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Research article

Enterprise architecture breakthrough for telecommunications transformation: A reconciliation model to solve bankruptcy

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ABSTRACT

Observations of communication service providers (CSPs) over the past five years have revealed that text services have reduced radically by around 75%, followed by voice services and the average revenue per user (ARPU). This condition signifies that telecommunications companies are being affected by digital disruption. A fundamental analysis of current business processes is thus necessary for future telecommunications success. In the area of corporate strategic management, studies on conversion of the Internet of Things (IoT)-based industry as a new customer are gaining popularity. This research analyzes the breakthrough operational activities through a customer-centric approach as well as end-to-end CSP business activities towards a new customer reconciliation model. The customer-centric activities address problem to solution and complaint to solution. In the future, CSPs are expected to have large numbers of newly registered customers from IoT-based industries. The strategic mechanism for transforming leaps from old business processes into new ones is a novel research subject using the business process management (BPM) method. Business process analysis has been facilitated by the Internationa Telecommunication Union (ITU) telecommunications standards body developed by TMForum as the global telecommunications industry association. This transformation involves development of organizational structure, business activities, technical specifications, information and communication flow, and operational schemes, modeled under the enterprise architecture strategic notation, whose result is a breakthrough enterprise architecture design for future telecommunications companies. The design contributes to strategic management knowledge on how collaboration between the telecommunications industry and other IoT-based industries is determined for real operations. This research presents a transformation scheme that can solve the potential problem of bankruptcy in the telecommunications industry through a case study of a smart city in the IoT-based industry.

1. Introduction

Today, we live in an era where disruptions are a norm in all industrial sectors and are promoted by the 4th industrial revolution. In the telecommunications field, customers often discontinue the main service because of the availability of several other interesting and useful applications as substitutes for voice and text services (Nesse et al., 2013; Paetsch et al., 2017), which are referred to as over the top (OTT). The emergence of new business models based on internet technology has rendered telecommunications as a network pipeline for its vertical industries without any impact on the supported commercial services (Asimakopoulos and Whalley, 2017; Oughton et al., 2018). According to the communication service provider (CSP) annual report summarized in Figure 1, SMS usage has dropped by 75% on average in the last five years. On the contrary, Internet access shows that payload data are increasing more than double annually. The main remaining competitive value for telecommunications is mobile Internet access.

Various industries have renovated their operations strategies using Internet of Things (IoT) devices to achieve success in the new industrial revolution. The IoT functions replace human involvement in the industry. This significantly improves the corporate value chain by allowing definitions of new business models (Dachyar et al., 2019), such as smart cities for the public service industry (Díaz-díaz et al., 2017a,b), smart health care for the hospital industry (Dachyar and Pertiwi, 2020), smart agriculture for the food industry, and disaster relief for government agencies (Dachyar and Nilasari, 2020). The most prominent technology enabling mobile internet access for IoT is the fifth-generation (5G) communication network, which has been planned for worldwide installation in 2020 by

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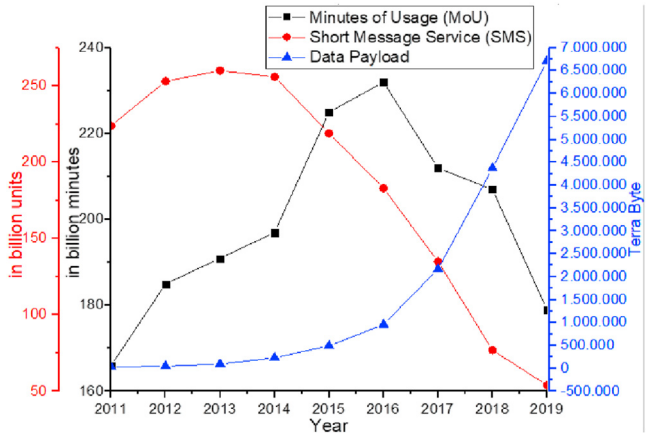

Figure 1. Trends regarding minutes of usage (MoU), short message service (SMS), and data payload (source: Telkomsel annual report).

various CSPs (D & A Manzalini, 2014), although some IoT requirements can also be supported by several existing technologies, such as 2G, 3G, and 4G once the IoT device requirements are met. The 5G is fully compliant with IoT connectivity requirements, such as ubiquitous, reliable, scalable, and cost-efficient technologies. The IoT-based industry has great potential for the new CSP company business model (Palattella et al., 2016).

The synergy between the capabilities of the CSPs to provide mobile internet and the IoT-based industry internet access requirement has interesting implications from the perspective of business process collaborations. This indicates that the cellular network industry value chain will transform to serve the large-scale development of IoT.

Company transformation is generally analyzed using the strategic management concept, especially in collaborations between different telecommunications and public service industries. The current strategic management research on IoT-based industries is insufficient and does not consider industrial collaboration strategies. For example, manufacturing cyber-physical logistics systems (Kiel et al., 2017), electronic human-robot interactions and video surveillance as a service (Thoben et al., 2017), and public service industries of the smart city ecosystem (Díaz-díaz et al., 2017a,b; Palattella et al., 2016) are all cases related to a single sector.

Other strategic research on CSPs is still limited to new products and business units only, yet it does not involve any IoT collaboration strategies (Joshy and Shenoy, 2010; Lara et al., 2018; Seraoui et al., 2017). Another exciting concept is that the B2B2X (Jhatakia, 2018) provides CSPs new concept models regarding business to businesses to variable x (Internet devices). However, it does not include any implementations for a specific business process area.

This research aims to generate new CSP business processes for the public service industry (smart cities) as a new customer, such that it is operationally supported by the CSPs' infrastructures as well as business organizations. A smart city consolidates various systems into an integrated city, including automation, sensors, reporting, monitoring, regulation, and various social services provided by the local government to its residents by utilizing sensor and actuator technology introduced by the IoT. The present study aims to fill this knowledge gap on the development of synergetic transformations for collaborations between different telecommunications and non-telecommunication industries for the utilization of IoT.

The telecommunications industry business process is structurally assessed through the Frameworx® eTOM. The IoT-based industry business process uses a combination of the business model canvas (BMC) and Context, Cooperation, Construct, Configuration, Capability dan Change (6C) to generate the IoT ecosystem. The mechanism to leap from an old business process "As Is" to a new process "To Be" is supported by the business process management (BPM) methodology and soft system methodology (SSM). The strategic framework mapping of the new business process is modeled using the enterprise architecture (EA) notation. This research focuses on designing a new business process in the EA (transformation/combination with the IoT-based industry) model for redefinition of the current eTOM framework process flow.

Herein, a qualitative analysis approach is used through strategic management analysis rooted in the SSM. The research was conducted using a focus group discussion (FGD) scheme with CSP experts. The ITU-T eTOM standard process flow is used as the initial reference, which consists of a custom module in the business process foundation that needs to be confirmed with the CSP companies. The "As Is" business processes

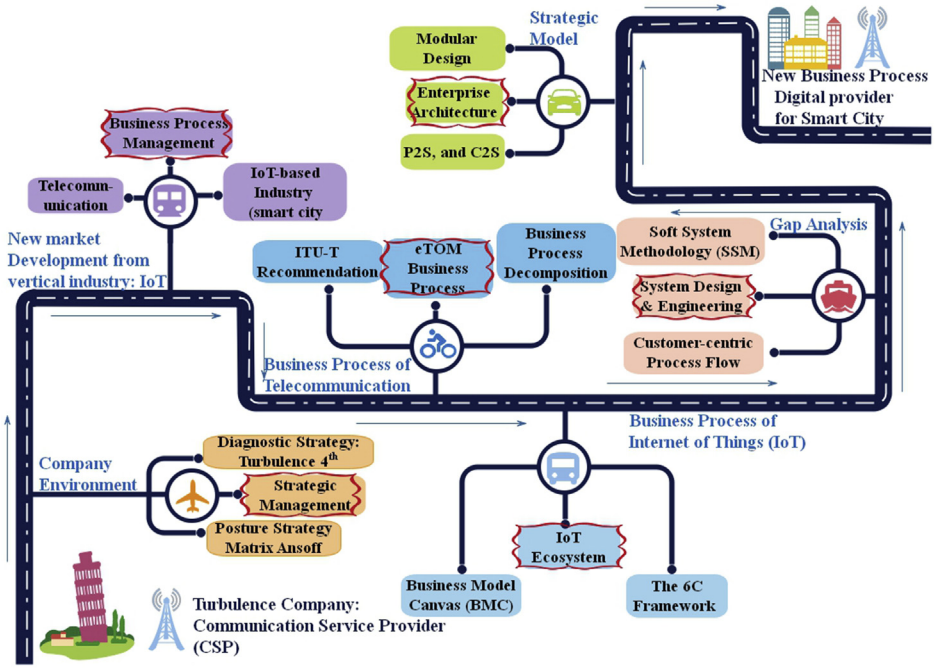

Figure 2. Artery strategic model.

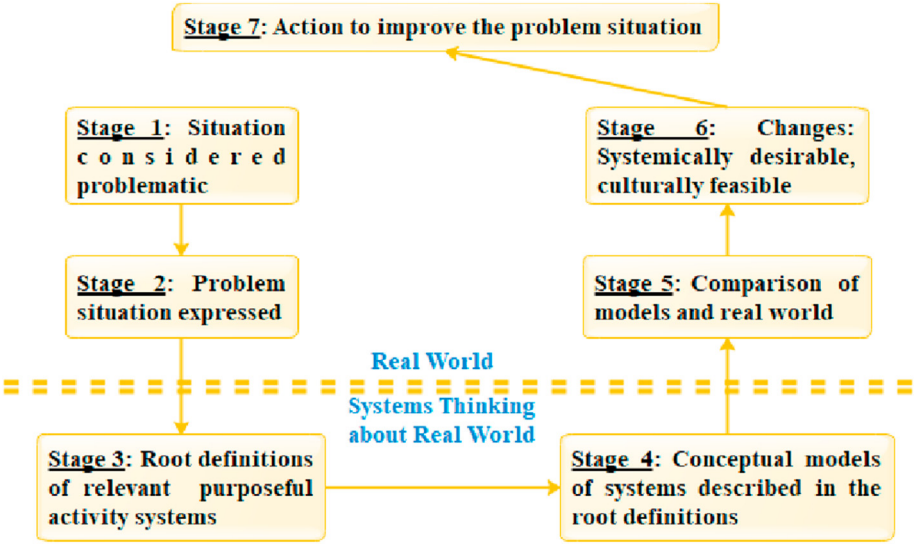

Figure 3. Phases of the SSM (Checkland, 2009).

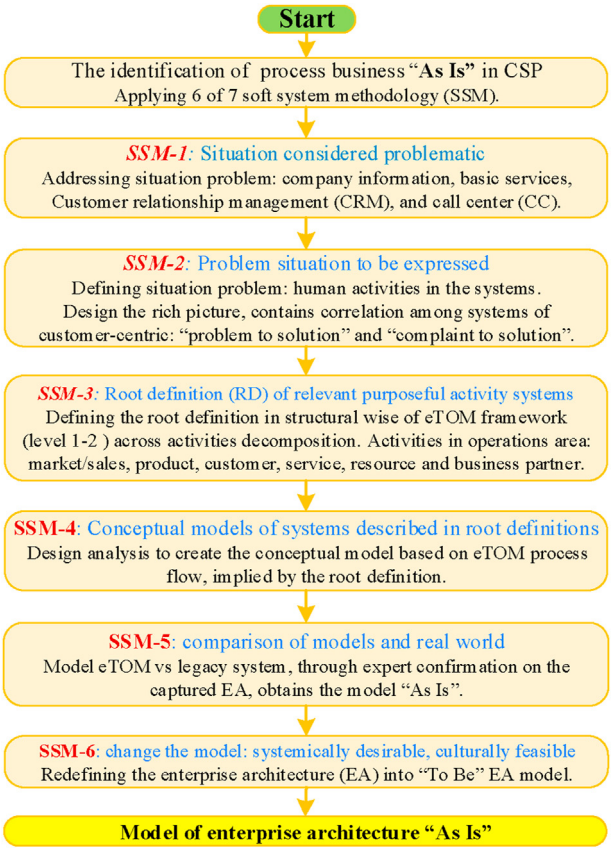

Figure 4. First research steps: CSP company EA model "As Is."

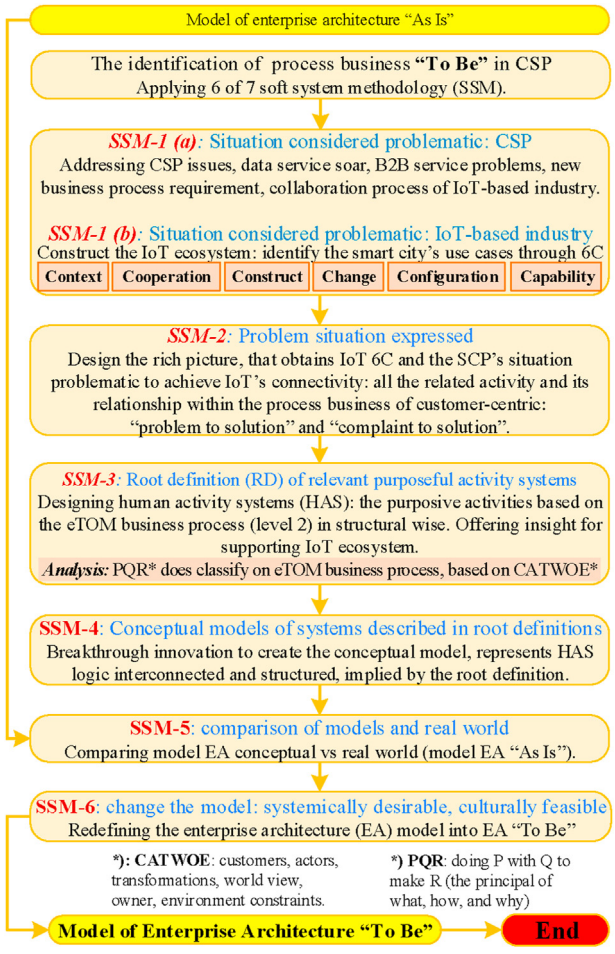

Figure 5. Second research steps: CSP & IoT EA model "To Be."

are obtained by assessments across the operator organization. The business process "To Be" is obtained via the subscriber-based service scheme approach with human and non-human collaborations.

The research benefit of this work is the knowledge growth in the telecommunications industry from the traditional mindset of CSP "voice + SMS" to broader cellular internet providers across industries. This transition leads to changes in the organization of a company and its activities. For the CSP companies, the research contributes to traditional value chain transformation from the business to consumer (B2C) to business to business (B2B) approach by development of the CSP's ability to explore and capture opportunities from the internet lifestyle in the digital market. The contribution of this work to the IoT-based industry is that companies that are transforming into the industry 4.0 system acquire valuable references to provide better quality services as well as achieve

Table 1. Customer care basic function.

Module	Sub-Function	Function Name
Customer Care	360-degree Customer View	Customer Query
		360-degree individual customer view
	Customer Management	New Postpaid Subscriber
		Customer Information Supplement
		Deactivate Subscriber
		Un-blacklist Subscriber for Recharge
	Service Changing	Change Customer Info
		Change Account Info
		Change Subscriber Info
		Change Offering
		Change Mobile No.
		Change SIM card
		Change Subscriber Password
		Suspend and Resume
		Prepaid to Postpaid
		Postpaid to Prepaid
	Service Management	Manage CUG
		Manage CUG Member
	Batch Operation	Batch create prepaid subscribers
		Batch deactivate subscribers
		Batch change prepaid initial balance
		Batch change primary offering
		Batch suspend subscribers

Table 2. Customer e-care basic functions.

Module	Sub Function	Function Name
E-Care	Data Presentation	Query Subscriber Information
		Query Customer Information
		Query Account Information
		Query Account Balance and Expiry Date
		Query payment/Recharge History
		Query PIN and PUK
		Query Prepaid/postpaid Call History
		Query Postpaid Bill
		Query History Transactions
	Handle Service Request	Modify Subscriber Information
		Modify Customer Information
		Modify Account Information
		Change Subscriber Password
		Postpaid/Prepaid Suspend
		Forget Password
		Recharge
		Pay Bills
	System management	Subscriber Login
		Unified Logout
		Change Language
		Contact Us

profitability, ease of service, and lower costs based on business process understanding collaborations.

2. Related work

This study explores the central concept of strategic management within the scope of industrial engineering knowledge. Concept studies deductively provide more detailed and solid principles that support the objectives of the overall research. The artery strategic model is shown in Figure 2; similar to arteries that work under high heartbeat pressure, in corporate scenarios this is equated to supplying strategic inputs to revive a company's business. These concepts are interrelated and integrated to establish a "strategic thinking framework", inspired by the Ansoff implanting strategic management scheme (Ansoff et al., 2019). This model helps the reader to understand the arrangement of ideas to study and further explore research concepts. The five main theories that support the flow of research thinking include strategic management, BPM, telecommunications business processes, IoT business processes, and system design and engineering.

2.1. Strategic management

Strategy management is a derivative of "Engineering Management" knowledge in Industrial Engineering ontology (IISE, 2019). The concept is applied to companies experiencing turbulence owing to disruptions that have considerable potential for company bankruptcy, e.g., the CSP in this case.

According to Ansoff, the "Father of Management Strategy" (Ansoff et al., 2019), there are several steps that companies need to adopt when dealing with problems in the corporate environment, starting with a "strategy diagnosis" so that companies can see the turbulence level affecting their current environment. CSP companies are categorized as scale 4 turbulence because their environments experience instabilities (environmental complexity, novelty of change), uncertainties (speed of change, visibility of future events), and discontinuities (frequency of turbulence level shifts, environmental turbulence levels). The next strategy is to analyze the company's position based on the Ansoff matrix; CSP conditions are generally in the "market development" quadrant. The best strategy is then realized by market development that focuses on adding new customers from the vertical industry.

Market development strategies usually focus on entry into new markets using existing products. The new business fields covered by the CSPs must be in accordance with the historical strength of the company. In the case of this study, after discovering the company's strategy position, a gap analysis was carried out based on the concept of BPM to determine the current state and objectives (description of the target state). The research proposal given is towards a position in shaping the "telecommunications + IoT-based industry." This new position is a reconciliation between telecommunications and its vertical IoT-based industry.

Strategies are thus obtained and evaluated through the company's new operational model, which is obtained via "systems design and engineering" knowledge. This knowledge is supported by the concept of systems thinking based on the human activity system (HAS) through SSM implementation, with the output being the CSP EA model.

2.2. Business process management

The BPM is a derivative of "Engineering Management" knowledge in Industrial Engineering ontology (IISE, 2019). Most of the current

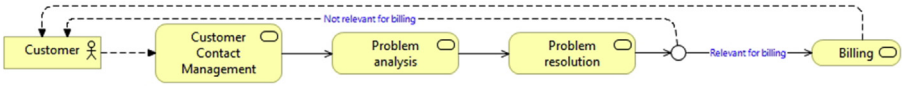

Figure 6. Stage 1: High-level process flow of P2S.

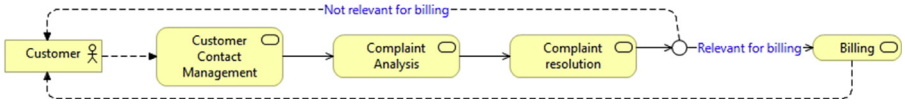

Figure 7. Stage 1: High-level process flow of C2S.

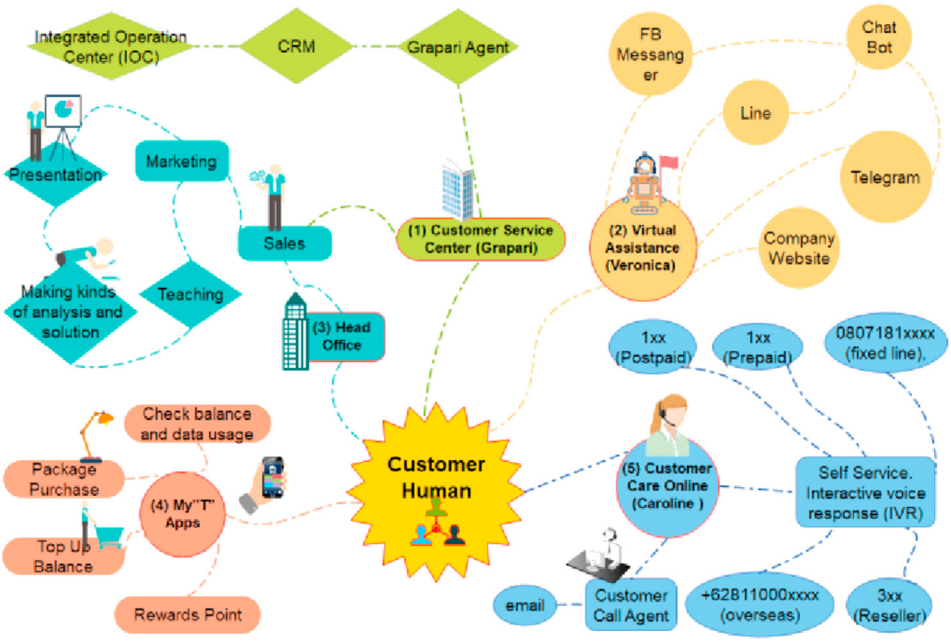

Figure 8. Stage 2: Rich picture of the CSP.

Table 3. Stage 2: "As Is" situation expressed for P2S.

Assumptions
• This scenario is only relevant for technical complaints, which are termed "problems." • Problems include unable to call or SMS, unable to access data/internet, no signal, unclear voice, or intermittent signal, all of which can be resolved at the "first-level support" layer or can be redirected to the next layer. • Non-technical complaints will be handled by other scenarios in C2S
Examples
• Customers call CC Ca****ne to report that there is no internet access. • Customers call to report that they are experiencing poor sound quality for calls, which are sometimes disconnected.

Table 4. Stage 2: "As Is" situation expressed for C2S.

Assumptions
• This scenario is only relevant for non-technical complaints, which are termed as "Complaints." • Complaints such as overdue provisioning, poor quality of customer service, incorrect billing adjustments, etc. are the scope of this process.
Examples
• Customer sends a complaint email to the sales & marketing team, or come to CSP head office, or customer writes into public media that mentioned about the dissatisfaction of using CSP company service for several reasons or condition.

understanding of BPM is inconsistent. The term is still debated, and many scholars have used BPM measures in the pre-1990s, but not all of them are traceable. Some believe that the concept dates back to the scientific management era. Information sources as far back as the eighth century are still widely quoted by other authors (Klun and Trkman, 2018). However, in essence, there will always be questions on managing business processes efficiently, where BPM is concerned with removing outdated business processes and replacing with new and better ones.

Recently, BPM is considered a collaboration between management and information technology (IT) that covers all resources: human, organization, application, documents, and others (Laurenza et al., 2018). BPM has become a profound concept and is considered as a systemic method for understanding, analyzing, implementing, and changing business processes and resources related to an organization's ability to create value. BPM is necessary to drive change in the organizational structure and eliminate human activities that are not able to add value to the core business, where this is needed to achieve success (Laurenza et al., 2018).

For implementing strategic management in this study because BPMs must analyze human activities in cross-company organizations, the SSM was used to understand and improve the organization in operations driven by human activities. SSM is a competent approach to analyze complex conditions/systems, where there are various perspectives on defining issues related to soft problems related to organization and human behavior, which are not deterministic but probabilistic (Checkland, 2009; Wang et al., 2015).

SSM is generally used to support industrial engineering practices in the field of systems engineering. Modeling with a systems approach is commonly referred to as system dynamics, which is often classified as a hard systems methodology (HSM), but SSM is used when there are new approaches to modeling systems that are more humanistic. SSM takes into account the various aspects of behavior, both in organizations and humans; this allows the SSM to analyze and model systems that integrate technology (hard) and human systems (soft) (Checkland, 2009). SSM is characterized as "system of inquiry," "inquiry process," "learning system, " "reflection in action," "an organized version of purposeful thinking," or

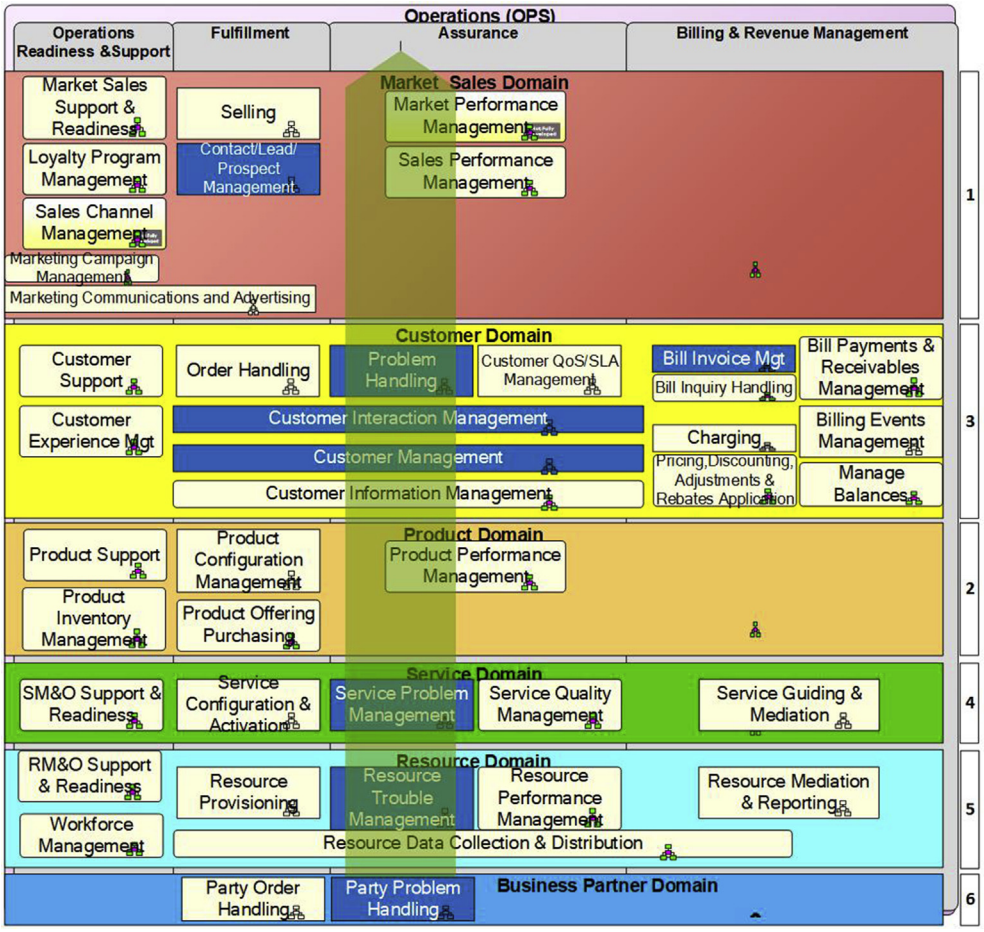

Figure 9. Stage 3: eTOM (level 2) business process P2S mapping.

"structured way of thinking" (Rose, 2000) via processing of the seven phases sequentially, as illustrated in Figure 3 (Ameyaw and Alfen, 2017; Checkland, 2009; Mehregan et al., 2012; Paucar-Caceres et al., 2016; Valente, 2017).

2.3. Business process of telecommunication

The International Telecommunication Union (ITU) is global body established to standardize and regulate international radio and telecommunications. ITU was founded to embody the principles of public-private partnerships (ITU, 2019). The division for telecommunications and ICT standards (ITU-T) provides recommendations M.3050.0 on telecommunications management (TMN) and network maintenance using the enhanced telecommunication operations map, Frameworx® eTOM (ITU, 2007). eTOM provides comprehensive standard operational mapping, which can be applied globally, as well as regularly updated operational standards for all countries.

eTOM works through a decomposition process technique, with a structured approach that considers the company's business processes and internal structure. The process definition is the core of the eTOM framework, which contains a hierarchical description of the processes and sub-processes (Czarnecki and Dietze, 2017). The process definition is organized in two business process categories: process decomposition (document GB921-D) describes business processes down to level 3, and process decomposition (document GB921-DX) expresses additional details on level 4 sub-business processes.

In terms of activities design within a telecommunications company, a change to business processes can be made through four domains: customers, technology, products, and business partners (Czarnecki et al., 2013; TMForum, 2018). The "CSP + IoT-based industry" collaboration idea is about the IoT-based industry as a new (non-human) customer for CSP companies; hence, this research focuses on customer-centric domain development. The customer-centric domain comprises all significant sales and customer activities. These activities are determined from an end-to-end perspective that starts and ends with the customer, such as (1) request to answer (R2A), (2) order to payment (O2P), (3) usage to payment (U2P), (4) request to change (R2C), (5) termination to confirm (T2C), (6) problem to solution (P2S), and (7) complaint to solution (C2S).

The joint industry force should maintain interoperability and resolve the current problems faced by both industries mutually. The CSP analysis on several "catalyst" processes was first obtained to explore possible early solutions from agile environments, including awareness of problems or complaints that might arise from new strategies (Filiposka et al., 2017). Our study proposes the P2S and C2S activities as the catalyst processes for promising early solutions. P2S and C2S process flows are essential to obtain various upfront threats in building a new business. New business processes that depart from the threats that arise before they are applied are analyzed in particular, using the proposed processes focusing on P2S and C2S.

2.4. Business process of IoT

In the era of massive Internet usage, the concept of IoT can be understood as the ability of devices (mostly cellular phones) to connect to and exchange information with a widespread network (a typical service ecosystem). A large number of devices with different capabilities, such as

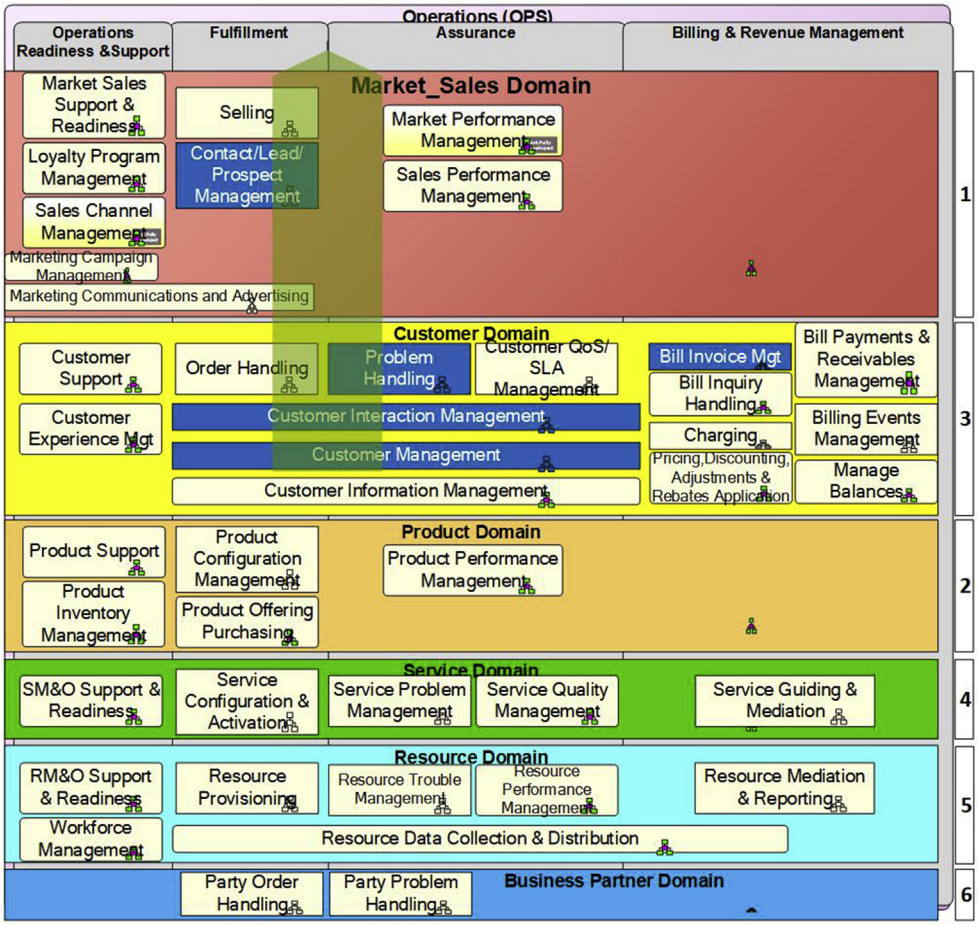

Figure 10. Stage 3: eTOM (level 2) business process C2S mapping.

sensors, actuators, smart objects, and servers, can be interconnected to develop interesting services and applications (Cheng et al., 2017). In an IoT environment, different industrial wide sensor networks (WSNs) involve complex and diverse sensors. Each sensor has its own requirements for readability, and various services have their own applications that require different types of sensors (Chi et al., 2014), e.g., stream vehicle videos in the IoT environment (Aliyu et al., 2018), extending control of Internet access to the physical world without human intervention (Andaloussi et al., 2018), thermal comfort of the occupants in the building (Park and Rhee, 2018), and more in the manufacturing industry, such as transforming energy production, supply, and consumption to meet high energy demands through intelligent automation of industrial energy producers and consumers (Shahzad et al., 2020). The IoT also acts as an enabling business digitization strategy (Sestino et al., 2020). The differences in such technical requirements cause variations in the business model. The landscape of IoT connectivity refers to the H.

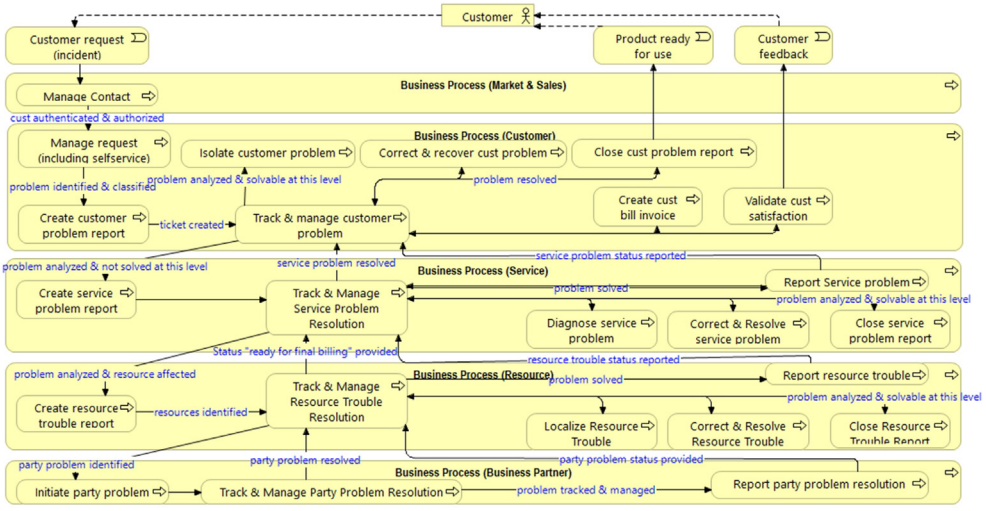

Figure 11. Stage 4: EA process flow for P2S.

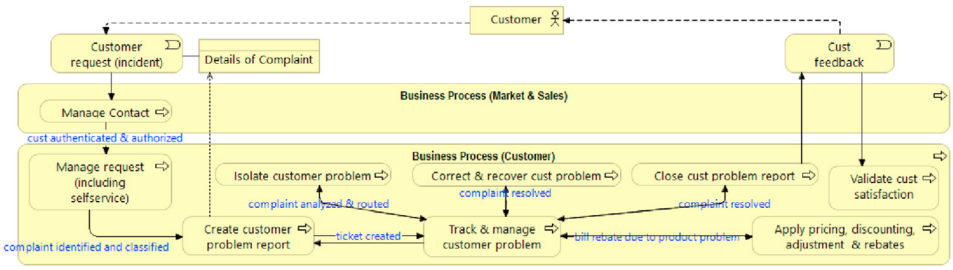

Figure 12. Stage 4: EA process flow for C2S.

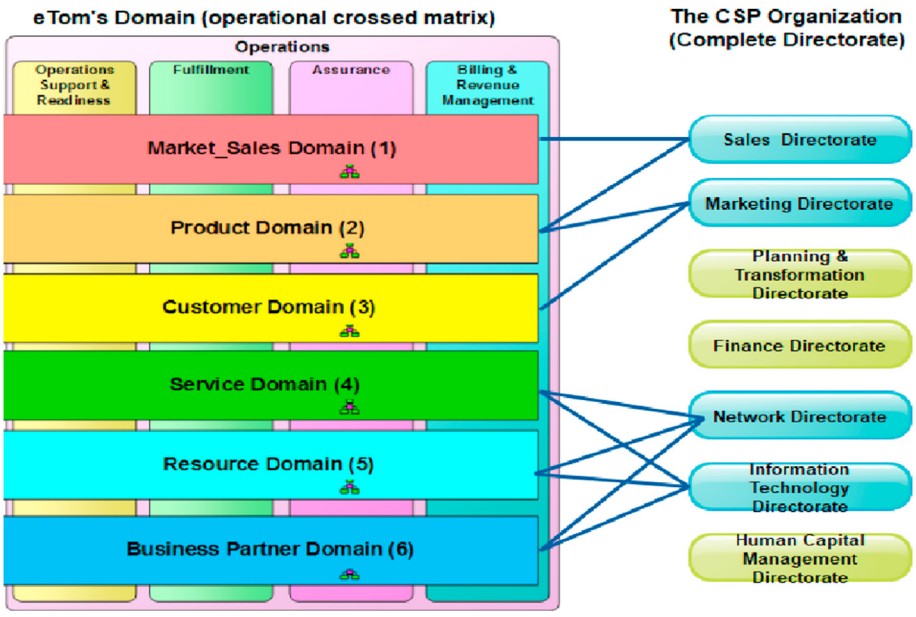

Figure 13. eTOM (operation) mapping to CSP organization.

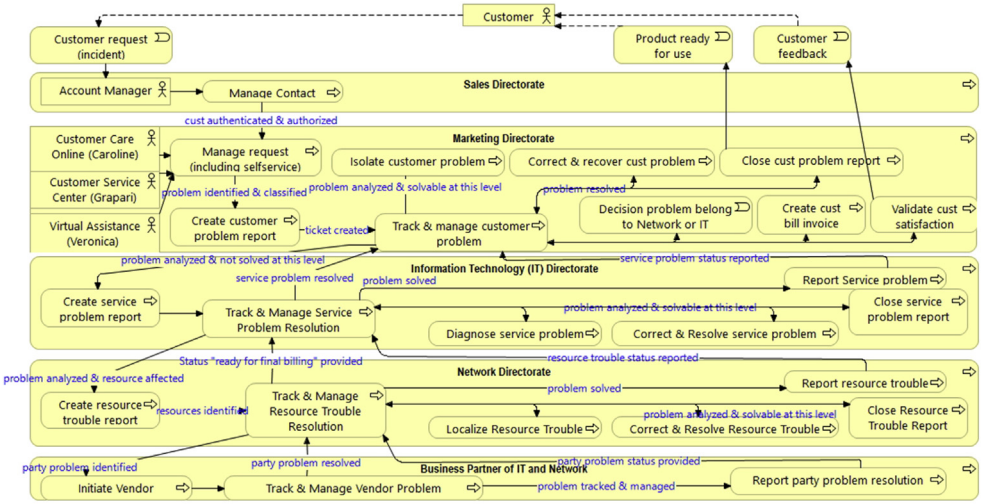

Figure 14. Stage 6: Real-world EA for P2S.

Markit white paper cited by (Saragih et al., 2018), which shows the various IoT connectivity technologies provided by CSP and its competitors.

Some authors (Ju et al., 2016; Nesse et al., 2013) argue that BMC is the most widely used business model in ICT, cloud computing, and IoT-related industries, and is best for understanding, discussing, creating, and analyzing business activities, including those (Gierej, 2017) who argue that a reliable business model framework in the context of the IoT-based industry is the concept of BMC. Understanding the business processes that operate on an IoT-based industry is not easy, and it is first necessary to describe the ecosystem that the IoT is built upon. According to Rong et al. (2015), the 6C framework can be used to understand the

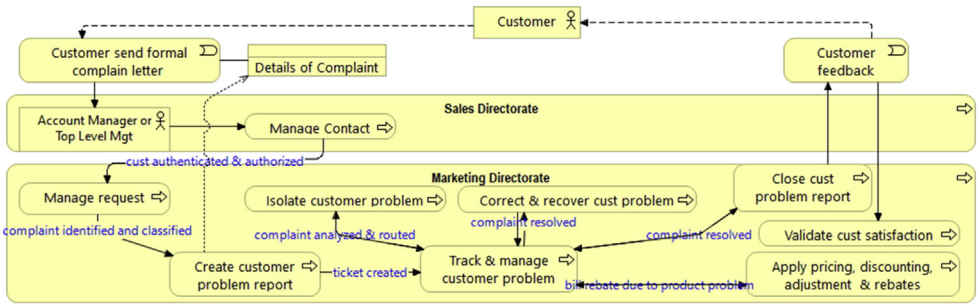

Figure 15. Stage 6: Real-world EA for C2S.

Figure 16. IoT public service industry of SmartSantander.

IoT ecosystem as well. The best approach to understanding, discussing, creating, and analyzing business processes, especially on IoT services, is by integrating the BMC and 6C frameworks.

The 6C framework involves context, construct, configuration, cooperation, capability, and change dimensions. The context aims to identify the environmental features of the supply network. The construct defines the fundamental structure and supporting infrastructure of the business ecosystem. The configuration aims to identify external relationships between partners in the business ecosystem and its configuration patterns. Cooperation reflects the mechanisms that partners use for interactions (mechanisms and governance) to achieve shared strategic goals. Capability investigates the key success features of the supply network from the functional display of design, production, logistical entry, and information management, among others. Changes in the business ecosystem are also investigated to demonstrate how system configuration patterns shift dramatically from one type to another.

2.5. System design and engineering

Implanting strategic management in companies requires a systems approach (Ansoff et al., 2019). When turbulent changes increase, the management must be able to develop a systematic approach to address unexpected uncertainties, novelty, and complexity. The systems thus become correspondingly more sophisticated because in the future, there may be more complex, novel, and less predictable situations that each complement and build upon previous ones.

In the work by Coskun (2019), the definition of the system is something complex or an organized "whole", which is a set or combination of things or parts that form a complex or consolidated total, and the system can be defined as an organized group of components (sub-systems) that are linked together in accordance with plans to achieve specific goals.

Systems are usually defined through designs that show the flow of services/processes across actors and tasks. The system strategy design is called the EA model, which is denoted using the ArchiMate language, a registered trademark of The Open Group TOGAF®. The design of this system strategy is a reference to the technical standards in IEEE 1471-2000, according to ISO/IEC/IEEE, 2011. ArchiMate is different from other languages such as the unified modeling language (UML) and business process modeling and notation (BPMN). It has a scope in corporate modeling in terms of how strategies can be based on company architecture, while UML and BPMN design are implementation models. The design uses ArchiMate version 3.0, which has feature advantages that have been integrated with the technological behavior concept, which describes the sensor and device behaviors that are interconnected in shaping the IoT ecosystem (Josey et al., 2016).

3. Methodology

The research approach involves implanting a series of strategic management concepts in the overall phases of the SSM, containing various frameworks that compromise the concept of systems thinking, modular design, and business processes to build holistic research scientifically for the CSP companies and IoT-based industries.

3.1. SSM-based strategic management

There are two main research steps: the expected output from the first group is to obtain the current "As Is" CSP company EA model; the expected output from the second group is to obtain the future "To Be" company EA model, which is a collaboration strategy for IoT and will be integrated into the CSP company's new business process.

The first group in the research step is summarized in Figure 4. Because the company business processes are currently non-existent or undefined, the researchers used the global business process practices of Frameworx® eTOM as the CSP company's initial business process. Then, they implemented SSM by comparing the eTOM process flow, which is a series of human activities. These activities serve as references for the telecommunication company business processes. The model is studied and adapted to current telecommunication companies.

"As Is" SSM Step 1: Situations considered problematic in CSP companies are listed as issues in CSP services and organizations through a consumer-centered domain approach with provision of basic service information, such as customer relationship management (CRM) information, call center (CC) information, and all media interfaces between companies and consumers.

"As Is" SSM Step 2: The problem situation is expressed and defined through assumptions and examples of human activities in systems. Express the system situation using assumptions depicted by "rich picture," which contains various relationships between the human objects that form the domain of the customer-centric business process, including P2S and C2S.

"As Is" SSM Step 3: Root definition (RD) of the relevant activity system. RD was defined in P2S and C2S by analyzing the eTOM framework

Table 5. Stage 1: IoT ecosystem through 6C framework translation.

1. Context	Missions	Vision: digital smart city innovation can make a difference: smart-life, smart-governance, smart-economy, smart-environment, smart-people, and smart-mobility. Mission: Smart city mobile device and sensor interconnections enable collection and analysis of big data, improve the ability to forecast and manage urban flows, thus achieving city intelligence.
	Barriers	• The city council should consider not only cost efficiency during project rollout but also other factors, including the quality of services (QoS) provided to citizens, environmental impacts, and social problems. • Network data privacy and integrity. • Financial sustainability, business model maturity, and remaining issues raised in the project implementation.
2. Cooperation	Coordination mechanism	The smart city interconnection capability of mobile devices and sensors is able to collect and analyze big data. The data can improve the ability to predict and manage urban flows. Sensors allow monitoring of traffic parameters such as intensity, density, speed, or queue scale after being integrated into the control center; thus, more efficient urban management and real-time responses to changing circumstances can be enabled.
	Governance System	The Santander City Council as the project manager or project coordinator. The University of Cantabria is responsible for IoT infrastructure management.
3. Construct	Structure	Waste management, water supply, tourism promotion, smart traffic management, smart street lighting, city incidence management, gardens and parks irrigation, citizen engagement management.
	Infrastructure	The system uses >5000 sensors to retrieve the status of each point. The sensor should access the internet network. The interconnections allow sensors to be accessed and controlled by the datacenter and citizen applications.
4. Configuration	Patterns	Smart Santander provides the resource configuration containing the specifications and detailed descriptions of the following resources: testbeds, gateways, and sensor nodes.
	External Relationship	Financial relationship: the project was funded by the European Commission's FP7 EU. Technical relationship: o Concessionaire company for waste management and water supply. o Content provider and brochure producer for tourism promotion. o Spanish traffic authority, information management and big data management for smart traffic management. o Energy supplier for smart street lighting. o Equipment provider for incidence management. o Vehicle provider for gardening, equipment provision, and irrigation system maintenance o City brain sponsor company for citizen engagement management o Companies NEC and Ideas4All provide their expertise in some areas of the value chain.
5. Capability	Communication and Accessibility	1. Waste management: promotional materials (corporate website, brochure, advertising), news in media, public conference, email from citizen information services at the city council, concessionaire's sales team is in contact with the city council. 2. Water supply: the concessionaire's sales team is in contact with the city council, customer service telephone line, promotional material, news in media, public conference, email from citizen information services at the city council, mobile applications for the citizens. 3. Tourism promotion: information stand staff in key areas, brochure handout, tourist information website, mobile application for citizens and tourists, public conferences, email from citizen information services at the city council, news and advertisement in the media. 4. Smart traffic management: local police, Spanish traffic authority website, news and advertisements in media, email from citizen information services at the city council, public conference, mobile application for the citizens, parking information boards. 5. Smart street lighting: promotional material, news in media, email from citizen information services at the city council, public conference, specific projected communication plan tailored for the service. 6. City incidence management: city council website, news in media, email from citizen information services at the city council, public conference, “el pulso de la ciudad” mobile and web application for users. 7. Garden and park irrigation: the concessionaire's sales team is in contact with the city council, promotional material, news in media, public conference. 8. Citizen engagement management: a meeting between city council officials and community associations and other representatives of different groups, email from citizen information services at the city council, public conference, Santander city brain social network.
	Integration and Synergy Ability	Interconnecting new services with the physical and virtual world through electronic devices distributed in homes, vehicles, roads, buildings, and other public environments
6. Change	Renewal (Platform Pattern Shift)	The following platform interfaces allow changes in the smart city environment: (1) access control interface (ACI), (2) experimental support interface (ESI), (3) application support interface (ASI), and (4) management support interface (MSI)
	Co-evolution (Interaction Pattern Shift)	Phase 0: 300 IoT devices, integration, mandatory features. Phase 1: Refinement, 2000 IoT devices, basic features. Phase 2: Refinement, 5000 IoT devices, advanced features. Phase 3: 20000 IoT devices, refinement, advanced features, preparation for exploitation.

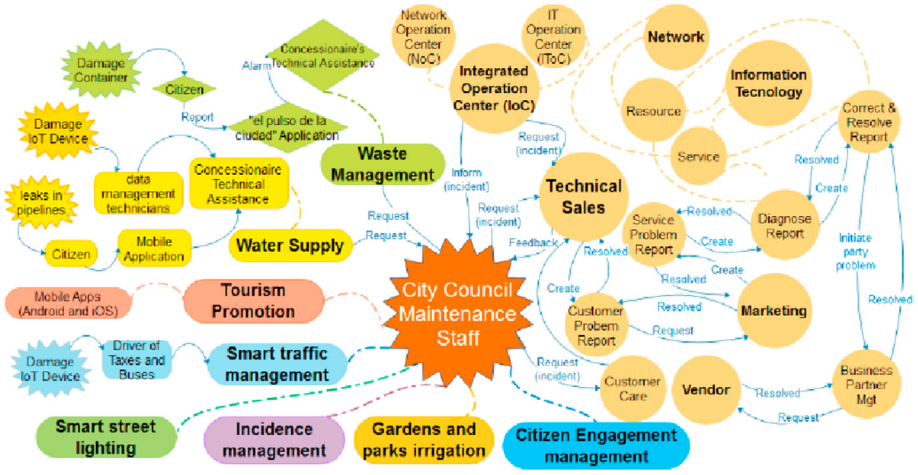

Figure 17. Stage 2: P2S rich picture of the new CSP company.

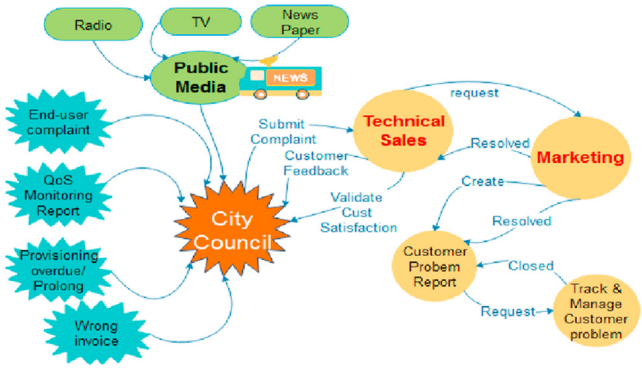

Figure 18. Stage 2: C2S rich picture of the new CSP company.

business processes catalog. The operational area of the company is defined by eTOM domains, including market/sales, products, customers, services, resources, and business partners.

"As Is" SSM Step 4: Conceptual models of systems are described in RD. The P2S and C2S conceptual models are designed based on RD analysis. The design analysis uses the framework eTOM process flow from the initial BPMN model to an EA model. The conceptual model identifies the main activities through a set of logical actions implied by the root definition.

"As Is" SSM Step 5: Comparison of models and real world. By executing the EA P2S and C2S models' redefinitions obtained in step 4, FGDs were conducted with experts from the CSP company. The changes obtained can redefine the overall EA domain and business process used in step 4.

"As Is" SSM Step 6: Change the conceptual model of the EA into a valid new model that can be referred to as the company's current process business "As Is."

The second group of the research step is summarized in Figure 5. At this stage, the CSP company's EA model "As Is" has been obtained and validated. Then a collaboration between the IoT company and telecommunication business process based on the CSP's EA "As Is" model is obtained from the first group research steps. The IoT company is treated from the perspective of the CSP company as a customer who is a newly defined customer subscriber type (non-human). Through the SSM approach, the following steps are taken to obtain the future "To Be" EA.

"To Be" SSM Step 1: Situations considered problematic in CSP companies are listed for all the issues in the CSP, how the CSP company responds to soaring data services due to the customer behavior, and the relationship of the new business process towards consumers. This step will define the requirements of the current business in each service line of the company, including the business processes that are considered problematic in the IoT's customer implementation. To construct the IoT ecosystem in a smart city, the 6C framework is applied. This IoT ecosystem should be supported by the business processes that will be provided later by the CSP company.

"To Be" SSM Step 2: Problem situation is expressed to design a "rich picture" that contains how the problem situation in CSP and IoT ecosystem can achieve IoT connectivity, comprising all the related activities and how these connected activities help build business processes that focus on customer-centric P2S (service problems to solution provided) and C2S (customer complaint to solution provided).

"To Be" SSM Step 3: RD of the relevant activity systems are obtained by designing HAS with specific objectives. Human activities align with the eTOM business processes in a structured manner (highest level to low level/detail) and interrelationships between processes that support the IoT ecosystem. The analysis tool used is PQR, which means doing "P" with "Q" to make "R" (based on the principles of what? how? why?) that is applied to the eTOM business process catalog descriptions according to each subject (human) defined in the CATWOE (Customers, Actors, Transformations, World View, Owner, Environment Constraint) scheme.

"To Be" SSM Step 4: Conceptual models of the systems are described in the RDs. Construct the conceptual design in the form of EA as HAS. The HAS is obtained from the eTOM's (level 2-3) business process catalog through a decomposition approach that achieves the purpose of the RD. Guidelines for creating a conceptual model are as follows: PQR, CATWOE, and RD. The model contains detailed activities that involve all business process information, inputs, outputs, and critical issues to build the HAS. Before modeling the business processes, the first step is to define ownership for each process in an "end to end" business flow based on the HAS. The top-level strategic direction is identified through owner responsibility. The process owner is responsible for each business process and specifically handles the following tasks: define the details of the process down to the operational level, plan and execute processes in daily business activities, determine escalation process on several related issues, and coordinate the crossing function interfaces, identification, and implementation of the potential optimization process. To define an "end to end" business flow scenario until it becomes a model, there are several stages as noted in the eTOM reference process: (1) defining ownership of the business flow, (2) analyzing the current status of "As Is," prioritizing and allowing coverage, (3) mapping eTOM "end to end" business flows, and (4) decomposition of process groups and business flows.

"To Be" SSM Step 5: Comparison of models and real world. This step compares the EA models from the previous steps to EA "As Is" (from the group one research step), which is the current CSP company, compared to the conceptual model in step 4 (from the group two research steps; Figure 5). Herein, a feasibility study is carried out by analyzing whether

Table 6. Stage 3: CATWOE analysis for P2S.

CATWOE	P2S
C, Customers	• City council as Smart City Project Manager • Integrated operation center (IOC) as the CSP internal service monitoring team. • Waste management representative: Concessionaire's technical assistance • Water supply representative: Concessionaire company • City council technical team presents the service problem report: Tourism promotion, Smart traffic management, smart street lighting, incidence management, garden and park irrigation, citizen engagement management.
A, Actors	Marketing/solution team, customer care channel, operational staff IT, operation staff network.
T, Transformation Process	CSP has an IoT-based industry communication channel: • CSP provides the interface of customer care online for smart city • Customer care online able to distinguish the problem report and complaint report. • The smart city representative is able to view the dashboard: problem report and resolve progress status. CSP able to handle the industry problem report. • The reporting format shall be defined: Unique ID, high-level problem description, the representative contact (phone/email) to resolve progress. • Each smart city has the customer unique ID or specific MSISDN prefix that distinguishes the existing customer. • CSP has an internal maintenance team to follow up on the problem resolution and problem report. • Trouble ticket or problem management of IoT-based industry is ready operated through CRM. CSP able to maintain service level agreement (SLA) • Monitor and escalate the problem in order to avoid the penalty • Dedication person in charge (PIC) to direct contact with the smart city representative. CSP able to handle the integrated operation center as the network monitoring report. • Each smart city network is online monitored by the network monitoring service (NMS) platform • An internal trouble ticket (TT) is raised by the IoC staff. • CSP has the internal maintenance team to follow up on the problem resolving, the problem report, and close the TT. • Report to the smart city representative about the problem that currently happens in the network, hence the smart city is noticed about this issue.
W, World View.	Managing the customer industry, with the available resources and constraint
O, System Owners	The City Council of smart city and CSP
E, Environment and its limitations	Availability of contact center and channels, Response time of trouble/incident, Time to solution/conclusion, The ratio of level resolution (level 1 until 4), Customer satisfaction measurement, Maintain the customer relationship, Usage of relevant information for the continuous process improvement, Permanent elimination of the problem root cause.

Table 7. Stage 3: CATWOE analysis for C2S.

CATWOE	C2S
C, Customers	• City council as Smart City Project Manager • City council technical team represents the service problem report: waste management representative, water supply representative, tourism promotion, smart traffic management, smart street lighting, incidence management, garden and park irrigation, citizen engagement management, and public media as the social alert for complaint.
A, Actors	Sales, marketing/solution team
T, Transformation Process	CSP has the IoT-based industry communication channel: • CSP provides the interface of customer care online for smart city • Customer care online able to distinguish the problem report and complaint report. CSP able to handle the industry report complaint. • The reporting format can be informal. • CRM shall be ready for problem management • Each smart city has the customer unique ID or specific MSISDN prefix that distinguishes the existing customer. • CSP has the internal marketing/solution team: follow up on the problem resolution, the problem report, and the decision to apply a discount. • Dedicated person in charge (PIC) for direct contact with the smart city representative. CSP able to maintain customer satisfaction • Dedicated person in charge (PIC) for direct contact with the smart city representative.
W, World View.	Managing the customer industry, with the available resources and constraint
O, System Owners	The city council of smart city and CSP
E, Environment and its limitations	Availability of contact center and channels, response time of the complaints, time to solution/conclusion, ratio of level resolution (level 1 until 4), customer satisfaction measurement, maintain customer relationship, usage of relevant information for the continuous process improvement, permanent elimination of the problem root cause.

the obtained EA design can be applied to the CSP's current organization and business model. The feasibility analysis should ensure that new business processes can be carried out by each subject (human) according to their role. There is also a possibility to assign a new role or new subject (human), if needed, by holistic HAS.

"To Be" SSM Step 6: Changing the model for systemically desirable and culturally feasible is a step toward changing the EA to a new model that is desired or deigned to be applied using the system and is culturally ready for the CSP company. The result of step 6 is the final EA model from the collaboration between CSP and IoT, which is called EA "To Be." This EA becomes a business process recommendation in the form of an EA strategy model for implementation by CSP companies.

"To Be" SSM Step 7: Actions to improve the problem situation is not in the scope for real-world implementation in CSP companies. The results of the EA are strategy recommendation for CSP companies, but all the changes to the CSP business processes are under the full authority of the companies themselves.

Table 8. Stage 3: eTOM process classifications for P2S and C2S.

Domain	ID	Frameworx® eTOM Process (What)	P2S	C2S
(1) Market Sales	1.7	Market Sales Support & Readiness	N.A	N.A
	1.9	Selling	N.A	N.A
	1.12	Market Performance Management	N.A	✓
	1.19	Loyalty Program Management	N.A	✓
	1.11	Contact/Lead/Prospect Management	✓	✓
	1.13	Sales Performance Management	N.A	N.A
	1.8	Sales Channel Management	N.A	N.A
	1.15	Marketing Campaign Management	N.A	N.A
	1.14	Marketing Communications & Advertising	N.A	N.A
(3) Customer	3.1	Customer Support	✓	N.A
	3.3	Order Handling	N.A	N.A
	3.7	Problem Handling	✓	✓
	3.8	Customer QoS/SLA Management	N.A	N.A
	3.9	Bill Invoice Management	N.A	✓
	3.10	Bill Payments & Receivables Management	N.A	N.A
	3.11	Bill Inquiry Handling	N.A	N.A
	3.2	Customer Experience Management	N.A	✓
	3.5	Customer Interaction Management	N.A	N.A
	3.13	Charging	N.A	N.A
	3.12	Billing Events Management	N.A	N.A
	3.4	Customer Management	✓	✓
	3.6	Customer Information Management	N.A	✓
	3.17	Pricing, Discounting, Adjustments & Rebates Application	N.A	✓
	3.14	Manage Balances	N.A	N.A
(2) Product	2.4	Product Support	N.A	N.A
	2.5	Product Configuration Management	N.A	N.A
	2.6	Product Performance Management	N.A	N.A
	2.11	Product Inventory Management	N.A	N.A
	2.9	Product Offering Purchasing	N.A	N.A
(4) Service	4.4	SM&O Support & Readiness	N.A	N.A
	4.5	Service Configuration & Activation	N.A	N.A
	4.6	Service Problem Management	✓	N.A
	4.7	Service Quality Management	N.A	N.A
	4.8	Service Guiding & Mediation	N.A	N.A
(5) Resource	5.4	RM&O Support & Readiness	N.A	N.A
	5.6	Resource Provisioning	N.A	N.A
	5.8	Resource Trouble Management	✓	N.A
	5.9	Resource Performance Management	N.A	N.A
	5.10	Resource Mediation & Reporting	N.A	N.A
	5.5	Workforce Management	N.A	N.A
	5.7	Resource Data Collection & Distribution	N.A	N.A
(6) Business Partner	6.8	Party Order Handling	N.A	N.A
	6.10	Party Problem Handling	✓	N.A

3.2. Primary and secondary data sources

An expert is a senior-level CSP company employee with more than five years of experience, having a job role in the company's strategic area under the CEO Office Directorate. The entitled expert's company department includes the enterprise enabler management department, the corporate sales strategy department, and the B2B channel account department. The company is the largest telecommunications operator in Indonesia, which has a market share of more than 160 million active subscribers (postpaid and prepaid), with a wide range of services available throughout Southeast Asia.

The smart city case is sourced from the well-known SmartSantander project in northern Spain, and the project has wide urban application. It presents a comprehensive documentation reference as a global pilot project smart city, especially in Europe (Hernández-Muñoz et al., 2011). To make this research applicable, SmartSantander has testing facilities for research and experimentation for various architectural research purposes that are combined with the project ecosystem to present a smart city.

3.3. Research instrument

The CSP customer-centric information applied in the current CSP company, such as wireless technologies used (GSM, CDMA_2000, LTE, WCDMA, NR, or other), customer self-care channels in the current system (web/apps/eCare, SMS, IVR, USSD, Twitter/FB/IG, or other), telecommunication services checklist (Voice, SMS, GPRS, MMS, VMS, MCN, M2M, or other), CSP to contact the customer and vice versa (SMS, email, letter, contact center, or other), prepaid subscriber lifecycle, postpaid

Table 9. Stage 4: Processes and sub-processes (levels 2, 3, etc.) for P2S.

1.11 Contact/Lead/Prospect Management
1.11.1 Manage Sales Contact
1.11.1.2 Develop Sales Contact
1.11.2 Manage Sales Lead
1.11.2.2 Develop Sales Lead
1.11.3 Manage Sales Prospect
1.11.3.2 Develop Sales Prospect
3.1 Customer Support & Readiness
3.1.1 Support Customer Interface Management
3.1.2 Support Order Handling
3.1.3 Support Problem Handling
3.1.4 Support Retention & Loyalty
3.1.5 Manage Customer Inventory
3.1.6 Support Bill Invoice Management
3.1.7 Support Bill Payments & Receivables Management
3.1.8 Support Bill Inquiry Handling
3.7 Problem Handling
3.7.1 Isolate Customer Problem
3.7.1 Isolate Customer Problem Flow
3.7.2 Report Customer Problem
3.7.2 Report Customer Problem Flow
3.7.3 Track & Manage Customer Problem
3.7.3 Track & Manage Customer Problem Flow
3.7.4 Close Customer Problem Report
3.7.4 Close Customer Problem Report Flow
3.7.5 Create Customer Problem Report
3.7.5 Create Customer Problem Report Flow
3.7.6 Correct & Recover Customer Problem
3.7.6 Correct & Recover Customer Problem Flow
3.4 Customer Management
3.4.1 Enable Retention & Loyalty
3.4.1.1 Build Customer Insight
3.4.1.2 Analyze & Manage Customer Risk
3.4.1.3 Personalize Customer Profile for Retention & Loyalty
3.4.1.4 Validate Customer Satisfaction
3.4.2 Establish Customer Relationship
4.6 Service Problem Management
4.6.1 Create Service Trouble Report
4.6.1 Create Service Trouble Report Flow
4.6.2 Diagnose Service Problem
4.6.2 Diagnose Service Problem Flow
4.6.3 Correct & Resolve Service Problem
4.6.3 Correct & Resolve Service Problem Flow
4.6.4 Track & Manage Service Problem
4.6.4 Track & Manage Service Problem Flow
4.6.5 Report Service Problem
4.6.5 Report Service Problem Flow
4.6.6 Close Service Trouble Report Flow
4.6.7 Survey & Analyze Service Problem
4.6.7 Survey & Analyze Service Problem Flow
5.8 Resource Trouble Management
5.8.1 Survey & Analyze Resource Trouble
5.8.1 Survey & Analyze Resource Trouble Flow
5.8.2 Localize Resource Trouble
5.8.2 Localize Resource Trouble Flow
5.8.3 Correct & Resolve Resource Trouble
5.8.3 Correct & Resolve Resource Trouble Flow
5.8.3.8 Heal Resource Trouble
5.8.4 Track & Manage Resource Trouble
5.8.4 Track & Manage Resource Trouble Flow
5.8.5 Report Resource Trouble
5.8.5 Report Resource Trouble Flow
5.8.6 Close Resource Trouble Report Flow
5.8.6 Create Resource Trouble Report
5.8.7 Create Resource Trouble Report Flow
6.10 Party Problem Handling
6.10.1 Receive Party Problem
6.10.2 Assess Party Problem
6.10.2.1 Involve External Party in Party Problem Assessment
6.10.2.4 Isolate Party Problem
6.10.3 Submit Party Problem
6.10.4 Report Party Problem Resolution
6.10.4 Track Party Problem
6.10.5 Resolve Party Problem
6.10.6 Manage Party Problem
6.10.7 Report Party Problem

Table 10. Stage 4: Processes and sub-processes (levels 2, 3, etc.) for C2S.

1.12 Market Performance Management
1.19 Loyalty Program Management
1.19.1 Loyalty Program Development & Retirement
1.19.1.1 Define Loyalty Program Requirements
1.19.1.2 Develop Loyalty Program Strategy
1.19.1.3 Develop Loyalty Program
1.19.1.3.1 Define Loyalty Program
1.19.1.3.4 Develop Loyalty Program Partnership
1.19.2 Loyalty Program Operation
1.19.2.1 Become Loyalty Program Participant
1.19.2.1.2 Join Loyalty Program
1.19.2.1.3 Provide Loyalty Program Participant Package
1.19.2.2 Earn Loyalty Program Currency
1.19.2.2.2 Earn Loyalty Prog Currency From Enterprise Partner
1.19.2.3 Earn Loyalty Program Reward
1.19.2.4 Redeem Loyalty Program Currency
1.19.2.5 Manage Loyalty Program Account
1.19.2.5.3 Provide Loyalty Account Communication
1.19.2.6 Leave Loyalty Program
1.19.2.7 Provide Loyalty Program Operation Report
1.11 Contact/Lead/Prospect Management
1.11.1 Manage Sales Contact
1.11.1.2 Develop Sales Contact
1.11.2 Manage Sales Lead
1.11.2.2 Develop Sales Lead
1.11.3 Manage Sales Prospect
1.11.3.2 Develop Sales Prospect
3.7 Problem Handling
3.7.1 Isolate Customer Problem
3.7.1 Isolate Customer Problem Flow
3.7.2 Report Customer Problem
3.7.2 Report Customer Problem Flow
3.7.3 Track & Manage Customer Problem
3.7.3 Track & Manage Customer Problem Flow
3.7.4 Close Customer Problem Report
3.7.4 Close Customer Problem Report Flow
3.7.5 Create Customer Problem Report
3.7.5 Create Customer Problem Report Flow
3.7.6 Correct & Recover Customer Problem
3.7.6 Correct & Recover Customer Problem Flow
3.2 Customer Experience Management
3.2.1 Customer Experience Maturity Assessment
3.2.4 Mapping and Analysis of Experience Lifecycles
3.2.4.1 Select Journey
3.2.4.1.1 Select Touchpoint
3.2.4.3 Analyze Journey
3.4 Customer Management
3.4.1 Enable Retention & Loyalty
3.4.1.1 Build Customer Insight
3.4.1.2 Analyze & Manage Customer Risk
3.4.1.3 Personalize Customer Profile for Retention & Loyalty
3.4.1.4 Validate Customer Satisfaction
3.4.2 Establish Customer Relationship
3.6 Customer Information Management
3.17 Apply Pricing, Discounting, Adjustments & Rebates

subscriber lifecycle, and customer care basic functions, are as listed in Table 1.

The billing media of postpaid customers (paper, email, application, or others), time period for inquiring about call data record history (CDR), and customer e-care basic function list is shown in Table 2. The CC basic information list and best practices of the CSP process flow eTOM in the customer-centric P2S domain are shown in Figure 11 and that for the C2S is shown in Figure 12. To capture the actual process flow in the CSP specifically for P2S and C2S, the process flow from the eTOM is explained and redrawn with help from the expert during the FGD session.

4. Results and discussion

There are two main groups in the research steps: "As Is" business process EA model and "To Be" model in CSP companies. The entire set of activities is analyzed using the SSM related to human activities in systems

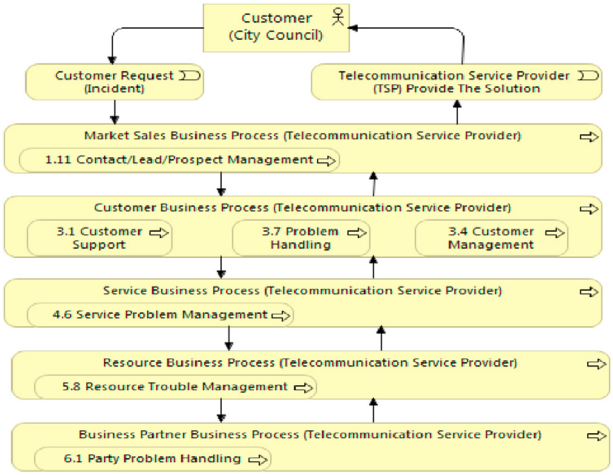

Figure 19. Stage 4: High-level conceptual model for P2S.

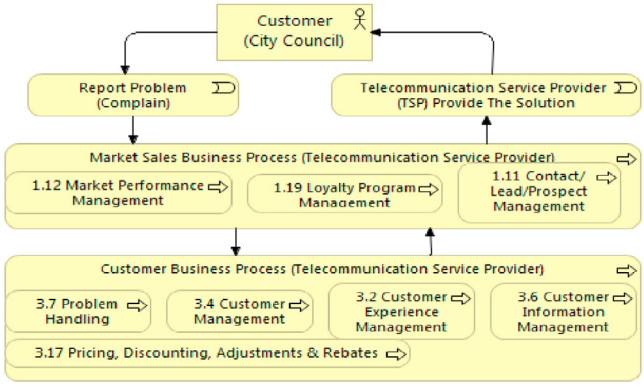

Figure 20. Stage 4: High-level conceptual model for C2S.

to express problems, determine issues, design conceptual models, and compare models with the real world.

After the "As Is" EA model is obtained, the model represented the company's real-world architectural model that is currently operational, which is referred to as the traditional or legacy model. The second group is a continuation of the stages to achieve the "To Be" model, is a strategy for CSP companies after collaboration with the IoT-based industry, where IoT is defined as a new CSP customer. The stage analyses help identify CSP business process gaps that need to be filled at the SSM stage.

4.1. SSM "As Is" stage 1

Stage 1: Situation considered problematic. The P2S process flow addresses the technical problems reported by the customer (Figure 6). This business process starts with the problem report (for technical problems, different support levels are distinguished). The customer-centric domain starts from the service problem events reported by the customer to the CSP company, with high-level company support covered through well-defined scripts or tools such as CRM activated by the customer contact management process. Then, the problem is analyzed, and sophisticated technical analysis activities are forwarded to the technology domain based on the problem ticketing scheme. The overall responsibility of problem handling in terms of the problem of ticket ownership remains in the problem resolution process. In addition, billing activities might be charged, which could be either credit notes as compensation or the invoicing of the problem resolution support.

The C2S process flow shown in Figure 7 deals with commercial complaints (non-technical). Complaints are received when the problem has been encountered multiple times to garner special attention from the CSP or non-technical issue impacting the customer. This business process does not have a direct interface with the technology domain. The processing of the complaint depends on its type and corporate strategy. Complaints can be differentiated into complaints related to clear legal obligations (e.g., wrong invoicing) and customer dissatisfaction (e.g., unfriendly behavior of sales staff). Both cases might involve billing activities resulting in credit notes, either as legal obligations or as goodwill compensation.

The current CSP company business process operates with traditional services: voice, SMS, and data. The research instruments in the questionnaire checklist and pictures that discussed in the CSP office meeting room. The FGD is led and presented by the researcher. To answer correctly, the expert should be able to understand each step of the data collection process and the detailed expected information in the instrument. The answer information contains the current CSP company's basic information, basic service information, CRM information, CC information, adjusted process flow diagram, and all discussions among researchers and experts related to the problem or issue at hand.

4.2. SSM "As Is" stage 2

Stage 2: Problem situation expression. The expressions of the problem situations are depicted via rich pictures, which function as context scenarios. CSP companies have five interfaces from the customer point of view:

(1) customer service offices that are managed by agents, who are able to receive customer requests directly, while the CSP company has a CRM application for assisting the operations agents in handling customers/subscribers. In response to a report of a technical problem, the agent will escalate it to the integrated operation center (IoC) by creating the trouble ticket (TT) complete with the problem description based on the technical case of its findings and adjusting the level of complexity of the problem based on a certain level of severity. To change or make a configuration on a live commercial system, the agent can directly proceed through CRM tools such as reactivate number and re-provisioning number when its signal is lost. The agent can also make a service request (SR) to request special services from various technical departments related to the issue clarity support, or the agent can also create a change request (CR) for commercial changes by the technical department.

(2) Virtual assistance is an application developed by the IT team to assist customers in their problem services independently using chatbots installed on the company's social media and websites. This virtual application is developed by the company's IT team that can address the most frequently asked questions; when enriched with AI capability, they are able to support customers with questioning robots based on keywords in the questions that can be linked to specific solutions.

(3) Head office, which is the CSP company's main office, contains a complete schematic of the company telecommunications, where the sales and marketing department's main office is located and can help with a variety of customer inquiries. To manage direct coordination from customer service to the head office, some of the sales and marketing teams may have separate offices in the customer service office (same location as no. 1).

(4) My "T" mobile app is an OTT application developed by the IT team that uses the Android® and iOS® platforms and can be installed on the customer's smartphone to assist with customer inquiries.

(5) Online customer care is a crowded company business unit that is able to handle many customer inquiries either by telephone or email; customers can directly talk to agents who work in 24 × 7 shifts. To reach the online customer care agents, the customer first proceeds to their self-service problem report by making a call to

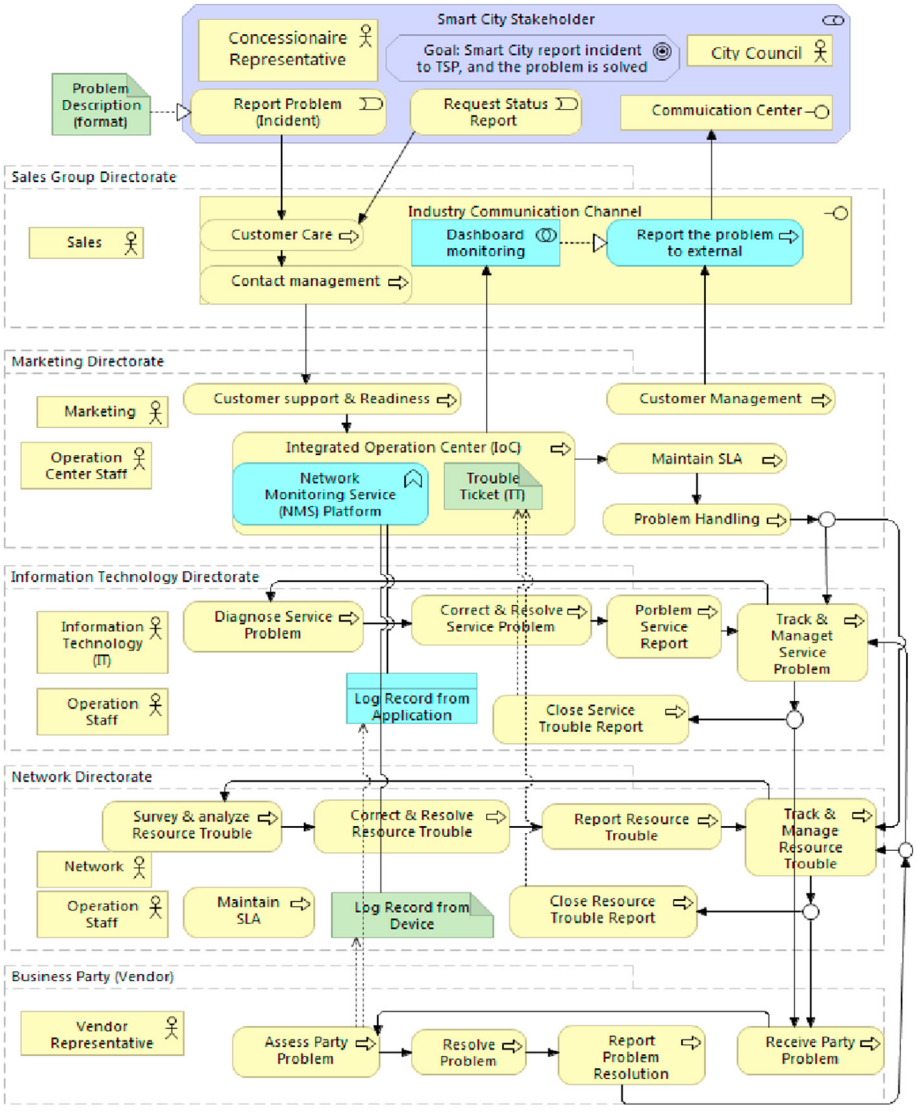

Figure 21. Stage 6: Future (Telco + IoT) EA for P2S.

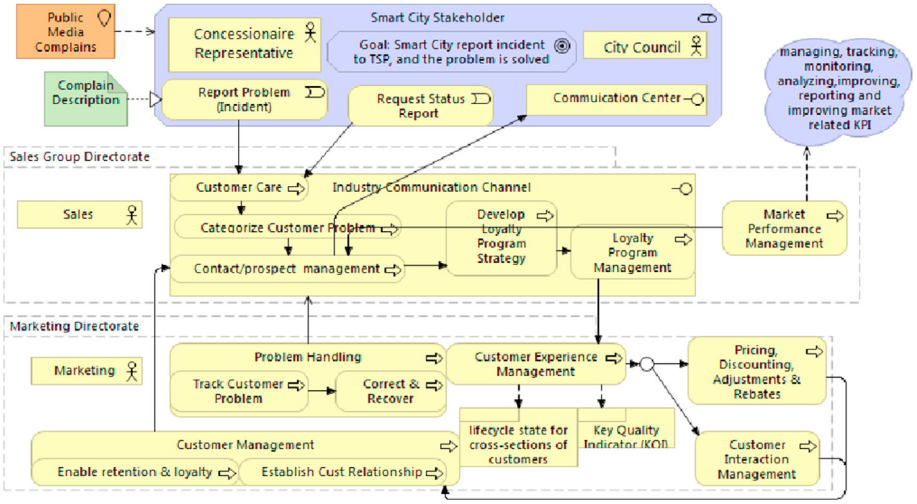

Figure 22. Stage 6: Future (Telco + IoT) EA for C2S.

the interactive voice response (IVR) system, which can be accessed through specific customer numbers: prepaid, postpaid, fixed-line, overseas incoming number (roaming), and reseller (recharge, dealer, bank). A rich picture of these five processes is presented in Figure 8.

According to SSM Stage 2, it is noted that the IoT-based industry is not recognized or does not function as a customer with appropriate access to the CSP. Further, the in-charge system may not be ready, or no media exist to receive or handle any problem reports from the IoT-based specific industry issue. Once the problem is raised and reported by the company IoT, there is no media to be serviced by the CSP; the IoT company can instead make a direct report by accessing the head office, but systems such as the CRM and TT in the IoC are not ready.

The P2S business process consists of activities related to technical complaints (problems) raised by customers through a specific media interface. The CSP's technical team responds by diagnosing the problem source according to the given description, submitting the analysis, making proper resolutions by change actions, monitoring progress, and closing TTs after their resolution. The basis of a problem is the occurrence of product/service unplanned disruptions or reduced quality of a product/service. Some of the assumptions and examples are provided in Table 3.

The C2S business process consists of complaints (problems) raised by the customer through a specific interface; most customers choose email as a formal letter. Complaints are usually sent by customers after a long-term service problem or dissatisfaction with poor service. Complaints need to be analyzed to identify the source of the problem/issue, submit a resolution, monitor progress, and close the problem ticket for the parties concerned. Complaints have a certain pressure factor when customers express that they are not happy/satisfied. For example, the C2S process deals with customer inquiries where the customer is not satisfied with the product or the speed of handling questions, inquiries, etc. Most of the complaints pressure the CSP company into solving the issue as soon as possible (ASAP). The assumptions and examples are provided in Table 4.

4.3. SSM "As Is" stage 3

Stage 3: RD of relevant purposeful activity systems. RD of the relevant systems define RD for P2S and C2S business processes supported by the eTOM framework as a cataloging tool to provide end-to-end best practices in business processes in organizations.

In line with CSP company analysis, the organizational area in eTOM defines a horizontal area consisting of marketing and sales domains, products, services, resources, and business partners. The vertical consists of various activities in the CSP operations domain, including readiness and support operations, fulfillment, guarantees, and billing and revenue management.

Vertical and horizontal areas that are related to P2S and C2S need to be drawn for detailed analysis of each business process, maturity level of the activity, relation with another business process, and other mandatory information in the eTOM catalog. A detailed description contains a description of the activities along with the actors, activities, and related activities to other business processes. It is displayed in a hierarchical structure from general to specific. In this RD, the definition of RD-related areas can be seen in the sections below for P2S and C2S. The related area is drawn in the eTOM Level 2 picture. An RD must be adequately formulated to capture the essence of the related system, and it is also important to note the factors flagged by researchers.

For business process mapping for P2S into the eTOM framework, first, activities are located inside the operations (OPS) area only, and situated vertically between the operation fulfillment and assurance. Based on the assumptions used, the activity will be used to respond to problems raised by customers via reactions/rectification until the problem is solved (considered as a fulfillment); at the same time, CSP should ensure (assurance) the service operation is handled normally. Billing and revenue management are only applied if there is a company fee policy imposed for serving customer inquiries. Operations Readiness & Support domain are excluded because service is not in the normal state (the problem that the service is not ready), as shown in Figure 9.

In the horizontal domain, activity is involved only when the service is active and used by the customer. The domains marketing and sales, customer, service, resource, and business partner support the problem rectification process. The "product" domain applied to all subscribers is uniformly configured; once the product has an issue, it will impact all live subscriber experiences and may attract complaints from customers. Owing to P2S activity only affecting some subscribers, the "product" domain is excluded. This can be seen in Figure 9 obtained from (TMForum, 2018) End-to-End Business Flows GB921E, which is aligned with Business Process P2S.

For business process mapping of C2S in the eTOM framework, all activities are located inside the operations (OPS) area only. It is situated vertically between operation fulfillment and assurance. The vertical domain scope is similar to that of the P2S.

In the horizontal domain, activity occurs when the service is active and used by the customer. The domain market and sales and customer support the complaint resolution. The "product" domain outside this scope has a similar reason as the P2S business process. Based on the assumptions, if the process flow is non-technical, product, service, source, and business partners are excluded. I f the process flow is a technical repeated problem, the P2S should be recognized separately by proper escalation. This C2S business process should maintain fulfillment and assurance in order to resolve the complaint as soon as possible. The area involved can be seen in Figure 10 obtained from (TMForum, 2018) End-to-End Business Flows GB921E, which is aligned with Business Process C2S.

4.4. SSM "As Is" stage 4

Stage 4: Conceptual models of systems described in RDs. To build a conceptual model for companies that have been operating for several years. As companies already have lengthy practical business processes, specific logical actions are needed to be able to recognize existing purposeful activities. The design analysis, through reference to the eTOM process flow as the global best practice, is expected to represent or be closest to the real process flow as a set of logical actions implied by the RD. The conceptual design is shown in Figures 11 and 12. A set of logical actions that represent the condition "As Is" in accordance with End-to-End Business Flow (BPMN notation) GB921E (TMForum, 2018) implied by the root definition, including the existing organizational mapping.

The BPMN notation process flow has a basic limitation that does not contain a strategic concept in the form of related organizations, as discussed in stage 3. The researcher analyzes the BPMN to create a model of the activity system. There are two possible approaches to create a system: (1) describing the eTOM element descriptions (stage 3) that comprise it, their current conditions, their relationship with the external elements affect the system, and (2) the conditions of the external elements. This approach provides a system description by regarding systems as entities receiving inputs and generating outputs into the ArchiMate 3.0 EA model. The resulting EA is then used as a visual guide during the FGD to collect data from experts.

4.5. SSM "As Is" stage 5

Stage 5: Comparison of models and real-world scenarios. A comparison between models and the real-world scenarios is obtained by discussing the EAs of P2S and C2S models obtained in step 4, with expert discussions in CSP companies. The mechanism used to obtain CSP company data is through an FGD. Researchers visit the CSP headquarters located in Jakarta, Indonesia, to discuss with company experts to obtain the current business process "As Is." Researchers conducted an EA model-

based approach obtained in step 4, which is based on eTOM's best practice framework. In the FGD, the EA model will be redefined for practical feasibility in the company to directly change the model if adjustments are needed. The latest obtained EA model is considered to be suitable with real-world "As Is" CSPs. In the FGD process, various information problems are obtained for various services related to customer relations.

The research activities obtain information in the following manner. (1) Obtain the current "As Is" business processes that considers the "T" companies' B2C to handle voice, SMS, and data services. (2) Confirmation and correction of the EA based on the process flow pictured in the questionnaire for both process flow P2S and C2S.

4.6. SSM "As Is" stage 6

Stage 6: Change the model: systemically desirable and culturally feasible. When carrying out FGD, it is important to achieve consensus between researchers and experts. The researchers found that there was a lack of understanding of the domains used for management in the company because the terms used were different. In the company where this strategy will be implemented, there are a number of terms that need to be mapped on the new EA model because there are inequalities with the terms used in eTOM best practices, even though they have aligned functions or roles with telecommunications company global management standards. The CSP company has seven directorates: (1) sales directorate, (2) marketing directorate, (3) planning and transformation, (4) finance directorate, (5) network directorate, (6) information technology directorate, and (7) human capital management director. The positions and roles mentioned above in the eTOM are typical and are defined in the horizontal domain. Horizontal eTOM domains include (1) market sales, (2) customers, (3) products, (4) services, (5) resources, and (6) business partners.

The researcher redefines the domains that were divided among several directors. In addition, there are also the responsibilities that are cross-matrixed among several directors. To overcome this misunderstanding, researchers use the process flow approach and an explanation of each business activity through the EA reference, as follows: Who is the actor? What roles do actors have? Do what activities? With whom? This is to determine which directors are interrelated? This allows the expert to recognize what domains and activities are intended even though they use different terms and move the discussion to appropriate mappings, as shown in Figure 13. Discussions based on process flow create common mindsets to obtain a similar understanding of the problem.

a) **P2S**

There are four interfaces between the customer and company in the P2S process flow. The first three interfaces are human support, which are the same as P2S; the last is a virtual assistant called Ve****ca. All problems are recorded in the TT management system automatically or manually according to the customer interface.

According to the founding during the FGD with the CSP company, there are four escalation levels to resolve the problem. The 1st level is the direct customer interface (front liner). The 2nd level is the Operations and Maintenance (O&M) team under marketing that dispatches the problem to a specific technology charge in the directorate network or IT. The 3rd level is handling the issue in the network or IT directorate. The 4th level is handling of the issue by the research and development (R&D) team of the company that is responsible for creation of the product/service and its troubleshooting; besides the internal technical team, the 4th level may include vendors or business partners. The overall process flow starts from the problem report, and the customer contact management ensures its record log, ticket creation, problem analysis, problem resolution, and ticket closing.

Marketing is responsible for tracking, managing, and specifying the customer problem; the network team is responsible for checking whether the problem is with the network or IT directorate by dispatching the TT accordingly.

The network or IT directorate who handles the ticket has the responsibility to diagnose the service or resource problem and then perform corrective actions to resolve the problem. In case a problem is not resolved in this phase, the ticket is dispatched to a vendor such as the R&D team or the product/technology owner (level 4). The final escalation to the vendor is the last corrective phase. After the problem is resolved, the ticket is closed and returned to marketing to share the product readiness. The P2S EA for a real-world situation is shown in Figure 14.

b) **C2S**

The process flow of the C2S is a non-technical problem that is handled by the sales and marketing directorate only. The problem treated as C2S is mostly received by notice or complaint letters sent by customers who are designated very important persons (VIP) to the CSP top management, which is internally routed to sales directorate for response.

The complaint is recorded by marketing through ticket management and internal follow up. This process might also involve the subject matter expert (SME) from the network or IT departments for quick consultations or advice.

The requests and questions from customers are compiled by marketing to determining customer request/inquiry feasibility. Marketing receives support from the network and information directorate on whether the resource and service for the request are available or not and might provide some sales analysis in the event that a solution or product is unavailable. The C2S EA for a real-world situation is shown in Figure 15.

4.7. SSM "To Be" stage 1 in IoT-based industry

Stage 1: Situation considered to be problematic in IoT-based industry. The IoT-based industry, which will be the new CSP customer, is the smart city industry, where this study uses the IoT ecosystem to explore the new business process. The Smart City Project is usually organized by local government or administrative authorities of the city. Our research uses the case of the SmartSantander, where the city council organizes the project. The project has eight primary use cases, which are displayed in Figure 16.

SmartSantander, as a smart city project with a wide range of urban services in a city, has eight types of services that have their own mechanisms called "use cases." Use cases are supported and managed by vendors who are supervised by the city council. All use cases are integrated under the leadership of the city council and smart city solution integrator. Researchers need analyses of the details of the operational conditions that will be integrated with the CSP. The CSP is a company that will help deliver wireless internet for all IoT devices that help develop smart devices, especially operational activities that are needed for CSPs, city councils, and vendor companies that provide service use cases. Smart city services must be integrated with actors, roles, task forces, and clear activities that build business processes, especially in the telecommunications business processes for P2S and C2S.

The IoT operational details can be obtained by analyzing a combination of the BMC and 6C frameworks of SmartSantander for all use cases, as seen in Table 5. The BMC has been summarized by Díaz-díaz et al. (2017a) and Díaz-Díaz et al. (2017b). The analysis can then be integrated with the CSP business processes.

4.8. SSM "To Be" stage 1 in CSP company

Stage 1: Situation considered to be problematic in CSP company. The situation problem received by the CSP company is addressed during the FGD with experts. The CSP company, starting in 2019, has been recognized for gaining more revenue from the B2B model to replace the

traditional B2C model. Some ad hoc organization charts and resources have been onboarded to support this new business model. Unfortunately, the implementation from B2B is not mature and faces many issues, especially in the business process area, which is not clearly defined and often has conflicts with the existing B2C business process. Below, some key transcripts are provided for the current business process practice.

Question: *How does your company distinguish B2B and B2C in real business process applications?*

Answer: *We have a B2B and B2C business model in our company. B2B is new, and it has special marketing. This year, our company is about to start focusing on enterprise customers. In order to have an internal spinoff, which is B2B, there are plenty of marketing resources transferred as B2B dedicated marketing. According to your presented organization chart, marketing is separated by consumer and corporate after all.*

Question: *What is the impact on your organization for this kind of B2B strategy focus?*

Answer: *From this structure, there is another new break called the CEO office, which is unseen in our formal organization chart. Thus, the CEO's office is all about transformation, under the managing director. Some structures beneath are called TMO, the transformation management office. This TMO plans to become an independent directorate later.*

Question: *Could you share what is the problem in this ad hoc organization practice?*

Answer: *The CEO's office is still the gray line of coordination, which is from the TMO team, can go directly to the chief executive officer (CEO) of this company.*

Question: *How about the problem of B2B and B2C practice in your company? Do your employee activities have a clear boundary?*

Answer: *Actually, the Telco initial business is B2C, and the maturity is also for B2C. When we try something new like B2B, sometimes the B2B treatment and all related kinds of things are forced to pull back into B2C. This is not right; there should be a different treatment that the company does. Before the transformation period until now, B2B activity actually "hitchhike" on B2C. As an example of a treatment that occurs in Gr***ri, the customer touchpoints are still riding in B2C, even though in nature, the business is very different. In B2B is a very corporate base, like corporate A and corporate B customers, then surely our treatment is definitely different according to the business agreements and business models that exist in each company. However, if it is about B2C, then the treatment can be mixed in many kinds and easily because B2C customers are divided based on revenue, and we can easily differentiate from segmentation.*

The following summary contains the unstructured information noted during the FGD.

- The initial report communication of the problem and complaint is from the IoT-based industry to the "T" company through a single point of contact via an account manager (AM). The AM is appointed by T company to handle several customers; the IoT company also recorded their AM interface for handling any requests, problems, and complaints. Although the IoT-based industry made a call to Customer Care Online, it will be answered by the online agent normally, but the agent cannot record or handle the issue. The agent will reject the call because its role does not have any scope for handling such customers.
- Information: Process complaint handling (high level). The channel team received complaints from the industry customer via admin team support (outsourced), for example, issue of changes to SIM card, changes to package, and roaming issues. Once there is an outstanding issue/delivery solution, the admin will step in; then, the AM is the point of contact who will interact with the customer.
- The problems and complaints raised by the IoT-based industry are handled by "T" company according to the mobile number, acknowledged as the mobile subscriber integrated services digital network number (MSISDN).
- The communication treatment among T company organizations still rely on traditional schemes, which involves human effort. For example, the corporate IT and network organizations do not know how to communicate with the business to deliver digital solutions comprehensively. The AM should mitigate any issue by finding a person across the organization with very difficult communication access and support owing to the directorate cross matrix.
- The fundamental company platforms such as CRM, customer care (CC), and enterprise resource planning (ERP) are not ready to sell digital solutions, where the wholesale involve in the all element by temporary approach and many of the customizations are based on MSISDN whose services are still managed manually.

4.9. SSM "To Be" stage 2

Stage 2: Problem situation expressed. This stage involves designing a rich picture that contains the problem situation in CSP for integration of IoT into the business processes. The rich picture illustrates the important processes and issues in the CSP organization, covering all possible activities and interrelations between various activities in building business processes that focus on P2S and C2S for the consumer "IoT-based industry." This rich picture contains informal sketches that represent the organizational entities that are related to customers, how new customers will communicate with the company organization, and the process flow that can occur between CSP and IoT, including internal flows.

Using a description of the IoT ecosystem previously obtained from the extracted 6C framework in Table 5 helps illustrate the complexity of the IoT-based industry that will be serviced by the CSP as an internet provider for IoT devices. The conditions received through a complete process, such as initiating P2S and C2S within the scope of activities to maintain a smart city internet connection, communication with the CSP team, and various sustainability activities in the operational process will be explained in this section.

The P2S business process activity is carried out for technical issues related to the availability of the internet network in a smart city. Technical sales from CSP companies receive problem reports from the City Council as the maintenance team that monitors performance based on inputs from the technical assistance team of the concessionaire's company, direct reports from the public through applications, drivers, and automatic alarms received on the dashboard. Reports received by the CSP can also be from online customer care points that handle problem reports from customers.

The problems experienced will be sent by the city council to the CSP operator company as problem tickets, or the CSP operator can take the initiative to monitor problems in the network in the problem location.

CSP has a department that patrols and oversees the health of its network and services through an IoC, which consists of two monitoring activities by the sub-directorate operation center: network and IT, which actively monitors network conditions through an automatic monitoring mechanism (an alarm will be sent by the device) or a periodic check from the maintenance team operated with a regular schedule based on direct machine checks or monitoring scripts. The health of the service is displayed on the dashboard, and the IoC is expected to report to the city council once there are technical service interruptions caused by the CSP company-side problems, so the city council and service sub-team is notified of problems with their internet network.

CSP internal processes are expected to have the same or better treatment for processing smart city problem reports compared to those currently used in traditional services. Each smart city can be identified with a unique customer ID, where the customer ID is supported by many

MSISDNs. The improvements in new business processes can be prefixed by the MSISDN specifically for industrial customers; Type: Bulk, Service: Data only, New payment prefix specific to the smart city subscriber with the smallest unit or multiple of 10000. Reports on IoC are prefixed with new numbers, and treatment at the core network is by specific throughput/priority. The CSP is also expected to provide billing convenience, error tracing, read logs or alarms, network habits, deletion/termination, and provisioning for the smart city. The rich picture for the P2S process is shown in Figure 17.

The C2S business process involves non-technical issues related to internet network services in smart cities. Complaints are received from the city council in the form of reports on inconveniences due to operator services that have been in use for a long time. Based on the accumulation of complaints from various use cases to build smart cities, can also be a dislike of the slow response of issue handling, inaccurate QoS reports, provision of obsolete or outdated services, and incorrect invoices that are not in accordance with the estimated usage of the city council. The smart city project is also used by citizens, so there is potential for the public to submit service complaints through public media such as newspapers, radio, and television. C2S is also part of the complaint that must obtain a resolution from the CSP. The rich picture for the C2S process is shown in Figure 18.

4.10. SSM "To Be" stage 3

Stage 3: RD of relevant activity systems. At this stage, various interrelated activities in the form of HAS, which can potentially offer insights into existing problems will be obtained and analyzed via RD.

RD must be well formulated to capture the essence of the system, and it is also important to note that the Customers, Actors, Transformations, World View, Owner, Environment Constraint(CATWOE) approach is applied to the P2S and C2S process flow. Any human activity that uses business processes in a structured manner and interrelationships between the sub-processes that support the IoT ecosystem need to be defined here. The application of CATWOE analysis may be summarized as follows.

We define the RD in the P2S process through analysis with CATWOE tools. The CATWOE analysis is shown in Table 6.

We define the RD in the C2S process through analysis with CATWOE tools. The CATWOE analysis is shown in Table 7.

After obtaining CATWOE, we need to identify business processes in the eTOM level 2 catalog. Not all level 2 business process lists can be applied to the P2S and C2S process flows. It is necessary to eliminate the eTOM catalog by marking with not applicable (NA), as shown in Table 8. Then, the main process that aligns with P2S and C2S is appointed following the RD above. The description and more extended information for each process may be found in GB921 (TMForum, 2018).

Criteria to eliminate (out of scope) P2S key activities. The activities related to selling, marketing, performance, billing, charging, inventory, order, purchase, reporting, readiness, etc.

Criteria to eliminate (out of scope) C2S key activities. The activities related to technical problems, except problem handling by the stakeholder marketing sales and customer, activities related to business partners, and overall elimination criteria for each process are shown in Table 8.

4.11. SSM "To Be" stage 4

Stage 4: Conceptual models of systems described in RDs. By analyzing the RD, the HAS can be obtained by defining activities from the eTOM level business process catalog from the general to more detailed/specific. Identifying leads from the highest level in the organization through decomposition of the activities at each level, each of which describes the activity along with its relation to other activities in a manner similar to that by Wang et al. (2015), allows modifications by linking general activities to details in business processes via a series of interconnected and structured activities with logic shown in Wang et al. (2015). The relationship between one HAS and another is necessary to build the entire process flow, including connections that exist in the processes of subprocesses.

The conceptual model is a breakthrough innovation that represents human activity system (HAS) through a set of logical actions categorized by the RD. To determine the "end to end" business flow, it is necessary to allocate eTOM level 2 processes along with their descriptions to achieve the overall desired business flow. Efforts to identify which eTOM areas or processes are relevant are not simple. First, each group process is defined and compiled into more details at levels 3 and 4. Based on the same needs and interdependence of certain functions or targets, it is necessary to use repeated activities, and activities with options ("or" | "and") in the processes at level 3. After identifying processes at level 3, the flow of business processes can be created subsequently in a logical sequence according to the RD.

Conducting analysis using the PQR, CATWOE, and RD. The PQR analysis represents all related processes and subprocesses in level 2 and 3 as "**what – P**", as can be seen in Table 9 (P2S business process) and Table 10 (C2S business process). Each process has a detailed description of the activities, context, and relationships to other processes, obtained from the catalog documentation in GB921 (TMForum, 2018), which is represented as "**how – Q**." Sub-processes and various context-relevant relations are created based on the RD and represented as "**why – R**", which contains the activity purposes.

The high-level process flow for P2S using the appropriate eTOM business process is shown in Figure 19.

The high-level process flow for C2S using the appropriate eTOM business process is shown in Figure 20.

4.12. SSM "To Be" stage 5

Stage 5: Comparison of models with real-world scenarios. The conceptual model obtained in the fourth stage is the CSP EA model, which will be proposed as the business process target to answer problems with the IoT collaboration solution as the new customer. The technique to validate whether the business process is feasible for application to CSP companies is to compare it with business processes through the EA "As Is" model, which is considered as the actual "real-world" enterprise model.

The "real world" EA model obtained in the "As Is" SSM-Stage 6 step is a valid model based on confirmation from CSP experts during the FGD. The model shows traditional services that are currently applied in the CSP business process. Comparisons are made at this stage, and the conceptual redefinition is performed at the next stage.

4.13. SSM "To Be" stage 6

Stage 6: Change the model: systemically desirable and culturally feasible. At this stage, the EA model is changed to a new model that is systemically desirable because it is culturally ready for the CSP company through comparative studies of the current company architecture. The "As Is" EA has been proven to be systemically desirable and culturally applicable, while the "To Be" EA is the target of this research before actual implementation in the IoT collaboration business model. Both "As Is" and "To Be" are examined starting from the new processes/subprocesses of "To Be" SSM Stage 4 that has been adapted to CSP organizations. Domain names, such as market sales, customers, products, services, resources, and business partners, are adjusted for the current directorates and roles, such as sales, marketing, IT, network, and business parties (vendors). Sales and marketing are separate roles in "T" company; the sales directorate focuses on the customer interface, while the marketing team focuses on the strategy and supports the sales team. The product domain is removed because this role is assumed by the marketing directorate. Other domains, including service, resource, and business partner, are simultaneously assumed by the directorate of networks and information technology.

The P2S and C2S processes involve two stakeholder areas: (1) the smart city as an industry whose operations utilize IoT technology to act as the company's new customer, and (2) the CSP company as a provider of internet connectivity with its telecommunications technology. The business process is addressed in the HAS between two stakeholders. The RD defines a target to which many processes are linked, and sub-processes are lumped based on the PQR concept.

In the P2S business process, the smart city stakeholders comprise actors, such as the concessionaire representatives and city council, with the goal of supporting problem solving for their IoT services with the help of CSP services. This P2S process has activities initiated by the smart city, where the smart city (1) reports the problem, and (2) CSP, with support from the business partner, internally provides technical collaboration to resolve the reported problem. The EA "To Be" P2S process is shown in Figure 21.

In the C2S business process, smart city stakeholders comprise actors, such as the concessionaire representatives and city council, with the goal of supporting complaints regarding their IoT services and customer satisfaction, with the help of CSP services. This C2S process has activities initiated by the smart city, where the smart city (1) reports the complaint, and (2) CSP, with internal support from marketing, provides non-technical collaboration to resolve the reported complaints. The EA "To Be" C2S process is shown in Figure 22.

5. Conclusion

The present study contributes to operational activities that support migration to industrial revolution 4.0. Companies use IoT as one of the means to remain competitive in the new industrial era. Different industries can be combined to achieve new collaborations through scientific and insightful research, especially in the telecommunications industry, which requires new strategies to successfully progress from turbulence.

This paper presents the implementation of a corporate breakthrough strategy with detailed orientation. Strategic policymakers, as architects of corporate transformation, can immediately see the research output as a new strategy that is easy to analyze and implement via the EA approach. Important factors, such as business processes, systems, documents, applications, technology, organization, and administration to identify the needs of CSP companies, can be easily determined and analyzed. Thus, a systematic and applicable reference to transform businesses from the traditional to new industrial models is presented.

This research opens new directions for further research via discussion on two initial business processes in the eTOM process flow in telecommunication companies: problem to solution (P2S) and complaint to solution (C2S); thus, initial problems are identified for reliable strategy. For a more comprehensive business process, this initial approach can be combined with other processes such as the request to answer (R2A), order to payment (O2P), usage to payment (U2P), request to change (R2C), and termination to confirm (T2C).

The research approach here is that CSP can collaborate with the "smart city" industry as a public service industry. Research on CSP companies that need to collaborate with other industries or achieve certain advanced collaborations, such as manufacturing, agriculture, electronics, health, and energy, can apply some of the methods noted herein.

This study has limitations with respect to the object of the research, which includes only CSP companies that need to create changes to their business processes, given their complexity. However, other IoT-based industrial collaborations may have variations. Another limitation is that each type of industry has different characteristics that result in different strategic model contributions, so it is essential to further analyze other IoT-based industries based on the proposed approach.

Declarations

Author contribution statement

M. Dachyar: Conceived and designed the experiments; Wrote the paper.

Teuku Yuri M. Zagloel: Analyzed and interpreted the data.

L. Ranjaliba Saragih: Performed the experiments; Contributed reagents, materials, analysis tools or data.

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The authors declare no conflict of interest.

Additional information

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