a more integrated organization and lower costs, is not such a simple approach in practice. However, Estonia has managed to demonstrate that it is possible to digitize almost all public services over a very short period of time. Currently, the majority of Estonian citizens can access public services online. As of 2002, since the introduction of the ID-card, 98% of Estonian citizens have had an electronic identity card, which is the key to using all digital services and obtaining most of them. Estonia's success in providing public e-services is owed to the partnership of central and local visionary governance, with

a proactive ICT sector, wide Internet access and a population open to the implementation of new ideas and technologies. Due to e-solutions, communication with the state is fast and convenient for everyone, so public services are much more efficient.

In each country analyzed, the legal framework on employment services is developed at state, national level and aims to ensure equal opportunities in terms of job search/loss, institutional and procedural framework, mechanisms that facilitate access to employment and protection of vulnerable groups. In all countries there are financial instruments to support people in difficulty. The institutional framework usually includes one or more central state institutions (ministry, agency) and their territorial structures. A special situation is present in Estonia, the Estonian Unemployment Insurance Fund being a quasi-governmental organization.

Job loss and job search activities are mainly carried online, electronic services available for job application, online jobseekers' registration and information services, mediation counseling are available in all countries. Unemployment registration services are not available just electronically, nor are job loss services. Under the current context, all the countries scrutinized are making efforts to provide citizens and companies with services to meet the demand and supply of jobs.

Analyzing the experiences of the four countries studied, it is obvious that the future of the administration is represented by the use of new technologies, by their incorporation in the daily activity of the administration, also in connection with employment services and job loss benefits provision. For Romania, such an approach will have profound effects and it requires both the structural transformation of the legislative framework, of the working procedures, and also the development of a new set of skills on the part of the public administration staff. The target is to reduce the direct interaction administration-citizen, the time to provide public services while increasing administrative transparency.

Author details

Ani Matei* and Dincă Dragoș Valentin
Faculty of Public Administration, National School of Political and Administrative Studies (SNSPA), Bucharest, Romania

*Address all correspondence to: amatei@snspa.ro

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Chapter 8

Network Function Virtualization over Cloud-Cloud Computing as Business Continuity Solution

Wagdy Anis Aziz, Eduard Babulak and David Al-Dabass

Abstract

Cloud computing provides resources by using virtualization technology and a pay-as-you-go cost model. Network Functions Virtualization (NFV) is a concept, which promises to grant network operators the required flexibility to quickly develop and provision new network functions and services, which can be hosted in the cloud. However, cloud computing is subject to failures which emphasizes the need to address user's availability requirements. Availability refers to the cloud uptime and the cloud capability to operate continuously. Providing highly available services in cloud computing is essential for maintaining customer confidence and satisfaction and preventing revenue losses. Different techniques can be implemented to increase the system's availability and assure business continuity. This chapter covers cloud computing as business continuity solution and cloud service availability. This chapter also covers the causes of service unavailability and the impact due to service unavailability. Further, this chapter covers various ways to achieve the required cloud service availability.

Keywords: Cloud Computing, Business Continuity (BC), Disaster Recovery (DR), Network Functions Virtualization (NFV), Virtual Machine (VM), High Availability, Failover, Private Cloud, Hybrid Cloud, Public Cloud, Recovery Time Objective (RTO), Recovery Point Objective (RPO), IaaS, Paas, Saas, DRaaS

1. Introduction

Cloud computing service outage can seriously affect workloads of enterprise systems and consumer data and applications [1, 2]. Several (e.g. the VM failure of Heroku hosted on Amazon EC2 in 2011) or even human (human error or burglary). It can lead to significant financial losses or even endanger human lives [3]. Amazon cloud services unavailability resulted in data loss of many high-profile sites and serious business issues for hundreds of IT managers. Furthermore, according to the CRN reports, the 10 biggest cloud service failures of 2017, including IBM's cloud infrastructure failure on January 26, Facebook on February 24, Amazon Web Services on February 28, Microsoft Azure on March 16, Microsoft Office 365 on March 21 and etc., caused production data loss, and prevented customers from accessing their accounts, services, projects, and critical data for a very long duration. In addition, credibility of cloud providers took a hit because of these service failures [4].

The business continuity (BC) is important for service providers to deliver services to consumers in accordance with the SLAs. When building cloud

infrastructure, business continuity process must be defined to meet the availability requirement of their services. In a cloud environment, it is important that BC processes should support all the layers; physical, virtual, control, orchestration, and service to provide uninterrupted services to the consumers. The BC processes are automated through orchestration to reduce the manual intervention, for example if a service requires VM backup for every 6 hours, then backing up VM is scheduled automatically every 6 hours [5].

Disaster Recovery (DR) is the coordinated process of restoring IT infrastructure, including data that is required to support ongoing cloud services, after a natural or human-induced disaster occurs. The basic underlying concept of DR is to have a secondary data center or site (DR site) and at a pre-planned level of operational readiness when an outage happens at the primary data center. Expensive service disruption can result from disasters, both manmade and natural. To prevent failure in a Cloud Service Provider (CSPs) system, 2 different disaster recovery models (DR) have been proposed: the first being the Traditional model, and 2nd being cloud-based, – where the first is usable with both the dedicated and shared approach. The relevant model is chosen by customers using cost and speed as the determining factors. On the other hand, in the dedicated approach a customer is assigned an infrastructure leading to a higher speed and therefore cost. At the other end of the spectrum the shared model, often referred to as the Distributed Approach, multiple users are assigned a given infrastructure, which results in a cheaper outlay but leads to a lower recovery speed.

2. Background

2.1 Cloud computing

Cloud computing is storing, accessing, and managing huge data and software applications over the Internet. Access to data is protected by firewalls. Users are still using their computers to access the cloud-hosted data/applications. The difference lies in the fact that these data/applications use no or little the storage and compute resources of these computers since they are running in the cloud.

Cloud computing provides the context of offering virtualized computing resources and services in a shared and scalable environment through the network. A big percentage of global IT firms and governmental entities have incorporated cloud services for a multitude of purposes such as those related to mission-oriented applications and thus sensitive data. In order to provide full-support for these applications and their sensitive data, it is vital to include ample provision of environments that incorporate dependable cloud computing.

The National Institute of Standards and Technology (NIST) in SP 800-145, NIST specifies that a cloud infrastructure should have the five essential characteristics listed below:

- On-demand self-service
- Broad network access
- Resource pooling
- Rapid elasticity
- Measured service

NIST also specifies three primary cloud deployment models:

- Public
- Private
- Hybrid

As well as three primary cloud service models:

- Infrastructure as a Service (IaaS)
- Platform as a Service (PaaS)
- Software as a Service (SaaS)

2.2 Essential characteristics

2.2.1 On-demand self-service

In cloud computing, users have the ability to provision any IT resource that they require on demand from a cloud, whenever they want. Self-service means that the consumers themselves carry out all the activities required to provision the cloud resource.

To enable on-demand self-service, a cloud provider maintains a self-service portal, which allows consumers to view and order cloud services. The cloud provider publishes a service catalog on the self-service portal. The service catalog lists items, such as service offerings, service prices, service functions, request processes, and so on.

2.2.2 Broad network access

Consumers access cloud services on any client/endpoint device from anywhere over a network, such as the Internet or an organization's private network.

2.2.3 Resource pooling

The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and re-assigned according to consumer demand. Usually, end-users have no knowledge about the exact location of the resources they may want to access, but they may be able to specify location at a higher level of abstraction (e.g., country, state, or datacenter). Examples of such resources include storage, processing, memory, and network bandwidth.

2.2.4 Rapid elasticity

Rapid elasticity refers to the ability for consumers to quickly request, receive, and later release as many resources as needed. The characteristic of rapid elasticity gives consumers the impression that unlimited IT resources can be provisioned at any given time. It enables consumers (in few minutes) to adapt to the variations in workloads by quickly and dynamically expanding (scaling outward) or reducing (scaling inward) IT resources, and to proportionately maintain the required performance level.

2.2.5 Measured service

A cloud infrastructure has a metering system that generates bills for the consumers based on the services used by them. The metering system continuously monitors resource usage per consumer and provides reports on resource utilization. For example, the metering system monitors utilization of processor time, network bandwidth, and storage capacity.

2.3 Cloud deployment models

A cloud deployment model specifies how a cloud infrastructure is built, managed, and accessed. Each cloud deployment model may be used for any of the cloud service models: IaaS, PaaS, and SaaS. The different deployment models present a number of tradeoffs in terms of control, scale, cost, and availability of resources.

2.3.1 Public cloud

A public cloud is a cloud infrastructure deployed by a provider to offer cloud services to the general public and/or organizations over the Internet. In the public cloud model, there may be multiple tenants (consumers) who share common cloud resources. A provider typically has default service levels for all consumers of the public cloud. The provider may migrate a consumer's workload at any time and to any location. Some providers may optionally provide features that enable a consumer to configure their account with specific location restrictions. Public cloud services may be free, subscription-based or provided on a pay-per-use model. **Figure 1** below illustrates a generic public cloud that is available to enterprises and to individuals.

2.3.2 Private cloud

A cloud infrastructure that is configured for a particular organization's sole use is termed private cloud. Departments and business units within an organization rely on network services implemented on a private cloud for dedicated to consumers. Generally, organizations are likely to avoid the adoption of public clouds as they are used by the public to access their facilities over the Internet. A private cloud offers organizations a greater degree of privacy, and control over the cloud infrastructure, applications, and data. There are two variants of a private cloud:

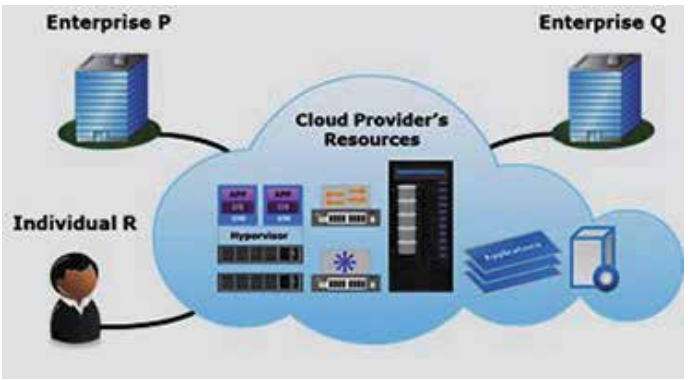

Figure 1.
A generic public cloud available to enterprises and individuals.

- On-premise: The on-premise private cloud, also known as an internal cloud, is hosted by an organization on its data centers within its own premises. The on-premise private cloud model enables an organization to have complete control over the infrastructure and data. In this model, the organization's IT department is typically the cloud service provider. In some cases, a private cloud may also span across multiple sites of an organization, with the sites interconnected via a secure network connection. **Figure 2** illustrates a private cloud of an enterprise that is available to itself.

- Externally hosted: In the externally hosted private cloud model, an organization outsources the implementation of the private cloud to an external cloud service provider. The cloud infrastructure is hosted on the premises of the external provider and not within the consumer organization's premises as shown in **Figure 3**. The provider manages the cloud infrastructure and facilitates an exclusive private cloud environment for the organization.

2.3.3 Hybrid cloud

The hybrid cloud infrastructure is a composition of two or more distinct cloud infrastructures (private or public).

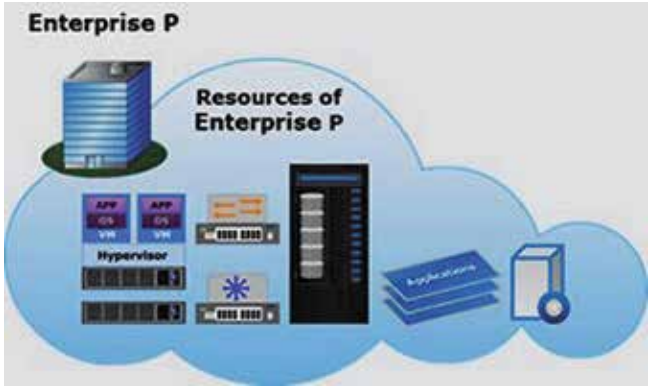

Figure 2.
An enterprise private cloud.

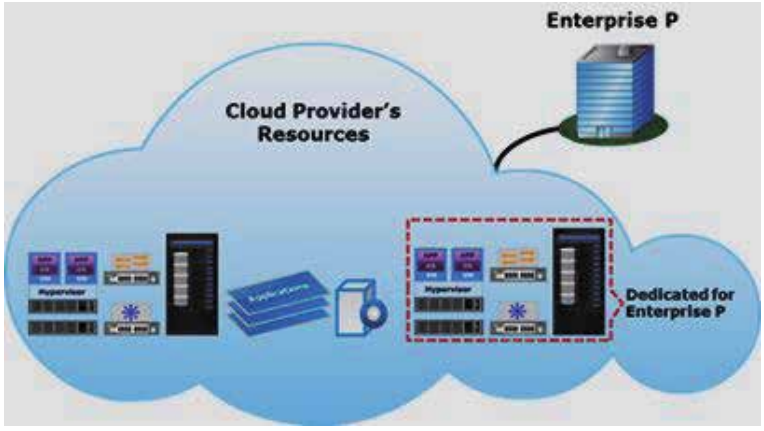

Figure 3.
An externally hosted private cloud.

In a hybrid cloud environment, the component clouds are combined with open or proprietary technology, interoperable standards, architectures, protocols, data formats; application programming interfaces (APIs), and so on. **Figure 4** illustrates a hybrid cloud that is composed of an on-premise private cloud deployed by an enterprise and a public cloud serving enterprise and individual consumers.

2.4 Cloud service models

2.4.1 Infrastructure-as-a-service (IaaS)

An end-user can access processing, storage, network resources hosted in a cloud infrastructure. The end-user can in particular run a multitude of software packages, which encompass a variety of applications as well as operating systems. The underlying infrastructure of the cloud is not managed or controlled by the consumer but he/she may have control over deployed applications, storage and operating systems, which may involve, for example in firewalls, a restricted use of specific components in the network.

IT resources such as storage capacity, network bandwidth and computing systems, may be hired by Consumers, for example in the IaaS model, from a Cloud Service Providers (CSP). The cloud service provider deploys and manages the underlying cloud infrastructure. While software, such as operating system (OS), database, and applications on the cloud resources, can be deployed and configured by Consumers.

In some organizations IaaS users are typically IT system administrators. In such cases, internal implementation of IaaS can even be carried out by the organization, with support given by the IaaS to its IT to manage the resources and services. In such examples the 2 options of Subscription-based or Resource-based (according to resource usage) can be implemented for IaaS pricing.

The IaaS provider pools the underlying IT resources and they are shared by multiple consumers through a multi-tenant model.

2.4.2 Platform-as-a-service (PaaS)

The capability provided to the consumer is the deployment of consumer-created or acquired applications created by means of programming languages, libraries, services, and tools supported by the PaaS provider. The consumer does not manage or control the underlying cloud infrastructure, including network, servers, operating systems, or storage, but has control over the deployed applications and possibly the configuration settings for the application-hosting environment.

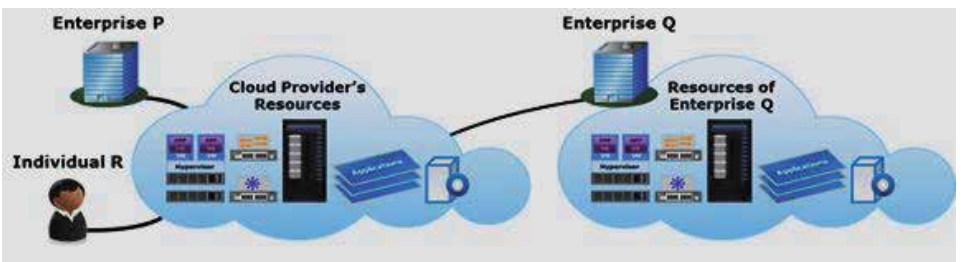

Figure 4.
A hybrid cloud composed of an on-premise private cloud and a public cloud.

2.4.3 Software-as-a-service (SaaS)

Within a SaaS context, the consumer can run SaaS provider's applications in a cloud infrastructure. The applications are accessible from various client devices through either a thin client interface, such as a web browser (for example, web-based email), or a program interface. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configuration settings.

In the SaaS model, a provider hosts an application centrally in the cloud and offers it to multiple consumers for use as a service. The consumers do not own or manage any aspect of the cloud infrastructure. In a SaaS context, a given version of an application, with a specific configuration (hardware and software) typically provides services to multiple consumers by partitioning their individual sessions and data. SaaS applications execute in the cloud and usually do not need installation on end-point devices. This enables a consumer to access the application on demand from any location and use it through a web browser on a variety of end-point devices. Some SaaS applications may require a client interface to be locally installed on an endpoint device. Customer Relationship Management (CRM), email, Enterprise Resource Planning (ERP), and office suites are examples of applications delivered through SaaS. **Figure 5** illustrates the three cloud service models.

2.4.4 Mobile "backend" as a service (MBaaS)

In the mobile "backend" as a service (m) model, also known as backend as a service (BaaS), web app and mobile app developers are provided with a way to link their applications to cloud storage and cloud computing services with application programming interfaces (APIs) exposed to their applications and custom software development kits (SDKs). Services include user management, push notifications, integration with social networking services [6] and more. This is a relatively recent model in cloud computing [7] with most BaaS startups dating from 2011 or later [8] but trends indicate that these services are gaining significant mainstream traction with enterprise consumers.

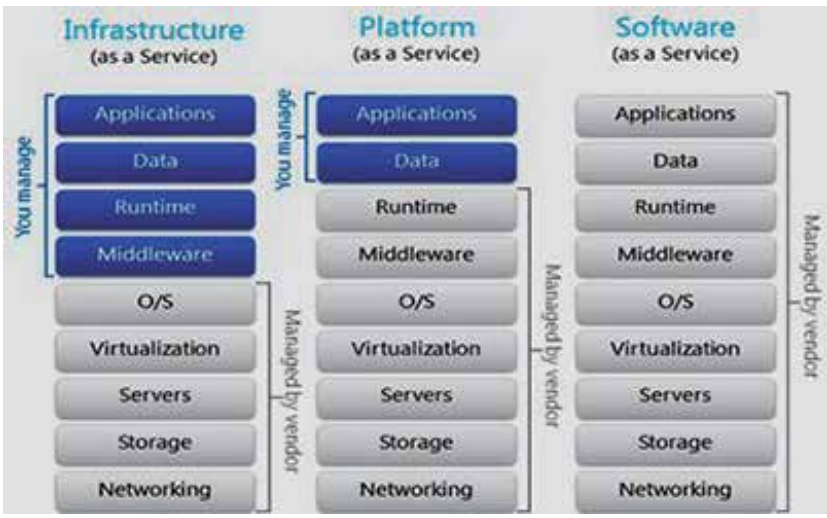

Figure 5.
Cloud service models.

2.4.5 Serverless computing

Serverless computing is a cloud computing code execution model in which the cloud provider fully manages starting and stopping virtual machines as necessary to serve requests, and requests are billed by an abstract measure of the resources required to satisfy the request, rather than per virtual machine, per hour [9]. Despite the name, it does not actually involve running code without servers [9]. Serverless computing is so named because the business or person that owns the system does not have to purchase, rent or provision servers or virtual machines for the back-end code to run on.

2.4.6 Function as a service (FaaS)

Function as a service (FaaS) is a service-hosted remote procedure call that leverages serverless computing to enable the deployment of individual functions in the cloud that run in response to events. FaaS is included under the broader term serverless computing, but the terms may also be used interchangeably [10].

2.5 Actors in cloud computing

Five roles in cloud environments are described in the NIST Cloud Computing Standards Roadmap document. These five participating actors are the cloud provider, the cloud consumer, the cloud broker, the cloud carrier and the cloud auditor. **Table 1** presents the definitions of these actors [4].

2.6 Network functions virtualization telco cloud

2.6.1 History

A group of network service providers at the Software-Defined networking (SDN) and OpenFlow World Congress in October 2012, originally presented the Network Functions Virtualization (NFV) concept (11). These service providers aimed to simplify and speed up the process of adding new network functions or applications.

Cloud Role	Definition (see also ref. [11])
Consumer	Any individual person or organization that has a business relationship with cloud providers and consumes available services.
Provider	Any individual entity or organization which is responsible for making services available and providing computing resources to cloud consumers
Broker	An IT entity that provides an entry for managing performance and QoS of cloud computing services. In addition, it helps cloud providers and consumers with management of service negotiations.
Auditor	A party that can provide an independent evaluation of cloud services provided by cloud providers in terms of performance, security and privacy impact, information system operations and etc. in the cloud environments.
Carrier	An intermediary party that provides access and connectivity to consumers through any access devices such as networks. Cloud carrier transports services from a cloud provider to cloud consumers.

Table 1.
The five actors in cloud computing environment.

2.6.2 Definition

NFV is set of techniques that virtualize network functions that are traditionally supported on proprietary, dedicated hardware, such as traffic forwarding or Evolved Packet Core (EPC) capabilities. With NFV, functions like routing, load balancing and firewalls are hosted in virtual machines (VM) or in OS containers. Virtualized Network Functions (VNF), are an essential component of the NFV architecture, as shown in the **Figure 6** below from ETSI NFV [12]. Multiple VNFs can be added to a standard server and can then be monitored and controlled by a hypervisor. ETSI NFV [12].

2.6.3 Features

Because NFV architecture virtualizes network functions that are thus supported on commodity hardware, network managers can add, move, or change network functions at the server level during a provisioning process. If a VNF running on a virtual machine requires more bandwidth, for example, the decision to scale or move a VNF is to be taken by NFV management and orchestration functions that can move the virtual machine to another physical server or provision another virtual machine on the original server to handle part of the load. Having this flexibility allows an IT department to respond in a more agile manner to changing business goals and network service demands.

2.6.4 Benefits

While NFV can benefit enterprises, service providers have a more immediate use case for it. Many see NFV's potential to improve scalability and better utilize network resources. If a customer requests a new function, for example, NFV enables the service provider to add the said function by configuring it in a virtual machine without upgrading or buying new hardware.

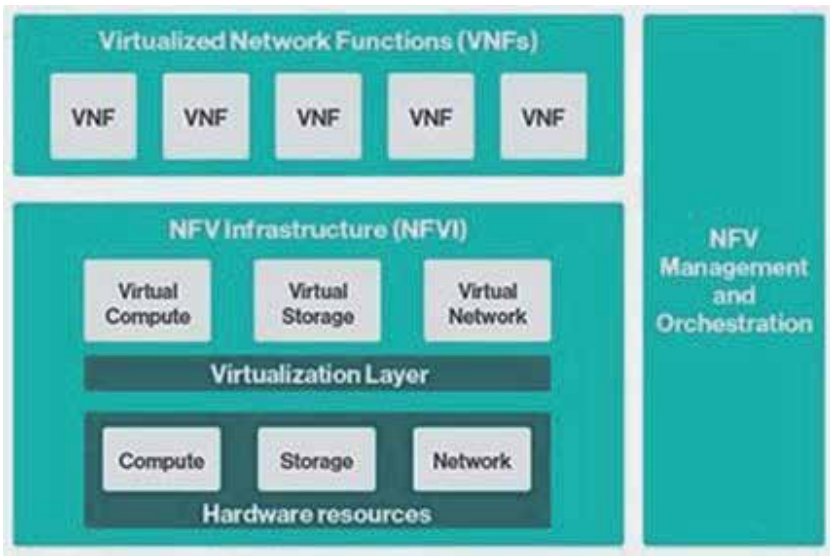

Figure 6.
Components of NFV architecture.

Basic NFV benefits also include reduced power consumption and increased the amiable physical space, since NFV eliminates the need for specific hardware appliances. NFV can then help reduce both operational and capital expenditures.

2.6.5 Cloud-native architecture is the foundation of 5G innovation

Through persistent effort and determination, Telecom operators are implementing a digital transformation to create a better digital world. To provide enterprises and individuals with a real time, on demand, all online experience requires an end-to-end (E2E) coordinated architecture featuring agile, automatic, and intelligent operation during each phase. The comprehensive cloud adaptation of networks, operation systems, and services is a prerequisite for this much-anticipated digital transformation.

In existing networks, operators have gradually used SDN and NFV to implement ICT network hardware virtualization, but retain a conventional operational model and software architecture. 5G networks require continuous innovation through cloud adoption to customize network functions and enable on-demand network definition and implementation and automatic O&M.

Physical networks are constructed based on DCs to pool hardware resources (including part of RAN and core network devices), which maximizes resource utilization.

The "All Cloud" strategy is an illuminated exploration into hardware resource pools, distributed software architecture, and automatic deployment. Operators transform networks using a network architecture based on data center (DC) in which all functions and service applications are running on the cloud DC, referred to as a Cloud-Native architecture.

In the 5G era, a single network infrastructure can meet diversified service requirements. Cloud-Native E2E network architecture has the following attributes:

- Provides logically independent network slicing on a single network infrastructure to meet diversified service requirements and provides DC-based cloud architecture to support various application scenarios.

- Uses CloudRAN to reconstruct radio access networks (RAN) to provide massive connections of multiple standards and implement on-demand deployment of RAN functions required by 5G.

- Simplifies core network architecture to implement on demand configuration of network functions through control and user plane separation, component-based functions, and unified database management.

- Implements automatic network slicing service generation, maintenance, and termination for various services to reduce operating expenses through agile network O&M.

3. Cloud computing for business continuity

Business continuity is a set of processes that includes all activities that a business must perform to mitigate the impact of service outage. BC entails preparing for, responding to, and recovering from a system outage that adversely affects business operations. It describes the processes and procedures a service provider establishes to ensure that essential functions can continue during and after a disaster. Business

continuity prevents interruption of mission-critical services, and reestablishes the impacted services as swiftly and smoothly as possible by using an automated process. BC involves proactive measures, such as business impact analysis, risk assessment, building resilient IT infrastructure, deploying data protection solutions (backup and replication). It also involves reactive countermeasures, such as disaster recovery, to be invoked in the event of a service failure. Disaster recovery (DR) is the coordinated process of restoring IT infrastructure, including data that is required to support ongoing cloud services, after a natural or human-induced disaster occurs. The basic underlying concept of DR is to have a secondary data center or site (DR site) and at a pre-planned level of operational readiness when an outage happens at the primary data center.

Cloud service availability refers to the ability of a cloud service to perform its agreed function according to business requirements and customer expectations during its operation. Cloud service providers need to design and build their infrastructure to maximize the availability of the service, while minimizing the impact of an outage on consumers. Cloud service availability depends primarily on the reliability of the cloud infrastructure (compute, storage, and network) components, business applications that are used to create cloud services, and the availability of data. The time between two outages, whether scheduled or unscheduled, is commonly referred as uptime, because the service is available during this time. Conversely, the time elapsed during an outage (from the moment a service becomes unavailable to the moment it is restored) is referred to as downtime. A simple mathematical expression of service availability is based on the agreed service time and the downtime.

$$\text{Service availability } (\%) = \frac{\text{Agreed service time} - \text{Downtime}}{\text{Agreed service time}} \qquad (1)$$

Agreed service time is the period where the service is supposed to be available. For example, if a service is offered to a consumer from 9 am to 5 pm Monday to Friday, then the agreed service time would be 8 x 5 = 40 hours per week. If this service suffered 2 hours of downtime during that week, it would have an availability of 95%.

In a cloud environment, a service provider publishes the availability of a service in the SLA. For example, if the service is agreed to be available for 99.999 percent (also referred to as five 9 s availability) then the allowable service downtime per year is approximately 5 minutes. Therefore, it is important for the service provider to identify the causes of service failure, and analyze its impact to the business.

3.1 Causes of cloud service unavailability

This section listed some of the key causes of service unavailability. Data center failure is not the only cause of service failure. Poor application design or resource configuration errors can also lead to service outage. For example, if the web portal is down for some reason, then the services are inaccessible to the consumers, which leads to service unavailability. Even unavailability of data due to several factors (data corruption and human error) also leads to service unavailability. A cloud service might also cease to function due to an outage of the dependent services. Perhaps even more impactful on the availability are the outages that are required as a part of the normal course of doing business. The IT department is routinely required to take on activities such as refreshing the data center infrastructure, migration, running routine maintenance or even relocating to a new data center. Any of these activities can have its own significant and negative impact on service availability.

In general, the outages can be broadly categorized into planned and unplanned outages. Planned outages may include installation and maintenance of new hardware, software upgrades or patches, performing application and data restores, facility operations (renovation and construction), and migration. Unplanned outages include failure caused by human errors, database corruption, failure of physical and virtual components, and natural or human-made disasters.

3.2 Impact of cloud service unavailability

Cloud service unavailability or service outage results in loss of productivity, loss of revenue, poor financial performance, and damages to reputation. Loss of revenue includes direct loss, compensatory payments, future revenue loss, billing loss, and investment loss. Damages to reputations may result in a loss of confidence or credibility with customers, suppliers, financial markets, banks, and business partners. Other possible consequences of service outage include the cost of additional rented equipment, overtime, and extra shipping.

3.3 Methods to achieve required cloud service availability

With the aim of meeting the required service availability, the service provider should build a resilient cloud infrastructure. Building a resilient cloud infrastructure requires the following high availability solutions:

- Deploying redundancy at both the cloud infrastructure component level and the site (data center) level to avoid single point of failure
- Deploying data protection solutions such as backup and replication
- Implementing automated cloud service failover
- Architecting resilient cloud applications

For example when a disaster occurred at one of the service provider's data center, then BC triggers the DR process. This process typically involves both operational personnel and automated procedure in order to reactivate the service (application) at a functioning data center. This requires the transfer of application users, data, and services to the new data center. This involves the use of redundant infrastructure across different geographic locations, live migration, backup, and replication solutions.

4. Building fault tolerance cloud infrastructure

This section covers the key fault tolerance mechanisms at the cloud infrastructure component level and covers the concept of service availability zones. This section also covers automated service failover across zones along with zone configurations such as active/active and active/passive.

4.1 Single points of failure (SPOF)

Highly available infrastructures are typically configured without single points of failure as shown in **Figure 7** to ensure that individual component failures do not

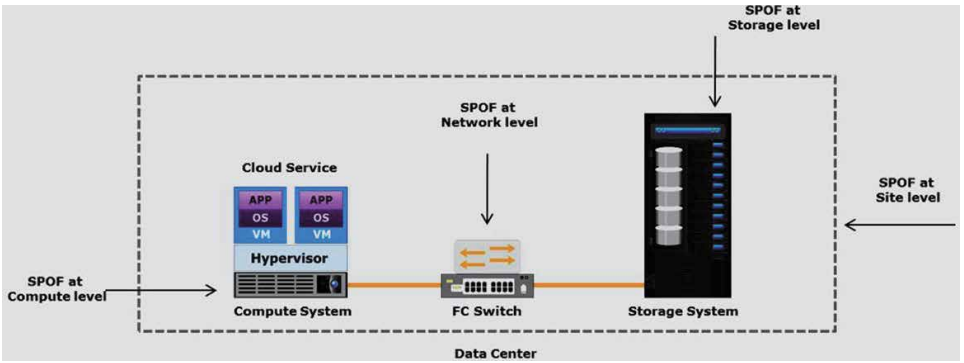

Figure 7.
Single Point of Failure.

result in service outages. The general method to avoid single points of failure is to provide redundant components for each necessary resource, so that a service can continue with the available resource even if a component fails. Service provider may also create multiple service availability zones to avoid single points of failure at data center level.

Usually, each zone is isolated from others, so that the failure of one zone would not impact the other zones. It is also important to have high availability mechanisms that enable automated service failover within and across the zones in the event of component failure, data loss, or disaster.

N + 1 redundancy is a common form of fault tolerance mechanism that ensures service availability in the event of a component failure. A set of N components has at least one standby component. This is typically implemented as an active/passive arrangement, as the additional component does not actively participate in the service operations. The standby component is active only if any one of the active components fails. N + 1 redundancy with active/active component configuration is also available. In such cases, the standby component remains active in the service operation even if all other components are fully functional. For example, if active/active configuration is implemented at the site level, then a cloud service is fully deployed in both the sites. The load for this cloud service is balanced between the sites. If one of the site is down, the available site would manage the service operations and manage the workload.

4.2 Avoiding single points of failure

Single points of failure can be avoided by implementing fault tolerance mechanisms such as redundancy:

- Implement redundancy at component level: (i) Compute, (ii) Storage, (iii) Network.

- Implement multiple service availability zones: (i) Avoids single points of failure at data center (site) level, (ii) Enable service failover globally.

It is important to have high availability mechanisms that enable automated service failover.

4.3 Implementing redundancy at component level

The underlying cloud infrastructure components (compute, storage, and network) should be highly available and single points of failure at component level should be avoided. The example shown in **Figure 8** represents an infrastructure designed to mitigate the single points of failure at component level. Single points of failure at the compute level can be avoided by implementing redundant compute systems in a clustered configuration. Single points of failure at the network level can be avoided via path and node redundancy and various fault tolerance protocols. Multiple independent paths can be configured between nodes so that if a component along the main path fails, traffic is rerouted along another.

The key techniques for protecting storage from single points of failure are RAID, erasure coding techniques, dynamic disk sparing, and configuring redundant storage system components. Many storage systems also support redundant array independent nodes (RAIN) architecture to improve the fault tolerance. The following slides will discuss the various fault tolerance mechanisms as listed on the slide to avoid single points of failure at the component level.

4.4 Implementing multiple service availability zones

An important high availability design best practice in a cloud environment is to create service availability zones. A service availability zone is a location with its own set of resources and isolated from other zones to avoid that a failure in one zone will not impact other zones. A zone can be a part of a data center or may even be comprised of the whole data center. This provides redundant cloud computing facilities on which applications or services can be deployed. Service providers typically deploy multiple zones within a data center (to run multiple instances of a service), so that if one of the zone incurs outage due to some reasons, then the service can be failed over to the other zone. They also deploy multiple zones across geographically dispersed data centers (to run multiple instances of a service), so that the service can survive even if the failure is at the data center level. It is also important that there should be a mechanism that allows seamless (automated) failover of services running in one zone to another.

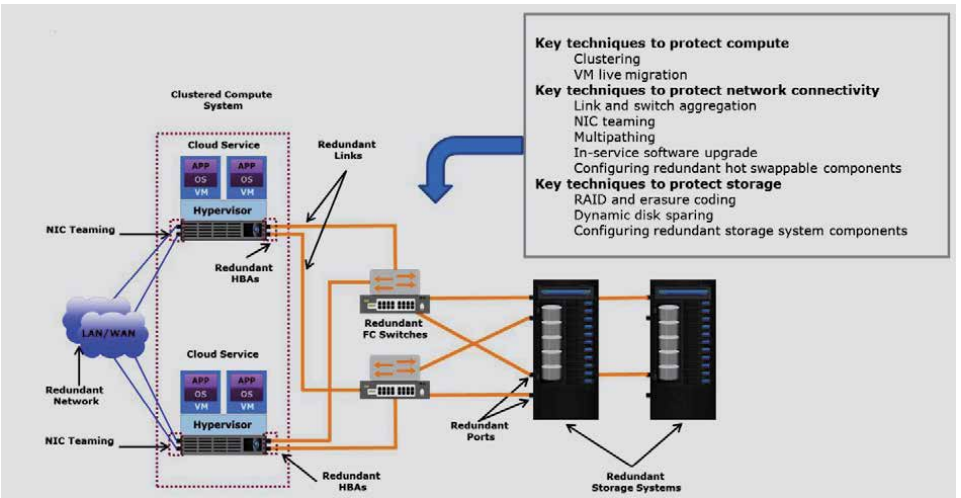

Figure 8.
Implementing Redundancy at Component Level.

To ensure robust and consistent failover in case of a failure, automated service failover capabilities are highly desirable to meet stringent service levels. This is because manual steps are often error prone and may take considerable time to implement. Automated failover also provides a reduced RTO when compared to the manual process. A failover process also depends upon other capabilities, including replication and live migration capabilities, and reliable network infrastructure between the zones. The following slides will demonstrate the active/passive and active/active zone configurations, where the zones are in different remote locations.

Figure 9 shows an example of active/passive zone configuration. In this scenario, all the traffic goes to the active zone (primary zone) only and the storage is replicated from the primary zone to the secondary zone. Typically in an active/passive deployment, only the primary zone has deployed cloud service applications. When a disaster occurs, the service is failed over to the secondary zone. The only requirement is to start the application instances in the secondary zone and the traffic is rerouted to this location.

In some active/passive implementation, both the primary and secondary zone have services running, however only the primary zone is actively handling requests from the consumers. If the primary zone goes down, the service is failed over to the secondary zone and all the requests are rerouted. This implementation provides faster restore of a service (very low RTO).

Figure 10 shows an example of implementing active/active configuration across data centers (zones), and the VMs running at both the zones collectively offer the same service. In this case, both the zones are active, running simultaneously, handling consumers requests and the storage is replicated between the zones. There should be a mechanism in place to synchronize the data between the two zones. If one of the zone fails, the service is failed over to the other active zone. The key point to be noted here is until the primary zone is restored, the secondary zone may have a sudden increase in workload.

So, it is important to initiate additional instances to handle the workload at secondary zone. The active/active design gives the fastest recovery time.

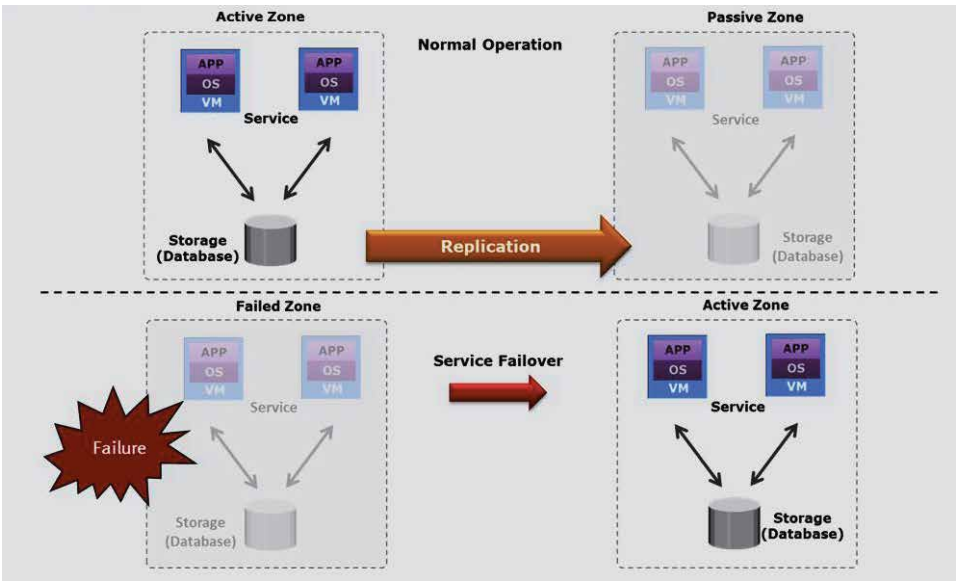

Figure 9.
Active/Passive Zone Configuration.

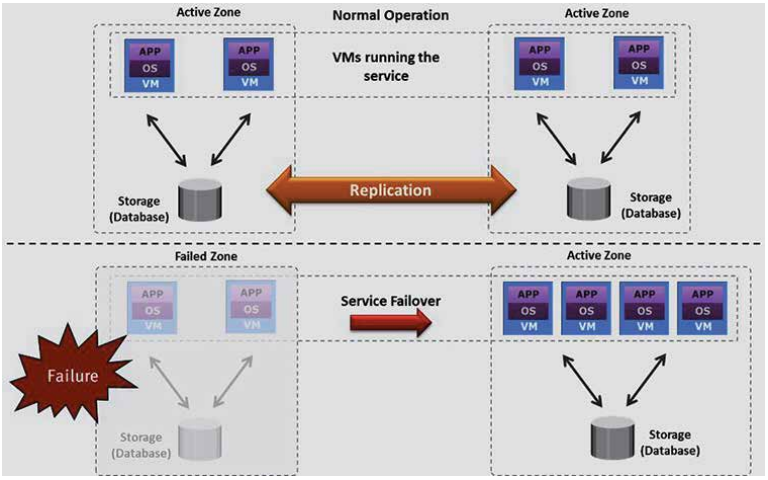

Figure 10.
Active/Active Zone Configuration.

The figure details the underlying techniques such as live migration of VMs using stretched cluster, which enables continues availability of service in the event of compute, storage, and zone (site) failure.

5. Data protection solution: backup

This section covers an introduction to backup and recovery as well as a review of the backup requirements in a cloud environment. This lesson also covers guest-level and image-level backup methods. Further, this section covers backup as a service, backup service deployment options, and deduplication for backup environment.

5.1 Data protection overview

Like protecting the infrastructure components (compute, storage, and network), it is also critical for organizations to protect the data by making copies of it so that it is available for restoring the service even if the original data is no longer available. Typically organizations implement data protection solution in order to protect the data from accidentally deleting files, application crashes, data corruption, and disaster. Data should be protected at local location and as well as to a remote location to ensure the availability of service. For example, when a service is failed over to other zone (data center), the data should be available at the destination in order to successfully failover the service to minimize the impact to the service.

One challenge to data protection that remains unchanged is determining the "right" amount of protection required for each data set. A "tiered approach" to data protection takes into account the importance of the data. Individual applications or services and associated data sets have different business values, require different data protection strategies. As a result, a well-executed data protection infrastructure should be implemented by a service provider to offer a choice of cost effective options to meet the various tiers of protection needed. In a tiered approach, data and applications (services) are allocated to categories (tiers) depending on their importance. For example, mission critical services are tier 1, important but less

time-critical services are tier 2, and non-critical services are tier 3. Using tiers, resources and data protection techniques can be applied more cost effectively to meet the more stringent requirements of critical services while less expensive approaches are used for the other tiers. The two key data protection solutions widely implemented are backup and replication.

5.2 Backup and recovery

A backup is an additional copy of production data, created and retained for the sole purpose of recovering the lost or corrupted data. With the growing business and the regulatory demands for data storage, retention, and availability, cloud service providers face the task of backing up an ever-increasing amount of data. This task becomes more challenging with the growth of data, reduced IT budgets, and less time available for taking backups. Moreover, service providers need fast backup and recovery of data to meet their service level agreements. The amount of data loss and downtime that a business can endure in terms of RPO and RTO are the primary considerations in selecting and implementing a specific backup strategy. RPO specifies the time interval between two backups. For example, if a service requires an RPO of 24 hours, the data need to be backed up every 24 hours. RTO relates to the time taken by the recovery process. To meet the defined RTO, the service provider should choose the appropriate backup media or backup target to minimize the recovery time. For example, a restore from tapes takes longer to complete than a restore from disks. Service providers need to evaluate the various backup methods along with their recovery considerations and retention requirements to implement a successful backup and recovery solution in a cloud environment.

5.3 Backup requirements in a cloud environment

In a cloud environment, applications typically run on VMs. Multiple VMs are hosted on single or clustered physical compute systems. The virtualized compute system environment is typically managed from a management server, which provides a centralized management console for managing the environment. The integration of backup application with the management server of virtualized environment is required. Advanced backup methods require the backup application to obtain a view of the virtualized environment and send configuration commands related to backup to the management server. The backup may be performed either file-by-file or as an image. Similarly, recovery requires either/both file level recovery and/or full VM recovery from the image. Cloud services have different availability requirement and that would affect the backup strategy. For example, if the consumer chose a higher backup service level (e.g. platinum) for their VM instances, then the backup would happen more frequently, have a lower RTO, and also have longer term retention when compared to lower-level service tiers. Typically, cloud environment has large volume of redundant data. Backing up of redundant data would significantly affect the backup window and increase the operating expenditure. Service provider needs to consider deduplication techniques to overcome these challenges. It is also important to ensure that most of the backup and recovery operations need to be automated.

5.4 Backup as a service

The unprecedented growth in data volume confronting today's IT organizations challenges not only IT management and budgets, but also all aspects of data

protection. The complexity of the data environment, exemplified by the proliferation and dynamism of virtual machines, constantly outpaces existing data backup plans. Deployment of a new backup solution takes weeks of planning, justification, procurement, and setup. Some organizations find the traditional on-premise backup approach inadequate to the challenge.

Service providers offer backup as a service that enables an organization to reduce its backup management overhead. It also enables the individual consumer to perform backup and recovery anytime, from anywhere, using a network connection. Backup as a service enables enterprises to procure backup services on-demand. Consumers do not need to invest in capital equipment in order to implement and manage their backup infrastructure. Many organizations' remote and branch offices have limited or no backup in place. Mobile workers represent a particular risk because of the increased possibility of lost or stolen machines. Backing up to cloud ensures regular and automated backups for these sites and workers who lack local IT staff, or who lack the time to perform and maintain regular backups.

5.5 Backup service deployment options

There are three common backup service deployment options that a cloud service providers offer to their consumers. These deployment options are:

- Local backup service (Managed backup service): This option is suitable when a cloud service provider is already providing some form of cloud services (example: compute services) to the consumers. The service provider may choose to offer backup services to the consumers, helping protect consumer's data that is being hosted in the cloud.

- Replicated backup service: This is an option where a consumer performs backup at their local site but does not want to either own or manage or incur the expense of a remote site for disaster recovery purposes. For such consumers, a cloud service provider offers replicated backup service that replicates backup data to a remote disaster recovery site.

- Remote backup service: In this option, consumers do not perform any backup at their local site. Instead, their data is transferred over a network to a backup infrastructure managed by the cloud service provider.

6. Data protection solution: replication

This section covers the replication and its types. This section also covers local replication methods such as snapshot and mirroring. This section further covers remote replication methods such as synchronous and asynchronous remote replications along with continuous data protection (CDP). Finally, this lesson covers a replication use case, Disaster Recovery as a Service (DRaaS).

6.1 Introduction to replication

It is necessary for cloud service providers to protect mission-critical data and minimize the risk of service disruption. If a local outage or disaster occurs, faster data and VM restore, and restart is essential to ensure business continuity. One of the ways to ensure BC is replication, which is the process of creating an exact copy (replica) of the data. These replica copies are used for restore and restart services if data loss occurs. Based on the availability requirements for the service being offered

to the consumer, the data can be replicated to one or more locations. Service provider should provide the option to consumers for choosing the location to which the data is to be replicated in order to comply with regulatory requirements. Replication can be classified into two major categories: local replication and remote replication. Local replication refers to replicating data within the same location. Local replicas help to restore the data in the event of data loss or enables to restart the application immediately to ensure BC. Snapshot and mirroring are the widely deployed local replication techniques. Remote replication refers to replicating data across multiple locations (locations can be geographically dispersed). Remote replication helps organizations to mitigate the risks associated with regional outages resulting from natural or human-made disasters. During disasters, the services can be moved to a remote location to ensure continuous business operation. In a remote replication, data can be synchronously or asynchronously replicated.

Replicas are immediately accessible by the application, but a backup copy must be restored by backup software to make it accessible to applications. Backup is always a point-in-time copy, but a replica can be a point-in-time copy or continuous. Backup is typically used for operational or disaster recovery but replicas can be used for recovery and restart. Replicas typically provide faster RTO compared to recovery from backup.

6.2 Local replication: snapshot

A snapshot is a virtual copy of a set of files, or volume as they appeared at a specific PIT. A snapshot can be created by using compute operating environment (hypervisor), or storage system operating environment. Typically the storage system operating environment takes snapshot at volume level, that may contain multiple VMs data and configuration files. This option does not provide an option to restore a VM in the volume. The most common snapshot technique implemented in a cloud environment is virtual machine snapshot. A virtual machine snapshot preserves the state and data of a virtual machine at a specific point-in-time. The VM state includes VM files, such as BIOS, VM configurations, and its power state (powered-on, powered-off, or suspended). This VM snapshot is useful for quick restore of a VM. For example, a cloud administrator can snapshot a VM, then make changes such as applying patches, and software upgrades. If anything goes wrong, administrator can simply restore the VM to its previous state using the previously created VM snapshot.

The hypervisor provides an option to create and manage multiple snapshots. When a VM snapshot is created, a child virtual disk (delta disk file) is created from the base image or parent virtual disk. The snapshot mechanism prevents the guest operating system from writing to the base image or parent virtual disk and instead directs all writes to the delta disk file. Successive snapshots generate a new child virtual disk from the previous child virtual disk in the chain. Snapshots hold only changed blocks. This VM snapshot can be used for creating image-based backup (discussed earlier) to offload the backup load from a hypervisor.

6.3 Local replication: mirroring

Mirroring as shown in **Figure 11** can be implemented within a storage system between volumes and between the storage systems. The example shown on the slide illustrates mirroring between volumes within a storage system. The replica is attached to the source and established as a mirror of the source. The data on the source is copied to the replica. New updates to the source are also updated on the replica. After all the data is copied and both the source and the replica contain

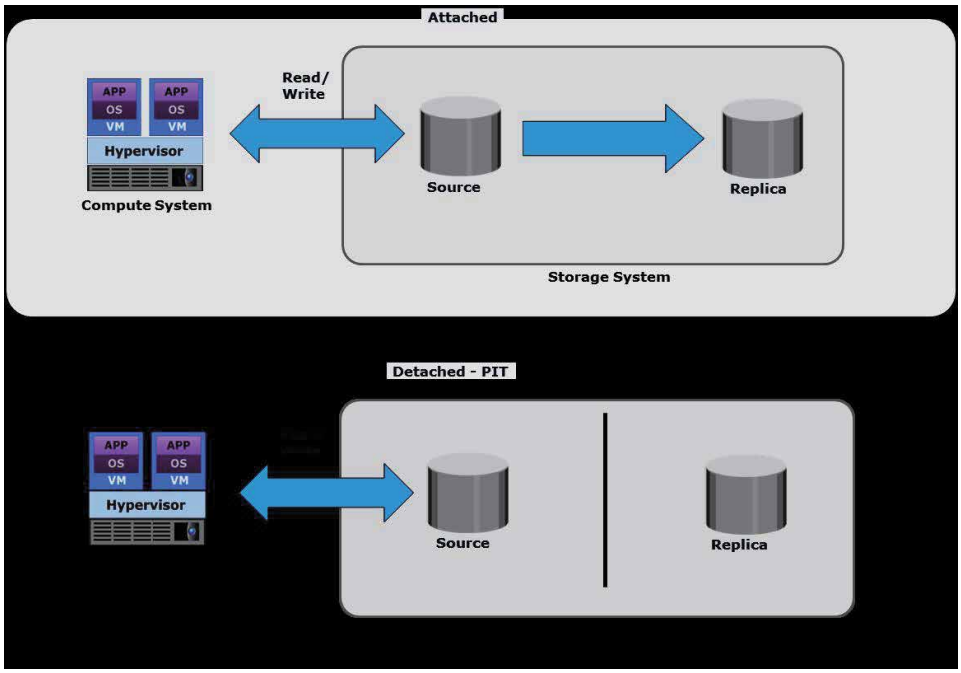

Figure 11.
Local Replication: Mirroring.

identical data, the replica can be considered as a mirror of the source. While the replica is attached to the source, it remains unavailable to any other compute system. However, the compute system continues to access the source. After the synchronization is complete, the replica can be detached from the source and made available for other business operations such as backup and testing. If the source volume is not available due to some reason, the replica enables to restart the service instance on it or restores the data to the source volume to make it available for operations.

6.4 Remote replication: synchronous

Synchronous replication as shown in **Figure 12** provides near zero RPO where the replica is identical to the source at all times.

In synchronous replication, writes must be committed to the source and the remote replica (or target) prior to acknowledging "write complete" to the compute

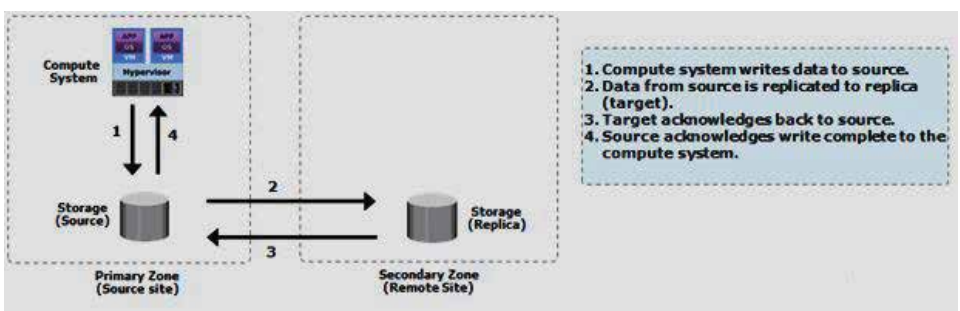

Figure 12.
Remote Replication: Synchronous.

system. Additional writes on the source cannot occur until each preceding write has been completed and acknowledged. This ensures that data is identical on the source and the replica at all times. Further, writes are transmitted to the remote site exactly in the order in which they are received at the source. Therefore, write ordering is maintained. The figure on the slide illustrates an example of synchronous remote replication. Data can be replicated synchronously across multiple sites. If the primary zone is unavailable due to disaster, then the service can be restarted immediately in other zone to meet the required SLA.

Application response time is increased with synchronous remote replication because writes must be committed on both the source and the target before sending the "write complete" acknowledgment to the compute system. The degree of impact on response time depends primarily on the distance and the network bandwidth between sites. If the bandwidth provided for synchronous remote replication is less than the maximum write workload, there will be times during the day when the response time might be excessively elongated, causing applications to time out. The distances over which synchronous replication can be deployed depend on the application's capability to tolerate the extensions in response time. Typically synchronous remote replication is deployed for distances less than 200 KM (125 miles) between the two sites.

6.5 Remote replication: asynchronous

It is important for a service provider to replicate data across geographical locations in order to mitigate the risk involved during disaster. If the data is replicated (synchronously) between zones and the disaster strikes, then there would be a chance that both the zones may be impacted. This leads to data loss and service outage. Replicating data across zones which are 1000s of KM apart would help service provider to face any disaster. If a disaster strikes at one of the regions then the data would still be available in another region and the service could move to the location.

In asynchronous remote replication as shown in **Figure 13**, a write from a computer system is committed to the source and immediately acknowledged to the compute system.

It enables replication of data over distances of up to several thousand kilometers between the primary zone and the secondary zones (remote locations). Asynchronous replication also mitigates the impact to the application's response time because the writes are acknowledged immediately to the compute system. In this case, the required bandwidth can be provisioned equal to or greater than the average write workload. Data can be buffered during times when the bandwidth is insufficient and moved later to the remote zones. Therefore, adequate buffer capacity should be provisioned. RPO depends on the size of the buffer, the available network

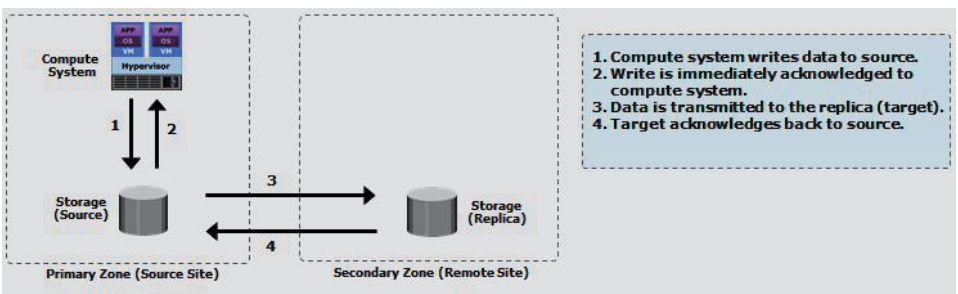

Figure 13.
Remote replication: asynchronous.

bandwidth, and the write workload to the source. Asynchronous replication implementations can take advantage of locality of reference (repeated writes to the same location). If the same location is written multiple times in the buffer prior to transmission to the remote zones, only the final version of the data is transmitted. This feature conserves link bandwidth.

6.6 Advanced replication solution: continuous data protection (CDP)

Mission-critical applications running on computer systems often require instant and unlimited data recovery points. Traditional data protection technologies offer a limited number of recovery points. If data loss occurs, the system can be rolled back only to the last available recovery point. Mirroring offers continuous replication; however, if logical corruption occurs to the production data, the error might propagate to the mirror, which makes the replica unusable. Ideally, CDP provides the ability to restore data to any previous point-in-time images (PIT). It enables this capability by tracking all the changes to the production devices and maintaining consistent point-in-time images. CDP enables one to perform operational recovery (protection against human errors, data corruption, and virus attacks) through local replication and disaster recovery through remote replication. CDP minimizes both RPO and RTO. In CDP, data changes are continuously captured and stored in a separate location from the primary storage. With CDP, recovery from data corruption poses no problem because it allows going back to any PIT image prior to the data corruption incident.

6.7 Replication use case: disaster recovery-as-a-service (DRaaS)

Facing an increased reliance on IT and the ever-present threat of natural or man-made disasters, organizations need to rely on business continuity processes to mitigate the impact of service disruptions. Traditional disaster recovery methods often require buying and maintaining a complete set of IT resources at secondary data centers that matches the business-critical systems at the primary data center. This includes sufficient storage to house a complete copy of all of the enterprise's business data by regularly replicating production data on the mirror systems at secondary site. This may be a complex process and expensive solution for a significant number of organizations.

Disaster Recovery-as-a-Service (DRaaS) has emerged as a solution to strengthen the portfolio of a cloud service provider, while offering a viable DR solution to consumer organizations. The cloud service provider assumes the responsibility for providing resources to enable organizations to continue running their IT services in the event of a disaster. From a consumer's perspective, having a DR site in the cloud reduces the need for data center space and IT infrastructure, which leads to significant cost reductions, and eliminates the need for upfront capital expenditure. Resources at the service provider can be dedicated to the consumer or they can be shared. The service provider should design, implement, and document a DRaaS solution specific to the customer's infrastructure. They must conduct an initial recovery test with the consumer to validate complete understanding of the requirements and documentation of the correct, expected recovery procedures.

For enterprises, the main goal of DR is business continuity, which implies the ability to resume services after a disruption. The Recovery Time Objective (RTO) and Recovery Point Objective (RPO) are two important parameters that all recovery mechanisms to improve. RTO is the time duration between disruption until the service is restored, and RPO denotes the maximum amount of tolerable data loss

that can be afforded after a disaster. By minimizing RTO and RPO, business continuity can be achieved.

Failover delays consist of five steps depending on the level of backup [13]:

S1: Hardware setup
S2: OS initiation time
S3: Application initiation time
S4: Data/process state restoration time
S5: IP forwarding time

Therefore, RPO and RTO can be defined as:
The Recovery Time Objective (RTO)
The Recovery Point Objective (RPO)

$$PRO \propto \frac{1}{Fb} \tag{2}$$

Where Fb is Frequency of backup

$$RTO = fraction\ of\ PRO + \sum_{S1}^{S5} T_j \tag{3}$$

During normal production operations as shown in **Figure 14**, IT services run at the consumer's production data center. Replication of data occurs from the consumer production environment to the service provider's location over the network. Typically when replication occurs, the data is encrypted and compressed at the production environment to improve the security of data and reduce the network bandwidth requirements. Typically during normal operating conditions, a DRaaS implementation may only need a small share of resources to synchronize the application data and VM configurations from the consumer's site to the cloud. The full set of resources required to run the application in the cloud is consumed only if a disaster occurs.

In the event of a business disruption or disaster as shown in **Figure 15**, the business operations will failover to the provider's infrastructure as shown in the figure on the slide. In such a case, users at the consumer organization are redirected to the cloud.

For applications or groups of applications that require restart in a specific order, a sequence is worked out during the initial cloud setup for the consumer and recorded in the disaster recovery plan. Typically VMs are allocated from a pool of compute resources located in the provider's location.

Returning business operations back to the consumer's production environment is referred to as failback. This requires replicating the updated data from the cloud repository back to in-house production systems before resuming the normal

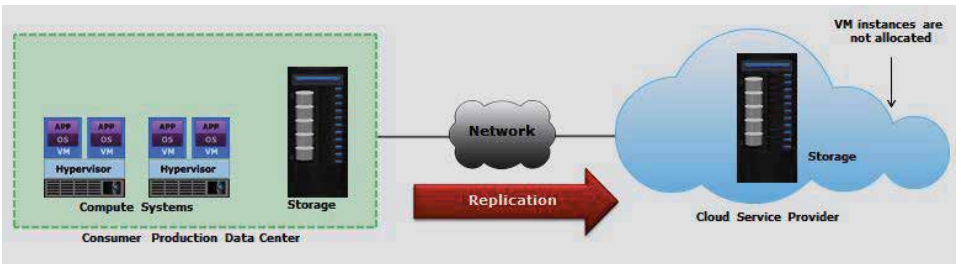

Figure 14.
DRaaS – Normal Production Operation.

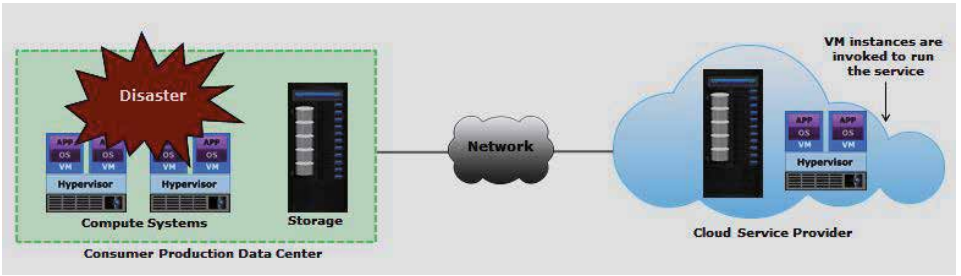

Figure 15.
DRaaS – Business Disruption.

business operations at consumer's location. After starting the business operations at the consumer's infrastructure, replication to the cloud is re-established. To offer DRaaS, the service provider should have all the necessary resources and technologies to meet the required service level.

Cloud-based DR solutions are attractive because of their ability to tolerate disasters and to achieve reliability and availability goals. Such solutions can be even more useful in small and medium enterprises (SMEs) environments, because the latter does not have many resources (unlike large companies). As shown in **Table 2**, data level, system level, and application level are three DR levels, which are defined in terms of system requirements [14].

The performance requirements that have to be met by DR are to minimize RPO and RTO. There are different DR approaches to develop a recovery plan. All these approaches are based on redundancy and backup strategies if resources are systematically reserved in the backup. The redundancy strategy relies upon distinct sites that have the ability to start up the applications after a disaster; whereas backup strategy relies upon replication technology [15]. The speed and protection degree of these approaches depend on the level of DR services that is shown in **Table 3** [16].

The objective of disaster recovery planning is to minimize RTO, RPO, cost, and application latency by considering system constraints such as CPU, network, and

DR Level	Description
Data level	Security of application data
System level	Reducing recovery time as short as possible
Application level	Application continuity

Table 2.
DR levels.

Model	Synchronize Time	Recovery Time	Backup Characteristics	Tolerance support
Hot	Seconds	Minutes	Physical Mirroring	Very High
Modified Hot	Minutes	1 Hour	Virtual Mirroring	High
Warm	Hours	1 to 24 Hours	Limited Physical Mirroring	Moderate
Cold	Days	More than 24 Hours	Off-site backup	Limited

Table 3.
Cloud-based DR models.

storage requirements. DR recovery planning can be considered as an optimization problem. DR plans include at least two phases:

- Matching Phase: In this phase, several candidate DR solutions are matched against the requirements to minimize RPO and RTO) of any data container, (a data container means a data set with identical DR requirements).

- Plan composition phase: Selecting an optimal DR solution which can minimize cost with respect to required latency for each data container.

6.8 Disaster recovery-as-a-service (DRaaS) challenges

In this section, we investigate some common DRaaS challenges in cloud environments.

6.8.1 Cost

One of the main factors to choose cloud as a DRaaS is its price. CSPs always seek cheaper ways to provide recovery mechanisms by minimizing different costs.

6.8.2 Replication latency

DRaaS depends on the replication process to create backups. Current replication strategies are divided into two categories: synchronous and asynchronous. However, they both have certain advantages and disadvantages. Synchronized replication, guarantees excellent RPO and RTO, but is dear and might affect system performance because of over-optimization. This problem is incredibly bad for multi-tier web applications because it can greatly increase the trip Time (RRR) between the first and backup sites. On the choice hand, the backup model adopted with asynchronous replication is cheaper and also the system has fewer problems, but the standard of the DRaaS is reduced. Thus, the transaction between costs, the performance of the system and replication latency is an undeniable challenge in cloud disaster solutions.

6.8.3 Data storage

Business database storage is one of the problems of enterprises that can be solved by cloud services. By increasing cloud usage in business and market, enterprises need to store huge amounts of data on cloud-based storage. Instead of conventional data storage devices, cloud storage service can save money and is more flexible. To satisfy applications and to guarantee the security of data, computing has to be distributed but storage has to be centralized. Therefore, storage a single point of failure and data loss are critical challenges to store data in cloud service providers [17].

6.8.4 Lack of redundancy

When a disaster happens, the primary site becomes unavailable and the backup site has to be activated to replace the primary site. It is a serious threat to the system. This issue is temporary and will be removed once the primary site is recovered.

6.8.5 Failure

The early detection failure time significantly affects the recovery time of the system, so it is important to detect and report rapid and accurate DRaaS failure. On the other hand, in many backup sites there is a big question: How to separate network failures and service interruptions.

6.8.6 Security

As mentioned earlier, disaster can be created by nature or can be man-made. The cyber-terrorist attack is one of the most man-made disasters that can occur for a variety of reasons. In this case, protecting and restoring important data will be the focus of the DRaaS programs other than system restoration [18].

6.9 Disaster recovery-as-a-service (DRaaS) solutions

In this section we discuss some DRaaS solutions that can address the problems and challenges raised by cloud-based DR.

6.9.1 Local backup

A solution to the dependency problem has been proposed in [19]. A Local Backup can be deployed on the side of customers to control data and to get backup of both data and even complete application on local storage. Local storage are often updated through a secured channel. By this technique, migration between CSPs and migration from public to private clouds, and from private to public clouds is possible. In the event of a disaster, local backups can provide the services that used to be provided by the CSP.

6.9.2 Geographical redundancy and backup (GRB)

Geographical Redundancy can be used in a traditional context. Two cloud zones mirror each other [17]. If one zone gets down, then the zone will be on and provide the services. A module monitors the zones to detect disaster.

Another research [20] has been proposed proposes a method to select optimal locations for multiple backups. The number of places is decided based on the nature of the application and service priority. Distance and bandwidth are two factors to settle on the simplest sites. However, this work neglects some critical factors such as the capacity of mirror sites and the number of node sources that can be hosted in each location.

6.9.3 Inter-private cloud storage (IPCS)

According to the Storage Networking Industry Association (SNIA), at least three backup locations are necessary for business data storage. Users' data should be stored in three different geographical locations: Servers, Local Backup Servers (LBS) and Remote Backup Server (RBS) [21].

6.9.4 Resource management

Hybrid clouds consist of many different hardware and software. In cloud-based enterprises, all business data are stored in storage resources of the cloud. Therefore, data protection, safety and recovery are critical in these environments. Data

protection is challenged when the data that has been processed at the primary host has not been stored in the backup host yet. There are three solutions for data recovery purposes [22]:

- Using fastest disk technology in the event of a disaster for data replication
- Prediction and replacement of risky devices: Some important factors such as power consumption, heat dissipation, and carbon footprint and data criticality (stored on each disk) can be calculated for a specific period

6.9.5 Pipelined replication

This replication technique [23] aims to gain both the performance of asynchronous replication and the consistency of sync replication. In synchronous replication, processing cannot continue until replication is completed at the backup site. Whereas, in asynchronous replication, after storing data in the local storage the process can be started.

6.9.6 Dual-role operation

To maximize resource usage, [24] introduces a technique which enables a host to operate as the primary host for some applications and to be the backup host for some other applications. In this architecture, clients send their requests to the backup host first, then the backup host transmits those requests to the primary host. After processing, the primary host sends a log to the backup and eventually replies to the clients. When a failure happens, the primary host becomes unavailable, and the backup host has to handle the requests sent to the failed host. However, this technique cannot guarantee a good service restoration by itself, because the backup site must share the resources between the requests that are directly sent to it and the redirected requests.

6.10 Disaster recovery-as-a-service (DRaaS) platforms

In this section some DRaaS systems are briefly introduced. In addition, benefits and weaknesses of each system are discussed.

6.10.1 Second site

The Second Site [25] is a disaster tolerance as a service system cloud. This platform is intended to cope three challenges: Reducing RPO, failure detection, and service restoration. Using a backup site: There is a geographically separated backup site that allows replicating groups of virtual machines through Internet links.

6.10.2 Distributed

Cloud System Architecture: In [26] the authors present a cloud architecture that provides high dependability of the system based on severe redundancy. The architecture is composed of multiple datacenters that are geographically separated from each other. Each datacenter includes VMs are active in physical. To perform DR, there is a backup server that stores a copy of each VM. In the case of a disaster, which makes a datacenter unavailable, the backup site transmits VM copies to another datacenter. Although this system architecture is expensive, it highly increases the dependability which can be adequate for (IaaS clouds. In addition, the

aforementioned paper describes a hierarchical approach to model cloud systems based on dependability metrics as well as disaster occurrence using the Statistic Petri Net approach.

6.11 Disaster recovery-as-a-service (DRaaS) open issues and future directions

In the previous sections, we described the main properties and challenges of DRaaS systems. However, some issues still require more effort to reach a level of DRaaS mechanisms in cloud computing.

6.11.1 Maximizing resource utilization

Cloud customers pay for DRaaS resources only after a disaster happens. However, these resources must always be available whenever they are needed. The revenue of the DRaaS servers is less. Therefore, CSPs need solutions to increase both the usage and the revenue of DRaaS servers while guaranteeing the availability of DRaaS services.

6.11.2 Correlated failures

Disasters that affect a specific area can lead to vast service interruption, and consequently, many customers have to be recovered by CSPs. In this case, it is possible that related servers cannot handle all the customers' requests. Therefore, it can be critical to multiplex customers' data of the same area in different servers. One major challenge in this case is how to distribute customers' traffic and data between cloud servers to minimize correlated failure risks with respect to required QoS for each server and also cloud SLAs [14].

6.11.3 Failover and failback procedures

In the event of a disaster, the failover procedure excludes failed resources and redirects workloads to a secondary site. Client-transparent procedures and fast IP failover requirements are two main challenges raised by this context. On the other hand, the cloud environment recovers from the disaster, application control has to be reverted to the original site. For this purpose, bidirectional state replication must be supported by the DRaaS mechanism. A portion of data may be lost because of the disaster in the primary site and new data will be created in the backup site. Therefore, one major challenge is how to determine new and old data which must be resynchronized to the primary site [24].

6.11.4 Disaster monitoring

In the case of a disaster, the sooner the failure is detected in either the primary site or the backup site, the better RTO. So, the challenge is how should the status of cloud be monitored and how a disaster can be detected as soon as possible [27].

6.11.5 Resource scheduling

The number of cloud-based services is increasing day by day and so has increased the complexity of cloud infrastructures. Hence, resource scheduling is a critical issue in modern cloud environments. This issue is more crucial for cloud-base platforms since they face unpredictable incoming traffic and have to consider a

variety of catastrophic situations. Building on this, more efficient resource scheduling techniques are needed in order for current DRaaS platforms to be optimized.

7. Application resiliency for cloud

This section covers the overview of resilient cloud application. This section also covers the key design strategies for application resiliency and monitoring applications for availability.

7.1 Resilient cloud applications overview

The cloud infrastructures are typically built on a large number of commodity systems to achieve scalability and keep hardware costs down. In this environment, it is assumed that some components will fail. Therefore, in the design of a cloud application the failure of individual resources often has to be anticipated to ensure an acceptable availability of the application. For existing applications, the code has to be rewritten to make them "cloud-ready" i.e., the application should have the required scalability and resiliency. A reliable application is able to properly manage the failure of one or more modules and continue operating properly. If a failed operation is retried a few milliseconds later, the operation may succeed. These types of error conditions are called as transient faults. Fault resilient applications have logic to detect and handle transient fault conditions to avoid application downtime. Key application design strategies for improving availability:

- Graceful degradation of application functionality
- Retry logic in application code
- Persistent application state model
- Event-driven processing

7.2 Graceful degradation of application functionality

Graceful degradation of application functionality refers to the ability of an application to maintain limited functionality even when some of the components, modules, or supporting services are not available. A well designed application or service typically uses a collection of loosely coupled modules that communicate with each other. The purpose of graceful degradation of application functionality is to prevent the complete failure of a business application or service. For example, consider an e-commerce application that consists of modules such as product catalog, shopping cart, order status, order submission, and order processing. Assume that the payment gateway is unavailable due to some problem. It is impossible for the order processing module of the application to continue. If the application or service is not designed to handle this scenario, the entire application might go offline. However, in this same scenario, it is possible that the product catalog module can still be available to consumers to view the product catalog. Also, the application could allow to place the order and move it into shopping cart. This provides the ability to process the orders when the payment gateway is available or after failing over to a secondary payment gateway.

7.3 Retry logic in application code

A key mechanism in a highly available application design is to implement retry logic within a code to handle service that is temporarily down. When applications use other cloud-based services, errors can occur because of temporary conditions such as intermittent service, infrastructure-level faults, or network issues. Very often, this form of problem can be solved by retrying the operation a few milliseconds later, and the operation may succeed. The simplest form of transient fault handling is to implement this retry logic in the application itself. To implement this retry logic in an application, it is important to detect and identify that particular exception which is likely to be caused by a transient fault condition. Also, a retry strategy must be defined to state how many retries can be attempted before deciding that the fault is not transient and define what the intervals should be between the retries. The logic will typically attempt to execute the action(s) a certain number of times, registering an error, and utilizing a secondary service if the fault continues.

7.4 Persistent application state model and event-driven processing

In a stateful application model, the session state information of an application (for example user ID, selected products in a shopping cart, and so on) is usually stored in compute system memory. However, the information stored in the memory can be lost if there is an outage with the compute system where the application runs. In a persistent application state model, the state information are stored out of the memory and usually stored in a repository (database). If a VM running the application instance fails, the state information is still available in the repository. A new application instance is created on another VM which can access the state information from the database and resume the processing.

In a tightly integrated application environment, user requests are processed by a particular application instance running on a server through synchronous calls. If that particular application instance is down, the user request will not be processed. For cloud applications, an important strategy for high availability design is to insert user requests into a queue and code applications to read requests from the queue (asynchronously) instead of synchronous calls. This allows multiple applications instances to process requests from the queue. This also enables adding multiple application instances to process the workload much faster to improve performance. Further, if an application instance is lost, the impact is minimal, which could be a single request or transaction. The remaining requests in the queue continue to be distributed to other available instances. For example, in an e-commerce application, simultaneous requests from multiple users, for placing orders, are loaded into a queue and the application instances running on multiple servers process the orders (asynchronously).

7.5 Monitoring application availability

A specialized monitoring tool can be implemented to monitor the availability of application instances that runs on VMs. This tool adds a layer of application awareness to the core high availability functionality offered by compute virtualization technology. The monitoring tool communicates directly with VM management software and conveys the application health status in the form of an application heartbeat. This allows the high availability functionality of a VM management software to automatically restart a VM instance if the application heartbeat is not received within a specified interval. Under normal circumstance, the resources that

comprise an application are continuously monitored at a given interval to ensure proper operation. If the monitoring of a resource detects a failure, the tool attempts to restart the application within the VM. The number of attempts that will be made to restart an application is configurable by the administrator. If the application does not restart successfully, the tool communicates to high availability functionality of a VM management software through API in order to trigger a reboot of the VM. The application is restarted as part of this reboot process. This integration between the application monitoring tool and the VM high availability solutions protects VMs, as well as the applications that run inside them.

8. Solutions and recommendations

To create a disaster recovery solution, an alternative location must be prepared to be able to recover a datacenter at failure occurring and the business can continue to run.. As a proof of concept of this solution, Microsoft Azure is used. Microsoft Azure is the public cloud to offer Disaster Recovery solution for applications running on Infrastructure as a Service (IaaS) by replicating VMs into another region even failure occurs on region level. The second proposed solution is a way of implementing highly available virtualized network element using Microsoft Windows Server and Microsoft System Center tools called High Availability Solution over Hybrid Cloud Using Failover Clustering Feature.

8.1 The first solution: network function virtualization over cloud-disaster recovery solution

Cloud Computing is making big inroads into companies today. Smaller businesses are taking advantage of Microsoft cloud services like Windows Azure to migrate their line-of business applications and services to the cloud instead of hosting them on-premises. The reasons for doing this include greater scalability, improved agility, and cost savings. Large enterprises tend to be more conservative with regards to new technologies mainly because of the high costs involved in widespread rollout of new service models and integrating them with existing organization's datacenter infrastructure.

Disaster recovery (DR) is an area of security planning that aims to protect an organization from the effects of significant disastrous events. It allows an organization to maintain or quickly resume mission-critical functions following a disaster.

Network & Mobile organizations require features that enable data backup or automate the restoring of an environment, while incurring minimal downtime. This allows organizations to maintain the necessary levels of productivity.

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Microsoft System Center has components that enable Network & Mobile organizations to back-up their data and automate the recovery process. The components used in this solution are Data Protection Manager (DPM) and Orchestrator.

Cloud computing is making big inroads into companies today. Smaller businesses are taking advantage of Microsoft cloud services like Windows Azure to migrate their line-of business applications and services to the cloud instead of hosting them on-premises.

The reasons for doing this include greater scalability, improved agility, and cost savings. Large enterprises tend to be more conservative with regards to new technologies mainly because of the high costs involved in widespread rollout of new

service models and integrating them with existing organization's datacenter infrastructure.

Windows Azure Pack is designed to help large enterprises overcome these obstacles by providing a straightforward path for implementing hybrid solutions that embraces both the modern datacenter and cloud-hosting providers.

Microsoft Windows Azure Pack brings Windows Azure technologies to private cloud integrating Windows Server, System Center to offer a self-service portal and cloud services. Microsoft Windows Azure Pack is now the preferred interface for private cloud environments. A hybrid cloud solution helps enterprises transform their current infrastructure to public cloud to achieve cost effectiveness. With advanced offloads, acceleration, virtualization, and advanced scale-out storage features, this reference architecture provides the most efficient, multi-tenant cloud that is built on top of Windows Azure Pack. Building on a familiar foundation of Windows Server and System Center, the hybrid cloud platform offers a flexible and familiar solution for enterprises to deliver business agility through self-provisioning and automation of resources.

The objective of this project is creating a hybrid cloud with Microsoft System Center 2016 and Windows Azure Pack (WAP) for storage management service.

A storage cloud can help the business units become more agile and dynamic to meet the fluctuating resource demands of their clients. Storage cloud also helps the larger organization to implement a pay-per-use model to accurately track and recover infrastructure costs across the business units.

In this solution, the software components required for deploying Windows Azure Pack (WAP) are downloaded and installed. Microsoft System Center 2016 components are downloaded and installed. The System Center Virtual Machine Manager (VMM), Operation Manger (OM), Service Manager (SM) and Orchestrator (ORCH) are configured and integrated for delivering self-service and automation. The problem of limited and shared storage owned by most of enterprises can be addressed by renting large storage from public cloud provider.

The scenario for deploying a hybrid cloud solution for enterprises to overcome this problem is introduced in this project. The tenant portal of WAP is configured to be a web portal interface for the users to request the services by himself. The services are pre-configured by admin portal WAP and accessed by the users through WAP tenant portal. Admin portal of WAP allows administrator managing clouds over a web browser. This tool also allows to enabling self-service and automation for end users in order to create virtual machines inside clouds. This solution introduces for enterprises to ensure the continuity of the service that is provided to the users by using a hybrid cloud solution of this project for managing the allocated storage [28].

The solution is based on 2 sites and one Public Cloud, Site 1 is the main datacenter which has the services such as Database Servers (VMs), Site 2 is the hot disaster recovery site which it has all equipment needed to receive the recovered data, The Public Cloud has the resources essential for the recovery process itself which are DPM and VMM. The user can be a mobile phone, computer or any other device that can connect to the network.

Backups are typically performed on a daily basis to ensure necessary data retention at a single location, for the single purpose of copying data. Disaster recovery requires the determination of the RTO (recovery time objective) in order to designate the maximum amount of time the business can be without IT systems post-disaster. Traditionally, the ability to meet a given RTO requires at least one duplicate of the IT infrastructure in a secondary location to allow for replication between the production and DR site.

Disaster recovery is the process of failing over your primary environment to an alternate environment that is capable of sustaining your business continuity.

Backups are useful for immediate access in the event of the need to restore a document but does not facilitate the failover of your total environment should your infrastructure become compromised. They also do not include the physical resources required to bring them online.

A backup is simply a copy of data intended to be restored to the original source. DR requires a separate production environment where the data can live. All aspects of the current environment should be considered, including physical resources, software, connectivity and security.

Planning a backup routine is relatively simple, since typically the only goals are to meet the RPO (recovery point objective) and data retention requirements. A complete disaster recovery strategy requires additional planning, including determining which systems are considered mission critical, creating a recovery order and communication process, and most importantly, a way to perform a valid test the overall benefits and importance of a DR plan are to mitigate risk and downtime, maintain compliance and avoid outages. Backups serve a simpler purpose. Make sure you know which solution makes sense for your business needs.

In normal situation, Customer can access their service through Microsoft Windows Azure Pack (WAP) portal from site1. System Center Data Protection Manager (DPM) makes a backup for site1 Virtual Machines (VMs). System Center Orchestrator (ORCH) operates a runbook for DPM to take recovery points of(VMs) of site1 to reduce any failure down-time Then, ORCH operates a runbook for System Center Virtual Machine Manager (VMM) to live migrate virtual machines of site 1. In a scheduled loop, ORCH operates a runbook for DPM to take recovery points of VMs of site1 as shown in **Figure 16**.

In a Disaster situation of site1, System Center Operation Manager (OM) detects failure of site1 and sends failure alert to ORCH. ORCH senses failure alerts, then runbooks is running automatically and operates DPM to perform a recovery for the backed up site1 and add the last recovery points taken. So that, our customer can access site 2 and find their service up, with decreased down-time as shown in **Figure 17**.

Setups (Installation), there are common Prerequisite for all of System Center Products which is SQL Database if we want a database for each product to store configuration files on them.

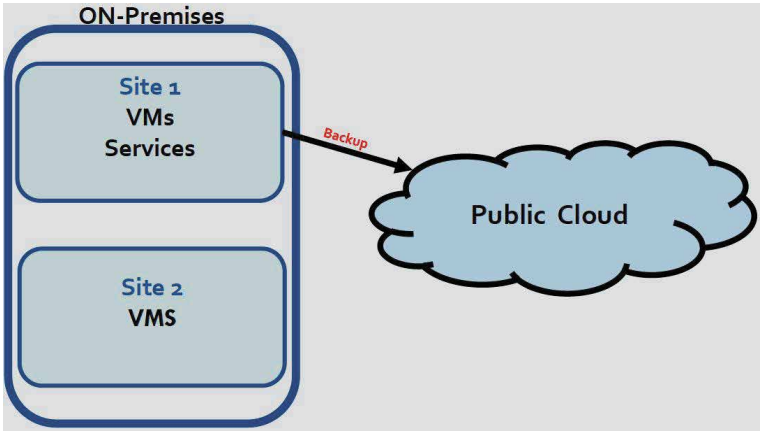

Figure 16.
Normal Case.

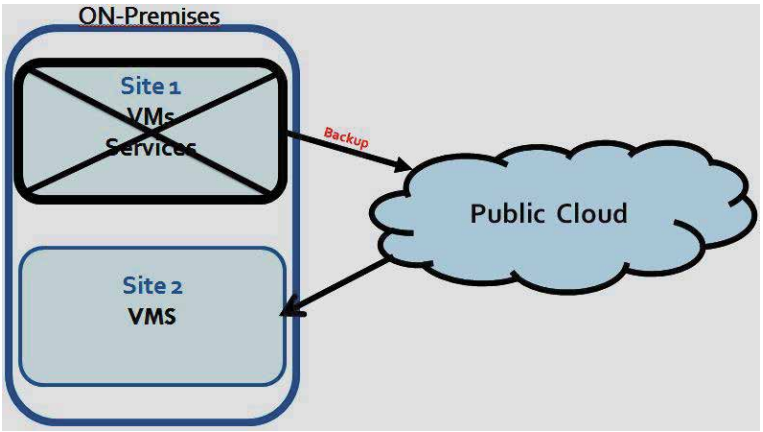

Figure 17.
Disaster Response.

8.2 The second solution: high availability solution over hybrid cloud using failover clustering feature

This solution is mainly concerned with two complementary aspects, Network Function Virtualization (NFV) followed by Hybrid cloud computing. Initially, virtualization of administrative components on premise of a company took place, such as Active Directory Domain Services (ADDS), System Center tools and Service Provider Foundation (SPF). Then we virtualized the Private Branch Exchange (PBX), the network function we are concerned with (NFV), by installing Elastix software on a virtual machine. This network function is one of the most important services adopted by various entities such as mobile operators. Thus, one of its main concerns is high availability. The availability of a system at time 't' is referred to as the probability that the system is up and functional correctly at that instance in time.

In our solution, we planned to achieve highly available voice service using Failover Cluster feature on Windows Server 2012. This is achieved by having any two identical nodes, a primary and a secondary one. Rather than having both nodes on premises of the company which may be not as cost efficient and may also be less safe since it is subjected to the same kind of failures on premise, we decided to have the secondary node on Microsoft Azure public cloud. This is called hybrid cloud computing.

In conclusion, the voice service is always running on the primary node on premises as long as there are no failures. In case of a critical failure directly affecting the voice service, its virtual machine would be migrated automatically to the secondary node on Azure's public cloud with minimum delay and not affecting the call. And thus, the voice service is proved to be highly available maintaining customer's confidence and preventing revenue losses (**Figure 18**).

The solution provides high availability for a VNF of a mobile operator, which is a Virtual Machine with cloud PBX-Elastix-installed on it as a proof of concept. **Figure 19** shows the topology of the project, which is a hybrid cloud. The on-premises part (private) represents the mobile operator and Microsoft Azure part (public) is the cloud service provider that provides a secondary failover cluster node as a part of a tenant plan. So when the Elastix server fails on premise, the Elastix service (virtual machine) is transferred to the cluster node in Microsoft Azure, making Elastix highly available [29].

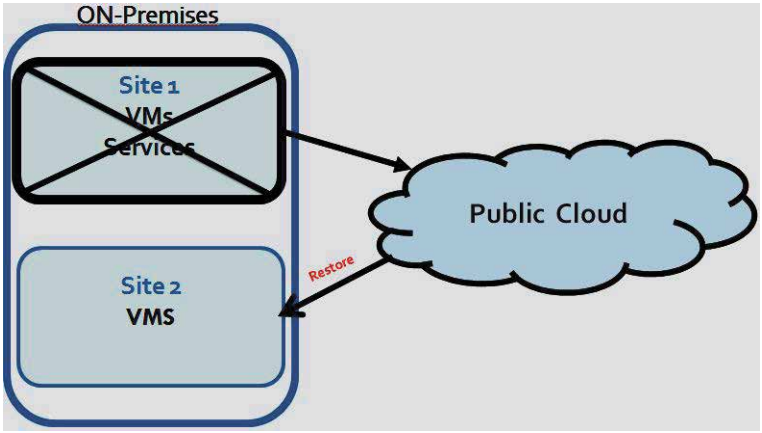

Figure 18.
Disaster Response.

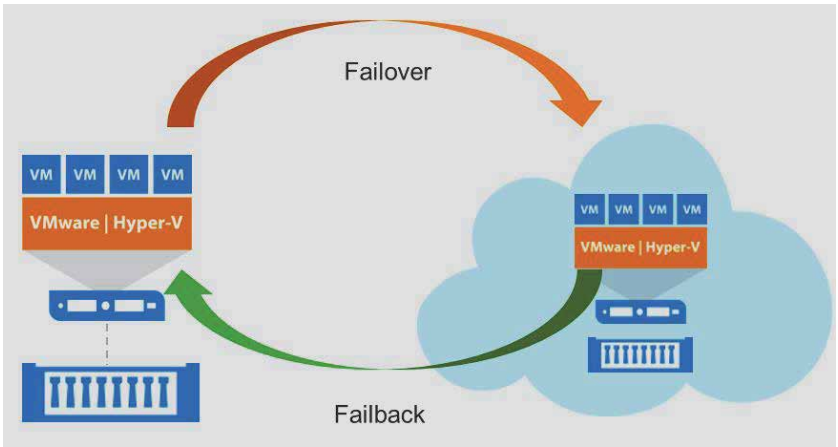

Figure 19.
Cloud Failover Scenario.

The topology components on-premises are:

- AD DS: It is the domain on premises, used for creating and authorizing Service Accounts of Microsoft System Center products. And logged on by all on-premises users and computers.

- VMM: The primary virtualization and management product of Microsoft System Center. It is used for adding hosts and clusters to the VMM library and for creating clouds, and so on. An administrator uses VMM for all management tasks including remote ones.

- Orchestrator: Its console is installed so that SPF can be installed because SPF is a sub-component of ORCH.

- SPF: SPF facilitates communication between Azure Pack and System Center products (VMM in this case). It reflects all changes that the participants (Azure Portals and VMM) made.

- Azure Admin Portal: This portal is managed by the on-premises IT administrators and is where user accounts and plans are created, and where resources are assigned to on-premises tenants through linking the users (tenants) with the plans.

- Azure Tenant Portal: This portal is used by tenants, the on-premises employees in this case. Tenants can view the services available to them and configure their own environment, such as deploying and managing VMs using the tenant portal.

- Failover Cluster Node 1: This is the on-premises node (primary node) of the Failover Cluster which has the virtual machine of Elastix on it along with other VNFs.

The additional components at Microsoft Azure are:

- Microsoft System Center: It is a suite of systems management products. The core products are: VMM, ORCH, SM, OM and DPM. They help IT build reliable and manageable systems and better automate processes.

- Azure Tenant Portal: This portal is used by azure subscribers; azure subscribers can be individual users or enterprises. In this case the mobile operator is a tenant assigned to a plan created by Microsoft Azure's Admin portal.

- Failover Cluster Node 2: The secondary public node of the Failover Cluster which Elastix virtual machine is migrated to and which takes over if node 1of the on-premise fails.

- SMB: Provides cluster nodes with a shared access to shared storage files.

Zoiper application is installed on the subscribers' mobile phones to make VoIP calls. Using Elastix web portal, a SIP extension is created for each subscriber to be able to create their own accounts on Zoiper (**Figure 20**).

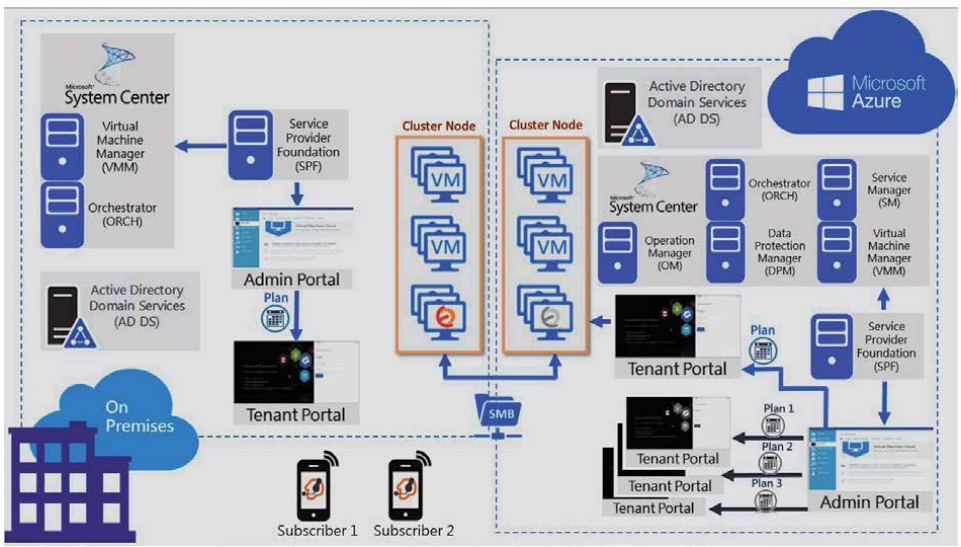

Figure 20.
Network Topology of the Project.

DOI: http://dx.doi.org/10.5772/intechopen.97369

Initially, a call is initiated between the two subscribers through Zoiper. The two subscribers will access the Elastix server deployed on the on-premises node as demonstrated in **Figure 21**.

In the case of failure of the on-premise node (primary node) while the call is ongoing, the Elastix virtual machine will be migrated to the Microsoft Azure node (secondary node), which now becomes the primary node. The Elastix virtual machine will continue running on the Microsoft Azure node by accessing SMB storage as demonstrated in **Figure 22**.

During the migration process, the downtime ranges from 2 to 3 seconds, which is barely recognizable by the user, and then the call proceeds normally. And thus, the voice service using Elastix is proved to be highly available. When the on-premises node is up again, the Elastix virtual machine will be manually migrated using the Failover Cluster Manager.

The overall goal of this solution is providing high availability solution for a virtualized network element using hybrid cloud computing. This will improve the performance of cloud services. Moreover, reduce the downtime of a service, which

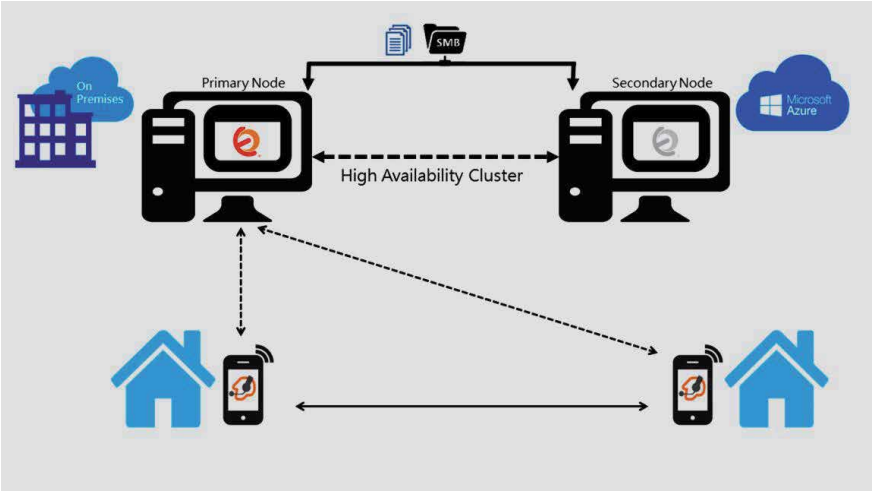

Figure 21.
The Call before Primary node failure.

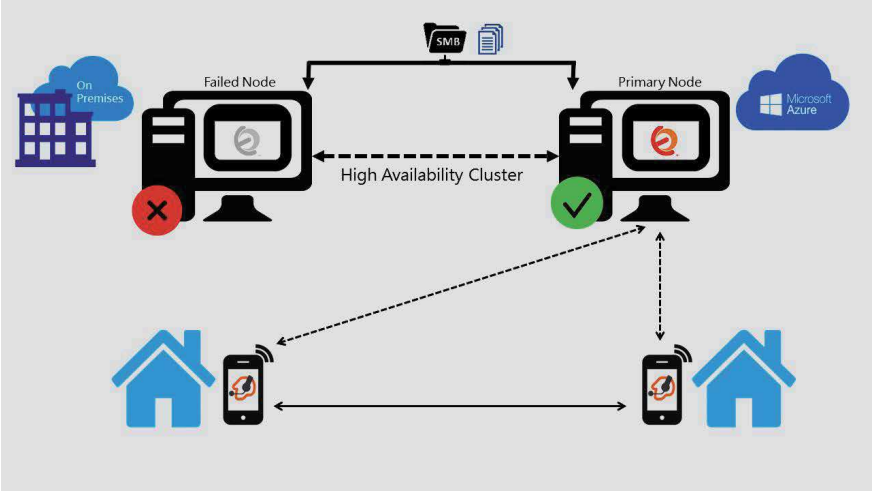

Figure 22.
The Call after Primary node failure.

would otherwise degrade the performance. This paper focused on conducting the solution using Failover cluster feature along with Microsoft System Center tools. Failures that might occur include but are not restricted to the following: network vulnerability, human mistakes, server, storage or power failures and need to be avoided.

As a conclusion, the cloud will remain subject to failure and failures can occur in the cloud as well as the IT traditional environment. Thus, high availability cannot be ensured, but it can be increased and improved, by avoiding common system failures through the implementation of different solutions and techniques.

9. Conclusion

This chapter covered the importance of business continuity in a cloud environment and how business continuity enables to achieve the required service availability. First, we briefly introduced cloud computing, including background, properties, advantages and challenges. This chapter also covered various fault tolerance mechanisms for cloud infrastructure to eliminate single points of failure. This chapter further covered data protection solutions such as backup and replication. Then, we discussed the details of DRaaS approaches. In addition, we also derived the main challenges of DRaaS mechanisms and proposed solutions to overcome them. Furthermore, the main DRaaS platforms are discussed, followed by open issues and future directions in the field of DRaaS mechanisms. Finally, this chapter also covered the key design strategies for cloud application resiliency.

Finally and as a proof of concept of cloud DR solutions, Microsoft Azure is used. Microsoft Azure is the public cloud to offer Disaster Recovery solution for applications running on Infrastructure as a Service (IaaS) by replicating VMs into another region even failure occurs on region level. The second proposed solution is a way of implementing highly available virtualized network element using Microsoft Windows Server and Microsoft System Center tools called High Availability Solution over Hybrid Cloud Using Failover Clustering Feature. The two solutions were successfully implemented and provided high performance and excellent results.

Author details

Wagdy Anis Aziz[1], Eduard Babulak[2*] and David Al-Dabass[3]

1 Ain Shams University Faculty of Engineering/Orange, Egypt

2 National Science Foundation, USA

3 Nottingham Trent University, England

*Address all correspondence to: babulak@yahoo.com

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Chapter 9

E-Services Quality: A Perspective of Service Providers and Service Users

Taiseera Hazeem AlBalushi

Abstract

Electronic service, refers to services offered over the information and communication technologies. These services are becoming increasingly important with continuously developed application in various domains (business, government, education and health) as these services provide benefits to all parties concerned from service providers, service users and the society. This chapter will shed light in e-services, definitions, components, and characteristics. As service providers want to boost the efficiency and quality to reach more users to utilize these services, a prime challenge in developing these services with high quality to meet users expectation becomes a must. Quality plays a major role to keep up a trust between service providers and users. Eight main quality dimensions are proposed as per the studies to examine the perspective of service providers and service users for government services (personalization, usability, performance, web design, security, user involvement, satisfaction and loyalty).

Keywords: e-service quality, e-government, quality factors, service provider, service user

1. Introduction

The world is becoming a small society which is totally blended with technology, therefore, prompt services technology need to be implementing in the society to meet its demands. These services are becoming y complex in volume and type to meet society's increasing expectations out of these services. Due to the advancements in ICT and digital transformation as well as the growing rate of internet and mobile technologies users has led to the emergence of new business models causing huge and rapid changes in service production as well as users expectations and behaviors. The impact was even dramatic in the public sector and e-government as its substantial growth was evident in last two decades to describe how ICT is utilized to boost the efficiency and quality of public administration in a government setting.

e-government is regarded as second revolution in public management/administration due its substantial critical role in transforming the way public services as well as the relationship between government (service providers) and citizens (service users) [1]. As e-governments thrive to offer their best services with highest level of quality, they rely on the quality and the usage by service

users [2]. To achieve highest level of trust between user/citizens and governments, quality is regarded as a key factor in this formula. As the main objective of e-government to make their services accessible and access the information smoothly and easily. The governments needs to continuously invest in their information technology, operations and infrastructure to assure reliable communication which ultimately satisfy the high quality service expectation of users/citizens [3].

An extensive amount of research was conducted from various domains (services, marketing, information systems, e-government) to measure service quality and various scales and models, frameworks were also proposed by different scholars as summarized by [4, 5] covering the domain of service quality, e-service quality and e-government quality.

In this course of study, a systematic literature review (SLRs) research methodology was carried to explore all relevant quality models, methods, factors, indicators, measures used in the process of maintaining the quality of service which satisfies the users/citizen satisfaction and loyalty level. The main purpose of this chapter is therefore to draw a roadmap as per existing studies of key elements for e-service quality dimensions which in return plays a significant role in enhancing overall service offering and usage by service providers and service users. As a result, this research will pave the way to put into the context in preparation for more studies to validate the presented quality factors in various service domains.

2. E-service quality

Service quality is becoming considerable area of research from various domains (operations, marketing, hospitality and information technology). SERVQUAL is a pioneer model which represent ten service quality dimensions for measurement of quality which are: responsiveness, competence, access, courtesy, communicating, creditability, security, understanding/knowing the customer, and tangibles [6]. The same model was revised by Parasuraman and et al. [7] it was simplified into five key dimensions: reliability, assurance, tangibles, empathy, and responsiveness. Although this model is one of the most classical models in measuring service quality it was adopted by many researchers in various domains [8–15].

It is very critical to main quality of e-services as more services online in response to the massive growth and demand by service users in light of the current situation. Various scholars offered means to measure quality in various context of applications. SITEQUAL [16] was initially developed to measure internet shopping sites perceived quality. On the other hand, Madu and Madu [17] argued that the quality can be measured by more extensive dimensions, thus proposed 15 dimensions of e-services quality; performance, features, structure, esthetics, reliability, storage capacity, Service ability, security and system integrity, trust, responsiveness, productive services, Web store policy, reputation, assurance and empathy. Quality was also studied in the domain of e-tailers and Cai and Jun [18] identified four effective dimensions which are: website design/content, trustworthiness, prompt/reliable service, communication. Additional five dimensions were proposed by Long and C. McMellon [19] which are: tangible, assurance, reliability, purchasing process, responsiveness. A *multiple-item scale (E-S-QUAL & E-RecS-Qual)* [20] was developed to measure *the quality of e-service of online shopping sites*. While Caruana et al. [21] proposed EtailQ a scale to measure online retailing service.

Quality was also measured in e-banking service in UK [22] identified seven quality seven dimensions: convenience/accuracy, accessibility/reliability, god queue management, personalization, friendly/responsiveness, customer service,

targeted customer service. Another study by Hussain [23] in e-banking domain as well identified six e- service quality dimension to have positive influence in measuring quality which are; reliability, responsiveness, ease of use, personalization, security, and website design. While a recent review study [24] found that reliability, efficiency, responsiveness, ease of use, security, website esthetic, credibility and personalization are key dimensions effecting e-banking domain.

Bauer et al. [25] developed a scale named as eTransQual to measure e-service quality with dimensions: functionality/design, enjoyment, process, reliability, responsiveness. Another hierarchical approach proposed by Fassnacht et al. [26] who identify three quality dimensions with sub dimension which are: Delivery quality (attractiveness of selection, information quality, ease of use, technical quality), environment quality (graphic quality, clarity of layout), out-come quality (reliability, functional benefit, emotional benefit).

Another hierarchical approach was proposed by Heinonen [27] with four quality dimensions and sub dimension which are: technical (outcome of service interaction), functional (interaction between the customer and all kind of interfaces of company for both personal and technical prospective), temporal (perception of the time of service), and spatial (customer perception on the physical place). While PesQ model [9] identifies four quality dimensions which are: web design, customer service, assurance and order management. Another six dimensions of e-service quality which are: trust, customized communication, ease of use, website content and functionality, reliability, and speed of delivery were proposed by [28]. Ha et al. [29] explores four dimensions which have a good impact on customer adoption of online shopping the dimensions are: website design, customer service, privacy/security, atmospheric/experiential. Akinci et al. [30] revised E-S-QUAL and E-RecS-QUAL of [20] in the context of e-banking in Turkey. While Lin et al. [31] develop a scale SSTQUAL for self-service technology which identifies seven dimensions which are: functionality, enjoyment, security/privacy, assurance, design, convenience, and customization.

Santouridis et al. [32] examined the applicability of e-service quality scale E-S-Qual and identify four dimensions which are: efficiency, fulfillment, system availability and privacy. On the other hand, Janita [33] explored service quality dimensions in B2B e-marketplaces and identify four dimensions which are: reliability, privacy, utility or the information, valued-add service. On the other and in the area of online service satisfaction, While Li [34] identified the key dimension in the domain of e-commerce websites in china: identify system related dimension and service related dimensions which are: system related (efficiency, ease of navigation, reliability, personalization, ease of use, speed) and service related (responsiveness, assurance, delivery, and customer service). Achchuthan et al. [8] Developed an model with five e-service quality dimensions which are: tangibility, empathy, responsiveness, reliability, and assurance. This was in the context of electricity services.

3. E-government service quality and dimensions

The rapid growth in information communication technology has change the way of communicating between governments and their citizens because of this change a new form of government introduced known as electronic government [35]. It has become significantly important to understand the relationships between the quality of the government services and its impact on users/citizens satisfaction. Quality dimensions of e-service become an important ingredient for e-governments to measure the users/citizens satisfaction. Many scholars explored

different approaches to find out the effective quality dimensions and measuring methods of online service quality which influences on the quality of e-services in context of e-government [2, 31, 35–51].

It is becoming an extreme challenge for e-government to maintain the service quality to ensure users/citizens satisfactions and loyalty. Therefore, and in order to meet this target, it is important to measure the quality of the service by quality factors/indicators known as dimensions. This will help in assuring that service provides are offering the services as per user's expectations. Thus, selection of dimension is based on their importance, reflected in the review of the literature during the studies in the domains e-service quality e-government service quality and also on web site quality. The main quality dimensions from the literature are discussed below and summarized in **Table 1** with their focus (service providers, service users). The focus of the studies was extracted as part of the methodologies used for data collection and analysis conducted by majority of the earlier studies in this area. It is significant to highlight that most of the studies presented regarded the achievements of high level of quality has resulted in achieving user satisfaction and loyalty.

3.1 Personalization

Personalization refers to the level of customization available under the control of the users per their needs and requirements. Alanezi et al. [56] admired from SERVQUAL unique feature of providing individual care to customers, which can only be possible by increasing capacity of citizens to customize e-government portal according to their needs. While, Surjadjaja et al. [52] identified that customization feature plays an enormous role in enhancing satisfaction of customer by easing out them in performing their normal routines of payments and services. Where, Lee et al. [53] accentuated that service quality improved the satisfaction level of citizen and left a positive impact, that increase the customer trust on the services offered by the customized e-government portal. In addition to that, Lee et al. [53] observed that personalization satisfied specific needs of customers with different choices. While, Suomi et al. [55] endorsed the importance of customization, as it help to designed the services pattern according to citizens personal choice. Where, Gilly et al. [59] identified that personalization in an online environment enhanced the trust and satisfaction of citizen over the system and allow them to provide personal information freely on their systems. While, Shareef et al. [69] describes personalization as an extent where, an efficient government portal performed their functions efficiently and always available to help their citizens in their needs.

To give some examples, personalization factor checks how well the service provider understand and respects the personal needs of the users while using these services with respect to language preferences and the way information presented in the portal to satisfy user needs. The portal is also relating to other websites that the users may be interested.

3.2 Usability/ease of use

Usability measures effectiveness, efficiency and satisfaction of a user as a result of utilizing the e-government portals. Where, ease of use explained as the availability of all necessary information which also be facilitated with advanced options for searching significant information. Several studies [57, 60, 61, 63–65, 89] observed that ease of use allows citizen's to utilize offered services frequently and also

Dimension	Model/instrument	Focus
Personalization	Antony Model [52], Lee Model [53], Ibrahim Model [54], Suomi Model [55], Alanezi Model [56], Alanezi Model [57], Al farsi Model [58], eTAILQ [59]	Service users
Usability/ease of use	SITEQUAL [60], WEBQUAL [61], WEBQUALTM [62], Santos Model [63], Fassnacht Model [64], WEBQUAL [65], Alanezi Model [56], Ladhari Model [66], Rehman Model [35], Sabote Model [67], Alanezi Model [57], Chen Model [68], Shareef Model [69], Hussain Model [70], Hein Model [71], Alfarsi Model [58].	Service users
Performance/efficiency/ responsiveness	Madu Model [17], SERVQUAL [72], Rev. SERVQUAL [73], E-S-Qual [74], E-Retail [19], Lee Model [53], Santoos Model [63], EGOVAST [47], E-GovQual [75], Shebani model [76], Sabiote Model [67], Santouridis [77], E-GovQual [78], Sharma Model [79], Stiglingh Model [80]	Service users
Web design	SITEQUAL [60], WebQual [81], eTailQ [59], Lin Model [53], Jun Model [82], E-S-QUAL [74], Caruana Model [83], PeSQ Model [84]	Service users and service providers
Security	SERVQUAL [72] SITEQUAL [60], Madu model [17], eTailQ [59], Antony Model [52], Santos Model [63], Caruana Model [83], Stoel Model [29], Suomi Model [55], Alanezi Model [56], Alanezi Model [57], e-SQ [66], SSTQUAL [31], Bhattacharya Model [42], Shareef Model [69], Sharma Model [79], Hussain Model [70], Stiglingh Model [80], Shanshan Model [85], Al farsi Model [58]	Service users and service providers
User involvement	Bhattacharya Model [42], Alanezi Model [57], E-GovQual [78], E-GSPTA [86]	Service users
Satisfaction/trust	Madu Model [17], WEBQUAL [61], WEBQUALTM [62], Antony Model [52], Jun Model [82], WEBQUAL [65], Tadisina Model [87], E EGovQual [88], E GovQual [75], Osman Model [49], EGSPTA [86]	Service users
Loyalty	Caruana Model [83], Shareef Model [69]	Service users

Table 1.
Quality dimensions and related studies.

influenced on soul satisfaction of citizen which also enhance customers trust on utilizing e-government services. Where, Shareef et al. [69] accepted ease of use a main formative dimension of service quality of e-government public administration. Accordingly, Mentzas et al. [90] affirms that the effectiveness of e-government portals enhanced with the availability of certain features such as, site map, FAQ's and availability of information about the services offered by e-government portal. Thus, availability distinctive features on e-government portal help to ease out the necessities of citizen and provide high degree of satisfaction to them.

This factor checks elements such as, how the users assess the portal structure with respect to ease of use, clarity and confidence. It also checks the portal for user friendliness and efforts required by users to interact with the portal.

3.3 Performance

Performance measures the responsiveness and reliability experienced with e-government offered services. Alanezi et al. [56] observed that performance of

the e-government portal depends on the response time of queries of the citizen. In addition to that, Alanezi et al. [57] also studied that immediate response on the queries help citizen to sort out their problems. Whereas, Shareef et al. [69] considered performance an extent that has to fulfill by the government portal according to the expectation of their citizens. While, Stinglingh et al. [80] accentuated that efficiency and responsiveness as an integral part of performance of that allows citizen to evaluate the quality of the offered services. Where, Mentzas et al. [75] relates performance with the efficiency and reliability of the services offered by the e-government portals.

Some of the items that effects the performance of the website can be response rate to queries and complains, facilitated communication and response from service providers, and providing information on timely manner.

3.4 Web design

The dimension can be referred as a tangible dimension, as it is an only interaction point between the citizen's and the e-government portal. The dimension is related to the overall layout of the website that includes design and available content, also correlate with the different studies presented by various researchers. Where, Caruana et al. [53, 83] accentuated that the website design is related to the reputation of the organization and also influence customer confidence over the portals.

Web design factor is important to foster effective communication with service providers by providing relevant and accurate information. The portal design should be easy to use and understand as well as being visually appealing.

3.5 Security

This dimension measures users' perceptions of how safe and secure they are concerning their personal information over the web site. The sense of security that e-government is fully secured provides trust to citizen to use e-government portals for their chores. While, Shareef et al. [69] studied security as a magnitude of citizens trust where citizen feel safe to disclose their personal information while they are interacting with different offered services provided on e-government portals. In SITEQUAL, Donthu et al. [60] evaluated security as an important parameter that enhanced the citizen trust while utilizing services offered by e-government portals.

By adhering to proper security measures, users are assured by service providers that their information is stored securely, and their privacy is protected, and the data provided is not used for any other purposes.

3.6 User involvement

The dimension user involvement refers to connection of e government portal to the citizen. Some researchers [75] studied dimension as citizen support, whereas bhattacharya et al. [42] studied it as citizen centricity, while Alanezi et al. [57] studied user involvement as a high level dimension and discussed it as the support and opportunities offered by the portal to e government services users. The vastness of dimension covers the availability of guidelines and availability of linked social forums. In addition to that the dimension also covers the interaction between citizens and portal through feedback on the provided services and the information about the failure of services through email and sms.

When service provides regard the users as key stakeholders of portal success via providing channels (social media, blogs, forums, etc.) where they can comment and give feedback about services provided.

3.7 Satisfaction

Satisfaction is a reaction that a customer shows to the extent to which his or her needs and expectations are met by the service offerings. This dimension measure overall experience and positive feelings towards using e-government services. Zaidi et al. [91] termed satisfaction as emotional level of citizen which they get after attaining a successful transaction. Where, Parasurman [74] accentuated satisfaction as a degree of perceived quality services that citizen acquires in their routine purchase from e-retail store. Whereas, Madu et al. [17] considered satisfaction has a major role in loyalty of customer with e-stores. In addition to that, Haliru et al. [92] affirmed satisfaction of customer tends to decline, if they are not happy with the quality of service provided and they will not likely to repurchase from the same store, if they are not happy with the offered services and better value of provided services.

3.8 Loyalty

The dimension loyalty is directly related to the degree of satisfaction of service provided by e-government portals. The measure of loyalty can be observed through pattern of availing the e-service through government portal. Accordingly, Caruna et al. [83] identified that the reliability and fulfillment of their jobs they want to do. In addition to that, Caruna et al. [83] also affirms that the level of customer services and providence of satisfactory privacy and security asserts the citizens loyalty on e-government portals.

4. Discussion and conclusion

This study aimed to investigate the quality dimension that are most relevant to the measurement of e-government services from the perspective of services providers and service users. Through investigation of previous literature eight main dimensions were proposed (personalization, usability, performance, web design, security, user involvement, satisfaction and loyalty). Most of the identified dimensions are examined against users' needs and point of view. On the other hand, security and design can be looked at from service provider perspective to prioritize their IT related investment to achieve higher level of security in offering these e-services and to design an intuitive website design to reach out more service users.

The proposed scale is valuable to countermeasure the factors which are influencing the quality of service in domain of e-government services. While there is breadth and depth of research in identifying and examining quality dimensions as per users perspectives, there are few studies [93] that are focused mainly on exploring service providers priorities and viewpoints when offering services.

This study can serve as a basis for future research and a roadmap on e-government services evaluation to assess them with respect to quality standards in order to improve citizens satisfaction and to increase usage, and trust of e-government services.

5. Limitation and future research directions

Like any other research in the area, there are some limitations to this study that needs to be considered. The quality factors studied in this research is as per an extensive literature review with specific focus to e-government quality domain. Therefore, and in order to generalize the effect of the identified factors, further studies are required in order to identify more general quality factors applicable to any domain of e-service. This will lead to the identification oof more critical quality factors as well as their overall effect on user satisfaction and loyalty.

In addition, an extensive examination is required to validate the proposed dimensions through qualitative and quantitative research methodologies. This will help with more detailed description of each factor as well as creation of specific items and metrics under each factor. It will also provide an opportunity to examine the factors in real context with different service provider domains as the reported results will very due to quality factors prioritization with respect to their unique nature and operations.

Author details

Taiseera Hazeem AlBalushi
Department of Information Systems, Sultan Qaboos University, Muscat, Oman

*Address all correspondence to: taisira@squ.edu.om

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Chapter 10

ICT Book Aspect Case Study

Józef Bohdan Lewoc, Eduard Babulak, Swieta Cukier, Erich Leitgeb and Mieczysław Rozent

Abstract

LD 6 is our "Generalized Colleague", a Leading Designer specialized in computer and communication system hardware, and pioneering/emerging/novel ICT application projects, in particular those intended for computer control systems, especially for the electric power industry. He assumed that the pioneers of the computing industry, of the best results in computer hardware, software and application projects should have the best results in defining and investigating the technological as well as off-technology (not technological aspects) of the computer development around the world. The Ld 6 is the nickname of the Leading Designer who devised an ICT book (Book 1) to disclose the impacts of the technological and off-technology aspects upon the ICT development in the countries similar to Hungary and Poland that were the most successful East Europe (Comecon) Countries developing ICT by their own and meeting the requirements of the general human culture, i.e. the ICT honest design and development. The history of writing the Book and publishing it is the subject matter of our paper (This paper). The publishing process of our Book was, generally and unfortunately, similar to rather popular of the ICT rather technology transfer process when the citizens of the technology beneficiary countries are treated similarly to the Ld 6, the basic complex hero of this paper.

Keywords: computer, computer network, hardware, software, pioneer, ICT, pioneering application, emerging application, novel application, technological aspects, off-technology (non-technological) aspects

1. Introduction

The problems of the technological and off-technology ICT development aspects being the a important basis of E-service domain, were discussed in the scientific mode and, soon after, this branch of technology and science was developed in a considerable degree. Examples of articles of this domains, resulting in high reference index may be as follows [1–3].

A survey of these and other journals that could be called using the keywords: ICT, ethics, human behavior showed that they were written, first of all, by theoreticians and not practitioners, being interested, primarily, in general and not detailed problems.. On the other side, LD 6 was interested in teaching good ICT design and development practices devised and/or learned during adequately long project periods in order that they were validated well by the Authors. In addition, LD 6 believed that the best good and ethical ICT development E-service practices could be described by the most experienced leading designers of the biggest knowledge of

ICT development covering the additional aspect of professional ethics and human behavior [4–22].

Therefore, Book 1 was devised to analyze the very successful Elwro (the former biggest Polish manufacturer of computers, complete with their E-service activities) involvement period in preparation to manufacture (1959–1961) and in production and implementation of computers (1961–1993). The history of development of Book 1, including its E-service aspect, is described in the Section 2 hereinafter.

2. Book 1 E-service development history (main body): a description of some Ld 6's grammar school education and upgrading period

This article discusses some conflicts theoretically implied from some pathological relations between his nation and the Semite nation, or from, de facto, between the Ld 6 and his, in practice, unplanned boss in this Book 1, who was invited for developing the description of the ICT theoretical aspects of ICT E-service development: the professional ethics and the Human Behavior (HB). To understand the views and believes of the Ld 6, we have to return to his secondary school (i.e. his Grammar School No. 1 (in Legnica, Lower Silesia) period.

He was alone, no his girl-schoolmates were apt to become his girl-friends due to his views and convictions. He was the best student in his Class and used to help his Colleagues by whispering answer to the questions asked by the School Teachers. The Teachers granted bad notes for him but he did not resign of whispering. All girls of his Nation called him a kind of a stupid bastard and ignored him. A positive change happened in the 4-th class when a Jewess of the Rose name joined his class: she, like her nation, simply loved the comradeship, especially that free of any financial or interest limitations. The comradeship of LD 6 was his basic characteristic encouraging him to be involved in E-service activities needing interest in helping other people.

In his 2-nd class, he was officially recognized the best Mathematician of his School, since he learned, himself, the integral calculus from an academic book on the Mathematical Analysis. But his Classmates made light of it and laughed of him: he may be used for solving mathematical problems, only. When a new class mate, Rose, joined them, she confessed that she, as well as her Nation, had a big respect to a real knowledge. Of course, the LD 6 advantage in mathematics proved to be a very important scientific basis enabling him a successful involvement in the E-service domain.

He was very poor then and some of his girl Classmates sneer of him and his old-fashioned clothes, especially two of them, trying to force him off his primus position. He was ashamed of his poverty and felt uneasy, and began to joke on the girls who wanted to change him on his primus position. They stopped to interfere him soon, so he stopped too. They gained a consensus: the Ld 6 continued whispering and received bad marks, the Girls received better marks than him and were treated as better students by the Teachers, but, for the Class, he would remain to be the Primus. When Rose joined their Class, she told him what she and her Wise Nation thought: the boy who, from his childhood years, had to struggle for anything, he wanted, is a much better candidate for a husband than the one whose parents were capable of buying him anything, he wanted. And, thus, Rose healed him of the poverty complex. Sometimes later, when he visited one of the Girls for a week during a prestigious networking conference in Paris and was welcome by her as some king of power, she confessed that she was still afraid of his jokes (more than twenty years later). His poverty resulted in working out, early, his capabilities of getting or, even,

making money which were very useful for him to help other people which has been a prerequisite of successful E-service involvement.

The Girls of his Nation liked talkative and insolent boys why the Ld 6 was very shy with respect to girls and they were not interested to them. He suffered a lot till Rose told him the opinion of her and her Nation: talkativeness and insolence not supported by a real knowledge and experience mean really nothing. This was very precious for working in E-service where his capabilities on arguing basing on his wide knowledge and experience helped a lot for him to be successful.

Listening to the Rose's opinions, the Ld 6 understood that probably all his learned or devised rules for living were included in the Jewish Nation good living practices and he decided to become a Judeophile, though he did not know this word then (the turn of 1959). However, the correct English spelling of the word is not given in the big Oxford-PWN dictionary even now (end of October, 2020). This helped him a lot to become a comrade who was approved by many people as a good E-service provider.

2.1 Organizational work

The Ld 6 was appointed for the position of the leading designer of the Book 1 project. He was very happy of that since he had been involved in investigation of technological and off-technology (non-technological) aspects of ICT development and believed that the leading designers of pioneering/emerging/novel ICT application projects, like him, are capable and, even more, obliged to perform such task in the best possible way. This was needed in order that he could work, effectively, in the E-service domain. His education university list was also very helpful since it included not only the practical degrees of PhD. and MSc. in Electronic Engineering/Mathematical Machine Specialty, but also MSc. Mathematics with distinction, making him capable of solving many theoretical ICT problems, even those unsolvable for other Electronic/ICT Engineers. In 1990, he tried to enter into connections with the IFAC TC 9.5 group involved in investigation of ethical problems. He submitted a paper with a thesis stating that East Europe ICT designers were better than their Western counterparts since they had had to learn and manufacture ICT in much worse conditions than their Western Colleagues (the Komuna (hated Communism system on the East) and undeserved, brainless embargoes on the West. He received bravos louder than other members of the Section, but the Session Chairman did not like the Ld 6's thesis and, most probably, threw his application to IFAC into a litter bin and the Ld 6 received the next Call for Papers from them after 10 years, and could and did enter into cooperation with the Federation after an extremely long waiting time. However, the publications edited by him and his group involved in design and implementation of pioneering/emerging/novel ICT application projects within the E-service domain proved to be rather interesting for the IFAC specialist environment.

2.2 The team assembled by Ld 6 for the Book 1 project

First of all, the Ld 6 assembled roughly 30 ICT pioneers of the biggest local ICT manufacturer, or the substitutes of the pioneers that had gone in the meantime, his former Colleagues from his initial employment period, who had led their projects successfully thus introducing their former biggest ICT Manufacturer, Elwro, into the E-service domain. He was very proud that, except of one pioneer invited to the Ld 6 Team, agreed to become the Book 1 Chapter Co-Authors. This one pioneer was cooperating with an easily recognized international ICT and automation corporation and had no chance to get the consent for Co-Authoring Book 1. Important

positions in the Book 1 project team were held by the Authors which were to discuss the Additional Aspects of Book 1 (ICT ethics and HB) (AA Experts), and the Publishers. During developing this Book 1, the group of the Book 1 Chapter Co-Authors was expanded of representatives of additional ICT experts of other ICT and ICT application providers invited by the AA Expert via the Ld 6.

2.3 The specifications similar to the in the Elsevier HardwareX journal are shown below in order that this journal requirements were met in Book 1 under discussion

Hereinafter, the descriptions and subjects of the hardware components under investigation are presented, constituting a basis for E-service work.

Hardware name	**Elwro (Odra-Series computers; the Elwro computers names were derived from the Odra River flowing via Wroclaw, the Polish ICT Capital City for many years, specialized in E-service domain computer and computer network applications.**
Subject area	Pioneering/emerging/novel ICT applications (in Poland and Hungary) under the Communist system domination, called by us WPR (Who has got Power is Right), belonging to the following subject areas: • Engineering and Material Science • Environmental, Planetary and Agricultural Sciences • General (Electric Power Industry, in particular) • Within the E-service domain
Hardware types	• Imaging tools • Measuring physical properties and in-lab sensors • Field measurements and sensors • Electrical engineering and computer science • Mechanical engineering and materials science • Other: Environmental safety, pioneering/emerging/novel system performance evaluation and robustness evaluation,
Open Source License	Unavailable in Hungary and Poland within the period under discussion. Mainly due to brainless and unjust embargoes, highly interfering the development of the E-service in the Countries.
Cost of Hardware	Unavailable in Hungary and Poland within the period under discussion. Mainly due the WPR system acting in contrary to E-service.
Source File Repository	Unavailable in Hungary and Poland within the period under discussion. Mainly due to brainless and unjust embargoes, and the WPR system, highly retarding the development of the E-service domain.

Hardware in context description.

The Orion Electronic Ltd. were the Hungarian first Manufacturer of computers for Computer Control Systems (CCS) in early nineteen hundred years. Unfortunately, their production range does not include any computers for E-service now. The reasons have been described for the Polish case study.

2.4 Hardware description

Like under Section 1, due to the very wide domain on paper (Polish computers manufactured from 1961 till some 1993) will be described depicting the hardware,

highlighting the customization rather than the exemplary steps of the procedure. In our opinion, the design and development of modern hardware, especially that intended for the E-service applications need a detailed knowledge and experience in hardware design, development and implementation. We believe that it may be gained only when local Manufacturers produce their solutions for E-service independently of severe and, often, unjust conditions for their work (political systems, colonial approach of technology providers, brainless and unjust embargoes).

2.5 Declaration of interest

It was assumed that the book chapter would be written by the Co-Authors as a fully volunteer E-service work (though the notion: work for the Society, used in Poland, performed under control of computer and computer application leading designers), would be much more adequate here, and there will be no conflict of interests nor debts for outsourcing work.

In particular, no Co-Authors may have any financial and personal relationships with other people or organizations that could inappropriately influence (bias) their work. Examples of potential conflicts of interest could include employment, consultancies, stock ownership, honoraria, paid expert testimony, patent applications/registrations, and grants or other funding. The Co-Authors will not have any interests in a summary declaration of interest statement in the manuscript file. The following has been stated: 'Declarations of interest: none'. This summary statement will be ultimately published if the E-service book chapter is accepted for printing.

Human and animal rights): the project will be performed in accordance with The Code of Ethics (Most Leading Authors are experts in this domain for ICT, in particular for E-service).

The Authors ensure that the work described has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for experiments involving humans, in conformity with the E-service domain rules.

All animal experiments should comply with the ARRIVE guidelines and should be carried out in accordance with the U.K. Animals (Scientific Procedures) Act, 1986 and associated guidelines, EU Directive 2010/63/EU for animal experiments, or the National Institutes of Health guide for the care and use of Laboratory animals (NIH Publications No. 8023, revised 1978) and the authors should clearly indicate in the manuscript that such guidelines have been followed. This follows from the fact that E-service does need really human behavior from the CCS (Computer Control System) designers and implementers interested in the real E-service work.

2.6 Continuation of the of the Book 1 development history

The Ld 6 was very happy of the conditions created for development of this Book 1: a complete team of the Manufacturer's pioneers (the successful leading designers/programmers) of the most important pioneering/emerging/novel Manufacturer's ICT projects belonging to the E-service domain (the pioneer who could not be an official Book 1 Chapter Co-Author, but the Consultant, only, of the very reach international ICT design and development CV, helped, in fact, the Ld 6 even more than the other ICT pioneers; on the other hand, the AA Experts (Additional Aspect Ones) were the best experts of a very big and prestigious Federation, in Off-Technology (Non-Technological) and Technological Aspects of ICT development. Therefore, the best needed information sources for the Book 1 development process was available and the AA Book 1 Editor position was appointed to the Leading AA

Expert, together with the Ld 6. The atmosphere for their work was simply enthusiastic: The local AA Experts were very apt to help with the Book 1 Project and the AA Expert appointed for the Book 1 Editor, who knew the very severe Ld 6's working conditions of the severe medical disaster (hip joint displacement, state after a severe blood escape, leukemia with chemistry treatment (especially dangerous in the CoronaVirus period), melanoma and various derivative disorders), volunteered that his one-time remuneration and possible royalties are transferred to the Ld 6. He was very happy about that since even the one-time payment for the Book 1 projects, for, as it was assessed, two years of work, would be enough for the necessary payable rehabilitation treatments of his Family patient (two times a month within 3 years). Such approach of Ld 6 was, for sure, a characteristic aspect of true E-service work.

2.7 Book 1 writing process

In accordance with the Book 1 development plan, the proper work on this project began from working out the description of the practical part describing the Computer Manufacturer (Elwro) work within the E-service domain. The description was prepared by the Ld 6 supported by the Team of former Elwro pioneers (or the substitutes of the pioneers who had gone in the meantime), who were successful leading designers of the major pioneering/emerging/novel computers or application projects. The Ld 6 belonged to the definite pioneers of Elwro in a subdomain of CCS, very important to the Country, especially within the E-service domain. Even before the first Elwro computer (UMC-1) was launched, the government representatives dreamed that the mathematical machines, as they were called in the pre-computer era in the Country, would highly increase the technological progress and, consequently, the living level in the Country (E. Bilski, B. Kasierski, 1920, private message).

The Elwro ICT pioneers were the hardware and software specialists who were proven bests on the most important hardware and software projects, needing the best knowledge of the computer hardware, software and application solutions. In addition, they should be characterized by a general human ingeniousness and should be capable of solving various technical problems due to, mainly, unjust and brainless embargoes (the embargoes were to restrict development of the Communist armed forces while the Red and Soviet Army never had any problems with the world top level electronic and ICT supplies (imported via, for instance, Finland, who tried to protect their freedom in such way) for their missiles and fighters, while the Ld 6 could not buy a good computer for his civilian customers to perform actual E-service work). The pioneers remembered glaring examples of ingeniousness of employees of various learned professions. For instance, an Elwro programmer was ordered to provide supplies of magnetic powder for their drum memories. He found a successful solution: he collected waste tapes of tape recorders, dissolved them in acetone and dried. And this worked successfully until the embargo for magnetic powder was canceled.

The Ld 6 and the other ICT pioneers worked hard, motivated by their target of publicizing their operative assumptions and results, in accordance with the E-service requirements. In most cases, the Ld 6 organized interviews with the assembled group of pioneers, translating their discussions and passing his translations for validation by the group (all pioneers' English fluency made it possible to work in such mode successfully). The open character of their work was, also, a characteristic feature of the E-service domain.

A year of such hard work made it possible to describe the technical history of Elwro since 1959 (when Elwro was established) till 1993, when the former biggest Polish Manufacturer of computers was sold to a very big International ICT and

Automation Corporation, and illegally sold (violating the contract conditions). The basic practical part was successfully completed and passed to the AA Expert for adding the description of additional aspects of the ICT development. The Ld 6 expected that this work would need less than half a year, needed for development of the basic practical part. However, this expectation was not met and the AA part needed as much as five years to be written incompletely. Due to such a prolonged writing period, this Book 1 had to be excluded of the E-service domain since the Reader waiting time was impermissible for such important project.

The basic reason for such time delay was that the AA Expert without any agreement with the Ld 6 decided to rewrite the basic practical part from the Eckersley English into the traditional English science language. The Eckersley English is toughed, even now, to the students of Oxford, the world capital city of teaching English countries. It is a simple and easily understandable language with its punctuation rules very helpful for the people not being ENS (English Native Speakers). Some people claim that the actual aim of the traditional English is that works written in such English are hardly understandable even for ENS-es and, therefore, look wise. However, Book 1, was oriented by the Ld 6 towards, first of all, poorly developed countries of, roughly, a very low number of NES-es. In addition, E-service requires that any work performed in that domain is easily understandable for non ENS countries, the beneficiary countries of the technology transfer processes, where the demand for novel technologies is highest.

The Ld 6 was in a very uncomfortable position. He would like to abandon the project, but he could not, in practice. He devised this Book 1 and this was to be a book about his Colleagues and for his Colleagues. They had worked at this Book 1. Therefore it would be a dishonor for him, a kind of some disaster, if he resigned of the project himself. He knew that he could be sacked off by the AA Expert and the Publisher, that they could steel his Book 1, but it would be their problem.

There was another important problem: the Book 1 quality: the AA Expert possessed no very much needed ICT education nor, even more, experience and his mistakes could be embarrassing to the Pioneers assembled by him for this project. A glaring example of such errors was as follows:

"The AA Expert sent to the Ld 6 an Odra 1325 computer (roughly ICL 1902a equivalent, but adapted by Elwro engineers for operation in Computer Control Systems (CCS)). Below the scheme of the external drum memory of the computer, rewritten in the only purpose that the AA Expert could claim that it was his figure, there was a single letter: M, and the AA Expert requested an explanation. The Ld 6 guessed at ones that it was a drawing error (the drawer incompetent as the AA Expert was not capable of redrawing the complete scheme and drew M instead of 16 MB), and proposed a simple correction in the legend:

$$\mathrm{M} \rightarrow 16\,\mathrm{MB}, \mathrm{i.e.}\, 16\,\mathrm{megabytes}. \tag{1}$$

The AA Expert Answer: You must have been wrong: the graphics depicted an external magnetic drum and what megabytes may do in a drum memory.

The Ld 6 thought: Sweet Jesus, he, a pretender for a position of an international ICT expert (he, even, requested, unsuccessfully, that the Ld 6 discussed difficult ICT issues with him), possessed the knowledge of the basic ICT notions poorer than the Ld 6's Grandson and Twin Granddaughters; it was a big shame even for the Grandson case though he was 27 then and was employed by a very recognizable international mobile telephone and ICT corporation as a software expert; but the Ld 6 did not know what could be said about his Granddaughters who were 11 years old, each, then, and had just begun learning informatics in the fifth class of their primary school.

The Ld 6 knew that the AA Expert wished to make an international ICT carrier (probably as a single member of the Book 1 development project) but decided to defend the quality of this Book 1 in order that a good quality book is produced nevertheless.

2.8 The beginning of the split in the Book 1 editor's and chapter co-authors group

The AA Editor sent to the Ld 6 a Book 1 section including a short description of the many century living conditions of the Jewish Nation in the Kingdom of Poland which was, in fact, a complete criticism of the Polish relations, simply discrimination of the Nation in the Kingdom of Poland. The AA Editor even complained that Jews had to build their houses out of city centers while this was not true in general and the location regulations were defined by individual sovereigns. And, while other Europeans countries expelled Jews from their countries and Spain developed the first ghettos for them, Jews were very welcome on the Polish territory and treated as the other citizens there. Many Jewish emigrants settled in Poland. Thus, the section included false information which was not supported by any evidence. The AA Editor accepted the rhetoric of some Israel minister who, in their Tv, accused Polish people that they had sucked anti-Semitism with their Mothers' milk, missing to mention even a word about a dairy research institute wherein this milk was investigated. Of course, high-level politicians may be stupid, sometimes insane, but this Book 1 trying to teach the world ICT environment how to develop this domain in severe political and economic conditions must have been wise in order that anybody wished to read and apply its advices, in conformity with real E-service conduction rules. In addition, nobody authorized the AA Editor to include such topics in this Book 1 and, for the Polish issues, the team of Polish ICT pioneers and the Ld 6 were responsible. The AA Editor did not ask them even about an opinion on the issues but the Reader would blame them that they had insulted their own Nation and even Jews would despise such Authors. Such AA Editor conduct is in contradiction with a real E-service behavior.

The AA Editor continued his action directed towards splitting the Book 1 author team. He accused the Ld 6 for supporting anti-Semitism. He could not call him an anti-Semite since some their common Colleagues knew his way to become a judeophile and they could protest. However, an anti-Semitism supporter was an undefined AA-Editor neologism and nobody understood its meaning, so nobody could protest. However, an accusation of a judeophile by a Jew would be rather week and the AA Editor asked a former Ld 6's friend and student (learning the pioneering/emerging/novel ICT application project performing from LD 6) to pass the information into the public domain in Poland. And he did it, generating serious troubles for his former friend and educator. Such methods an be called provocations and are impermissible for E-service work.

The problem of anti-Semitism support was exhausted, so the AA Editor defined another one: the share of the editors in this Book 1. The AA Editor claimed that he wrote more than 70% of Book 1. The Ld 6 was not a compliant leading designer, at all, and reminded that he had to eliminate the embarrassing errors of the AA Editor due to the incompetence of the latter in ICT (see hereinabove) and it was assumed that the share in Book 1 was fifty-fifty. In addition, the AA Editor withdrew his subsidy for the Ld 6 (due to the very severe medical problems in his family), treating his empty promises as glass balls that should be an enough remuneration for the Ld 6. Such a conduction was even more severe for LD 6 than making light of his problems at all, since the latter could have tried to get financial supports from other sources. In no way, it was in agreement with the E-service requirements.

The next AA Editor's attack was oriented towards the team of Elwro pioneers appointed for Book 1 Chapter Co-Authors. The AA Editor protested but the publisher confirmed that officially. Therefore, the AA Editor devised that the Editors should sign a new Book 1 publishing contract. The old contract was annulled and the new contract was to be delivered by the publisher till June, 24, but it was not delivered to the Ld 6 till now (2020, October, 28-th). The Ld 6's suspicions were met but this Book 1 had not been edited before the date. This is not a reason of happiness since there is, till now, no book teaching the world Reader how to develop ICT in severe political and economic conditions. And such an academic book is severely needed now, in the period of an inappropriate, colonialism based technology transfer processes around the world. Thus, the AA Editor actions were in a severe contradiction with the permissible targets and methods of E-service demands.

3. Results and discussion

The young, wise and active boys in various countries, especially those poorly developed ones, may be attracted by the views and conviction of the Semitic Nation, characterized by comradeship even unlimited by the costs that should be paid, a great respect to the real knowledge, the poverty of young boys, in opinion of Jews, produced a chance for them to upgrade earlier in gaining needed things in comparison with those of rich families that could buy, for them, everything they wished, Jews preferred boys shy with girls since talkativeness and self-confidence not supported by real knowledge mean merely nothing. As in the case of the Ld 6, the characteristics preferred by the Semitic Nation, produced the best results in the adult life.

The secondary school education and the great love to Rose made the Ld 6 a good candidate for large-scale ICT application projects of a pioneering/emerging/novel character. He understood better than his counterparts that no harm may be done to his Colleagues and that all of us are Colleagues of each other. He understood also that he should learn enough to be competent in the complex domain of ICT. However it would not be good to surrender to the individuals possessing power and using it inappropriately, i.e. as WPR-s (Who has got Power is Right). Surrendering to people possessing power and, what happens together frequently, who do not possess sufficient knowledge and experience is not appropriate HB (Human Behavior) since if leads to conquering the world by undereducated individuals who cannot lead the world duly.

4. Conclusions

Undereducated and inexperienced individuals should not be allowed to execute pioneering/emerging/novel ICT application projects of high impacts of the people using them, provided that their work could be classified as E-service activity.

Large-scale ICT projects should be duly led under control of experienced leading designers and distributed governing should be avoided; in other case, it would be very doubtful that the projects could be classified within the E-service domain.

5. Further work

Considering that it is doubtful to reinstate the Book 1 project, it is very appropriate to speed-up realization of a proposed book series devised by LD 6, as below:

6. A book series: good ICT system design and implementation practices

6.1 Foreword

What are the good ICT (Information and Telecommunication Technology) system design and implementation practices?

In the opinion of the Editors and the Chapter Co-Authors of this Book Series (the Team), they are the practices proven in the ICT system and network design and implementation process. The Team thought that it was very worthwhile to write a book on the good ICT system design and implementation practices devised and proven during executing some important pioneering/emerging/novel ICT systems and networks that could be recognized as E-service work.

6.2 Introduction

This Book 3, the first book (the herald) of the Book Series, has been devoted to the practices devised and proven when realizing the first two Polish computer control systems. The example of Poland (the Country) was chosen purposefully: Due many adverse conditions, in particular the unreasonable embargoes imposed on the modern computer equipment, the designers in the Country had to find their own solutions for their projects for much more problems than their colleagues working comfortably in well developed countries. Therefore, the designers of the Country must have learned more than those of the West and could devise, test and prove more and better good ICT design and implementation practices than those working abroad. Due to their very severe technological and political conditions, they could develop and validate their E-service solutions better than the West designers and implementers working in comfortable conditions of designing and implementation.

Book 3 describes the steel-bar mill material flow control system designed, installed, started up and commissioned in the Steel-Bar Mill of the Huta Warszawa Metallurgical Plant, and the Radio-Astronomy centre dish control and data processing system. Both systems were designed of the Odra 1204 computer, designed and developed by the biggest then computer manufacturer in the Country, Elwro. The application of the material flow control system is described. The hardware and software of the systems are discussed. A special attention was put to performance evaluation since, due to various embargoes imposed on the computer equipment, the Odra 1204 computer featured with operating characteristics worse than those of computers available in well developed countries. The metallurgical system development process is described together with the period of commissioning in the field. The descriptions of the system trial run and the final phase for this case study follow. The ethical and Human Behavior (HB) aspects are discussed and the conclusions are given. When realizing this project, LD 4 (the leading designer, Willy Wojsznis) and LD 6 produced the first proof that complex CCS-es could be designed and developed by Polish engineers making use of home hardware and software, in agreement with the E-service domain requirements.

6.3 Earlier experience

The Leading Designer 6, the main hero of this Book 3, was a co-author of the first Polish computer control system (both hardware and software). Soon he

became the leading designer of many emerging (pioneering) ICT application projects. At that time, the Country (Poland) was governed by the undemocratic Communist political system called, by the Editors, a WPR (Who has got Power is Right) one. The executive body of WRP, called PoPs (Power of People) used to deprive leading designers of successful projects of the glory of the leading creator, promotion and money due to the designer and attacked them strongly, usually, when a project was completed. Since WPR provided PoPs with unlimited, in practice, power with regard to the designers, the latter, usually, lost and were not allowed to lead another project. As a matter of fact, a similar mode of conduct was adopted often by big corporations offering Hi-Tech transfer to poorly of even well developed countries.

Therefore, the Leading Designer 6, never entered any battle with PoPs. He was also a professional English – Polish translator so he was financially independent from PoPs of the ICT domain and could change his team, department or even employer when his project was implemented, and pretend a WPR dupe. The WPR system loved dupes and wished to change all citizens of the Country into dupes; therefore, the Leading Designer 6 was granted new important projects. His earlier projects were to be expanded and/or proliferated by other leading designers so he had to educate and upgrade them beforehand. It was an LD 6 method, that was very useful to design and implement E-service ICT applications within an unjust and brainless political systems, such as Communism and Capitalism based on Colonial traditions.

6.4 Personal experience

Usually, around the world, educators applied the top-down technique, enumerating and describing various methods or procedures in such a way that the only proof of their correctness was, in fact, that the professor mentioned them. The Leading Designer 6 and the Editors as well as the Co-Authors' were not interested in advertisement nor proliferation of their own methods since they could not know if the methods would work well in future pioneering/emerging/novel conditions. Therefore, the goal was to teach his students, as he called his younger Colleagues involved in the ICT application projects he led, how to devise such methods and procedures and upgrade them duly.

So the Leader rejected the educational rhetoric and always presented the premises and their impacts on the leading designer's decisions. In order that the students gained self-assurance, if they proposed a feasible solution competent to his one, the students' one was always launched. This was a very successful upgrading method.

This worked perfectly: all pioneering/emerging/novel ICT application systems the Leader designed and implemented were expanded and proliferated successfully by his younger Colleagues and enriched, justly, his personal achievements.

This Book 3 has been written in a similar style: a lot of detailed technical and other information has been given so that the Reader is capable of verifying if the Chapter Co-Authors' theses are true. All these method and, even, tricks, made it possible, for Ld 6, to apply the methods and practices enabling E-service work many years before this notion was introduced to ICT.

6.5 The book series planned

Ref. **Table 1.**

Book No	Book title and Editors: The Good ICT Design and Implementation Practices: X Case Studies X: (Chronologically)	Short Book Content:
3	X: Metallurgical and Radio-Astronomic Case Studies. J. B. Lewoc, E. Babulak, D. Al-Dabass.	The first two computer control systems designed in Poland. The Leader and the Teams had to learn most and fastest in in their lives, and their discoveries were very valuable to ICT of Poland (and around the world). Many useful design and implementation practices have been worked out, validated and presented to the Reader.
4	X: Regional Power Control System Boards (SAPI ODM) Case Studies, E. Babulak, J. B. Lewoc, M. Rozent	The first Polish industrial control systems which generated very big benefits for the country (Poland) (several billion Euro) through enabling control of more than 70% of power flowing via the Polish electric power network during close to 20 years. Many useful design and implementation practices were learned and/or validated on the large-scale systems.
5	X: Power Network Control Engineers' Training, M. Rozent, J. B. Lewoc, E. Babulak.	The power system control engineer work was very difficult and hard in conditions of failures in the power system and needed good training for them. Though, at that time (at the turn of nineteen seventies), very most large scale computer simulators failed, the Team devised a solution enabling to train successfully, within some 10 years, more than 90% of the power network control engineers in the country. This Book 3 will describe the important practices learned and developed for this case study.
6	X: Major Specialized Devices/Systems for the Power System Control, J. B. Lewoc, E. Babulak.	The success of the Institute (IASE) projects in power system control induced some interest of the power industry in smaller and cheaper solutions for similar applications. This resulted in design and development of a microprocessor based "mini SAPI ODM" and a microcomputer based visual power industry display. This Book presents the good practices learned and validated on that case-study.
7	X: Communication Network of MSK Interuniversity Computer Network, E. Babulak, J. B. Lewoc, A. Izworski.	The case study was the first Polish computer network realized within an European, primarily, movement to construct heterogeneous networks. The good practices learned an on the cases study are discussed.
8	X: Data Base for Power Plants (Badel), J. B. Lewoc, E. Babulak, I. Chomiak-Orsa.	This project was initiated for a big power plant in the country. Though it was stopped during the Martial Law, after a few years was reinitiated in the power generating unit control and has competed successfully with the systems offered by the world biggest corporation in the area. This Book will describe the good practices leading to such success.
9	X: Network Performance Evaluation Projects, E. Babulak, J. B. Lewoc, M. Rozent.	The MSK project was a research one and it was possible to develop some tools and perform investigations of network performance. This Book will describe the good practices learned and validated.
10	X: Computer Network Robustness Evaluation Projects, J. B. Lewoc, E. Babulak, A. Izworski.	The projects were used to investigate and optimize robustness of typical computer control systems (of the star or common-medium types).

Table 1.
Book series proposed:

Acknowledgements

The article has be written under auspices of International Federation of Automatic Control (IFAC), Technical Committee 9.5, Working Group WG 03. The Authors acknowledge thankfully the substantive help provided for this work.

Author details

Józef Bohdan Lewoc[1*], Eduard Babulak[2], Swieta Cukier[3], Erich Leitgeb[4] and Mieczysław Rozent[5]

1 Retired from the Research and Translation Agency Leader (Leading Designer), Wroclaw, Poland

2 Computational Science and Cyber Security, Funding Member of the Future Al Lab, Lynchburg, VA, USA

3 Retired from Melbourne Hospital, Melbourne, Australia

4 Graz University of Technology, Graz, Austria

5 Insofter, Wroclaw, Poland

*Address all correspondence to: jblewoc@wroclaw.home.pl

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Edited by Kyeong Kang

E-service is an increasingly popular business practice and a critical part of supporting the global information society. The *Digital Service Platforms* book reduces the ambiguity about e-service by clarifying how to take advantage of it as well as how to overcome barriers and issues. It includes ten chapters in three subject areas: e-service and social media, e-service concepts, and e-service quality and development. Chapters cover such topics as organization-community relationships, systematic e-service innovation, social media ecosystems, accessibility experience design, Industry 4.0, public e-employment services in different countries, and more.

Published in London, UK

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ISBN 978-1-83969-103-4