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Health Information Systems Enabled Transformation of Service Ecosystems: The Case of Indonesian Healthcare

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Abstract

Information and Communication Technology (ICT) has contributed significantly to the socio-economic development of societies. In particular, developing countries are now beginning to undertake ICT-enabled transformations that previously took place in the western world. However, while the proliferation of ICT is considered a crucial enabler of this transformation, ICT for Development (ICT4D) projects continue to fail as they do not achieve the anticipated societal impacts. Therefore, a holistic and systemic perspective of ICT4D research is needed to enhance the current understanding of these phenomena.

This study addresses this knowledge gap through an in-depth investigation on how the structure of public health ecosystem in Indonesia is changed and transformed following Health Information Systems (HIS) introduction. A qualitative multiple case study was conducted across three district-level government. The analysis reveals the distinctive impacts of HIS introduction on the structural properties of the ecosystem, which include institutional rules, resources configuration, actors' institutional logics, and practices. This study also identifies three *mechanisms* (*adoption-incorporation*, *breaking-making*, and *self-reinforcing*) of HIS enabled transformation which constitute two pathways (*enslaving* and *emergence*) of the ecosystem's transformation.

The findings of this study offer theoretical contributions to ICT4D and service literature and practical contributions to HIS implementation in Indonesia. The transformation process of the ecosystem's structure offers a systemic perspective of ICT4D, which overcomes the tendency to overemphasise the significance role of technology and agency in developing countries. The pathways of transformation complement those earlier studies investigating the reasons for numerous failures of the top-down technological transfer and the importance of inclusion, engagement, and empowerment of the societal groups in ICT4D. To service literature, this study offers insights into the origins and lifecycle of practices and how they emerge in the ecosystem, which shed light on the dynamic and evolving nature of ecosystem's structure that currently has not been adequately understood. Finally, the results of this study advocate the autonomy of the district's health providers, the inclusion and engagement of local actors, and the use of the incremental approach to HIS implementation in public health ecosystem.

Declaration

This is to certify that:

- i. the thesis comprises only my original work towards the PhD,
- ii. due acknowledgement has been made in the text to all other material used,
- iii. the thesis is less than 100,000 words in length, exclusive of tables, maps, bibliographies, and appendices.

Luthfi Ramadani

December 2019

Publications

Some sections of this thesis are published in the following articles:

Ramadani, L., Kurnia, S., and Breidbach, C. F. 2017. “**Advancing ICT4D Research through Service-Dominant Logic**,” in 28th Australasian Conference on Information Systems, Hobart, Australia.

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Glossary

BPJS	<p>Badan Penyelenggara Jaminan Sosial (kesehatan): Organization who administers Indonesian healthcare insurance as mandated through JKN (Jaminan Kesehatan Nasional = National Healthcare Insurance).</p> <p>In this thesis, BPJS specifically refers to BPJS kesehatan.</p>
Cadres	The frontline health workers at Posyandu working under the supervision of midwives / PHC's officials.
DOT	Directly Observed Therapy (DOT), a treatment strategy for Tuberculosis patients endorsed by World Health Organization.
e-Puskesmas	Primary Health Care Information Systems developed by private Indonesian vendor. It is currently the largest share in the nation.
ICD X	International Statistical Classification of Diseases and Related Health Problems (ICD), 10 th revision by the World Health Organization (WHO).
JKN	Jaminan Kesehatan Nasional: Indonesian Health Insurance Program initiated in 2013, administered by BPJS.
Mother and Child	<p>Program/division responsible for mother and child health (prenatal, postnatal, baby and toddler <5 years old).</p> <p>Indonesia = KIA (Kesehatan Ibu dan Anak).</p>
PHC	Primary Health Care (Indonesia = Pusat Kesehatan Masyarakat, abbreviation: Puskesmas).
PHC IS	Primary Health Care Information Systems. The core information system for primary health care which includes patient management, electronic medical record, and PHC organisational management.
PCare	An application system for BPJS patients' admission at primary health care.
Posyandu	Pos Pelayanan Keluarga Berencana – Kesehatan Terpadu: one-integrated service station, a neighbourhood/village-

	level pre and postnatal healthcare provider for women and toddlers (under 5 years old).
Puskesmas	Pusat Kesehatan Masyarakat (Primary Health Care/PHC): the public health providers operating under health district government. Each puskesmas normally is responsible for several villages (area-based), currently regarded as the gatekeeper of public health comprising promotive, preventive, curative (basic) care.
SIHA	Sistem Informasi HIV-AIDS: a program-based application system for data management and reporting for HIV.
SIKDA	Sistem Informasi Kesehatan Daerah: a regional electronic health information system for local public health providers distributed by the Ministry of Health. It is the earlier version of offline-based PHC IS.
SIKDA Generik	Online based SIKDA developed by the Ministry of Health for district health government and primary health care.
SIMPUS	Sistem Informasi Manajemen Puskesmas: Primary Health Care Information Systems. In this thesis, it specifically refers to a customized version of SIMPUS currently operating in District Bungatanjung.
SIP	Sistem Informasi Puskesmas: standards and forms for manual/electronic data management and reporting for primary health care.
SISMAL	Sistem Informasi Malaria: a program-based application system for data management and reporting for Malaria.
SITT	Sistem Informasi Tuberkulosis Terpadu: a program-based application system for data management and reporting for Tuberculosis.
SP2TP	Sistem Pencatatan dan Pelaporan Terpadu Puskesmas: an earlier version of data management and reporting forms and standards for primary health care (manual or electronic). SP2TP has been revised/extended to SIP.

1 Introduction

"You can see the computer age everywhere but in the productivity statistics."

(Robert M. Solow, Nobel Laureate, 1987)

1.1 Prelude

In 2016, the McKinsey consulting company published a paradoxical situation about digitalisation phenomenon in Indonesia. The report states:

“Indonesia is in a nascent stage of digitisation. However, the country presents a curious paradox: its digital denizens are among the world’s most active, [...] but overall the country lags in embracing the benefits of modern technology.“ (Das et al. 2016, p. 2)

As an Indonesian, the researcher of this study both agrees and wonders about this viewpoint. The statement suggests the new form of Solow’s *productivity paradox* which delineates the negative correlation between digital resources provision and their benefits. As a developing country, Indonesia’s digitalisation agenda in the core pillar for Sustainable Development Goals (SDGs), including health and education, is still among the lowest around the world (Rokhman 2011; World Health Organization 2018). In public health, specifically, while the initiative for the national health information systems has been introduced nearly 1.5 decades ago, currently the country is still jammed in basic digitisation agenda. In particular, the nation is still dealing with constant problems with the data reporting system either in district or in central government, some of which are even kept manual (Mahendradhata et al. 2017). These phenomena indicate that there is a need for a systematic inquiry to conceptualise such a complex social system regarding digitalisation agenda—an inquiry that is entitled specifically to Information Systems (IS) scholars.

Following this quest, this thesis presents an exploratory study on Health Information Systems enabled transformation in public health service ecosystems in Indonesia. The study draws on transdisciplinary perspectives from Information and Communications Technology (ICT) for Development (ICT4D) literature, service science literature, and Information Systems (IS) literature.

1.2 Information and Communication Technology (ICT) for development

In 2009, Indian government implemented an ICT system called “Mother and Child Tracking System” (MCTS) (Gera et al. 2015; Sahay 2016). The main objective of this system was to track the interaction between expectant mothers and health workers by collecting the complete reports of primary health care practices. Through this project, the government intended to have an advanced surveillance and monitoring system as a way to improve the nation’s maternal and child health status. However, as reflected by Sahay (2016), the realisation of the project did not consider the condition of the key actors in the fields which made the project go off-track. The health workers suffered from insufficient training and coaching, the uncertainty of job and salary status, and frequent power and internet outage. Worsened by the fact that the health workers felt “overburdened with data documentation work” (Gera et al. 2015, p. 1), the impact of the system on the nation health was not as expected (Gera et al. 2015; Sahay 2016).

Gera et al. (2015) and Sahay (2016) are only a few amongst numerous studies that call for deemphasising the technology in ICT4D (Bernardi et al. 2017; Braa et al. 1995; Brown and Thompson 2011; Dobson and Nicholson 2017; Hayes and Westrup 2012; Madon et al. 2007; Njihia and Merali 2013; Walsham 2012). The case of MCTS presented above represents at least two common problems emerged from overemphasising the technology in development. First, the macro-level actors (e.g., government) impose the ICT implementation without significant effort to understand the grassroots’ condition (Avgerou 2008; Madon et al. 2007; Sahay 2016). The case of MCTS shows that the off-track project is caused by a top-down initiative from the government that neglects the condition or needs of the actors at the bottom (frontline health workers). As Sahay (2016) states, “while huge technology-based investments were made, simple needs of the field nurse like better travel support and new registers were practically ignored” (p. 174).

Second, overemphasising the technology causes its isolation from their environment which leads to the failure in considering a holistic perspective of the ICT4D (Hayes and Westrup 2012; Madon et al. 2007; Njihia and Merali 2013). The environment comprises not only supporting infrastructure to operate the system (e.g., power and internet) but also complementary resources such as IT Human Resources (knowledge and skill) and intangible resources (e.g., management, culture, job certainty) (Bharadwaj 2000; Melville et al. 2004). Further, the project of MCTS disoriented its objective from *transforming* the nation’s health

service to the *adoption* of an advanced surveillance system. While both objectives might work simultaneously, the priority should be balanced between the government's goals, contextual settings, and expectations of the context's requirement or the local actors (Sahay 2016).

Therefore, there is a need to extend ICT4D research beyond the adoption, adaptation, or acceptance to a holistic perspective of ICT4D (Walsham and Sahay 2006). Notable ICT4D scholars have suggested that the challenge of ICT in developing countries is no longer the diffusion of infrastructure or communication technologies, but how ICT transforms and improves the social system with incisive outcomes (Walsham 2012). Overemphasising the technology in ICT4D, including the diffusion, adoption, acceptance, and the rate of ICT investment, creates a misnomer that the development in ICT4D corresponds with the degree of ICT resources acquisition (e.g., Dedrick et al. 2013; Riffai et al. 2012; Venkatesh and Sykes 2013). This causes a further misconception which is commonly referred to as the deterministic perspective of ICT for development (Alcaraz et al. 2012; Sahay 2016).

The discussion above implicates the needs to shift the focus of ICT4D from the domain of technology to the domain of the context so the researcher can have a systematic view of how ICT contributes to societal development (Avgerou 2008; Madon 2000; Walsham et al. 2007; Walsham and Sahay 2006). The development of the society is a complex process involving multiple factors such as the social structure and practices, multi-actors' interaction, and actors' attitude toward changes (Chaudhuri 2012; Hayes and Westrup 2012). Accordingly, employing a systematic perspective allows scholars to have a holistic depiction of the social system and to investigate its changes by means of ICT. In this regard, the notion of *ecosystem* is adopted (Lusch and Nambisan 2015) to depict the complex context (i.e., public health) considered in this study.

1.3 Research focus

1.3.1 Focus and positioning of the study

The focus of this study is defined through three aspects: the context of ecosystem, ICT artefacts, and the epistemological stance on ICT and social structure.

The context of ecosystem—This study selects public health *service ecosystem*. The notion of the service ecosystem as the theoretical construct extends the healthcare research that traditionally focused on the dyadic relationship between the service provider and service customer (Frow et al. 2016; Pop et al. 2018). Thereby, the context of public health provides a

proper representation of service ecosystem due to diverse types of actors involved, namely, the *providers, receivers, controller, and supporters* of service provision (Mantzana et al. 2007). These actors span across different *levels of ecosystem* from micro-level to macro-level (Frow et al. 2016). Dyadic interactions between health workers in a Primary Health Care (PHC) and the focal patients occur at the *micro-level* of healthcare ecosystems. The PHC is managed by district-level health government at the *meso-level*, which may be working together with the local professional association, technology vendors, or health insurers. At the *macro-level*, the central government is working with regulatory bodies and medical association to monitor and improve the overall ecosystem.

ICT artefacts—Health Information Systems (HIS) are selected as the ICT artefacts in the service ecosystem. HIS for public health are embedded in the interconnected network of multilevel social systems, spanning diverse ICT resources across multiple actors and institutions. In this regard, studying service ecosystems, as a theoretical construct, offers a systemic perspective of the role or impact of ICT enabled transformation. For example, in an instance of an excellent medical service provision that uses Electronic Health Record (EHR), the benefit gained from the better clinical decision is not only perceived by the micro-level actors (e.g., the patients) but also by the actors at district-level (e.g., officer or system administrator) who collect data and control the local practices. In the long run, the central government will have more valid data that enable data-based healthcare program planning. Consequently, a more comprehensive understanding will be obtained about the holistic impact of the introduction of specific ICT artefacts.

The epistemological stance on ICT and social structure—This study takes a stance that the institutional structure of the ecosystem (i.e., the society) is transformable (Bhaskar 1975; Giddens 1984; New 1994). The institutional structure of social system is dynamic and continuously changing, due to any disruptions emanated from the internal system (e.g., change of market, new regulation, incremental innovation, or social shift) or external factor (e.g., disruptive innovation) (Mignerat and Rivard 2009). Another source of change is the emerging role of *institutional entrepreneurs* (Powell and DiMaggio 1991) who mobilise resources or control financial and institutional policy based on their higher social position (Fligstein 1997).

The dynamic of ecosystem structure can be observed by looking at the constellation of resources and the institutional rules, which are manifested in the actors' enactment of practices (Giddens 1984; Orlikowski 2000). Accordingly, studying the HIS enabled

transformation of service ecosystem basically corresponds to investigating how the components of social structure (rules, resources, actors, and practices) change and transform following the deployment of HIS. As such, the researcher takes the ecosystem's structure as the focus of studying ICT enabled transformation which minimises the tendency of deterministic perspective of technology in ICT4D. Indeed, the deterministic perspective of technology undermines the dynamics of actors as well as the contextual settings. This dynamic includes the relationship between technology and actors which are continuously changing over time (Bhaskar 1975).

1.3.2 Research questions

The notion of 'transformation' is chosen in this study to emphasise that this study looks at both *process* and *outcome* of HIS introduction to service ecosystem's structure. Next, this study adopts the notion of a service ecosystem to emphasise the complex multi-actors' involvement in ICT4D as well as the role of social structure. Finally, this study considers the 'introduction' of HIS rather than the 'adoption' of HIS to clarify its positioning that this study focuses on the dynamics within the service ecosystem by means of HIS introduction rather than on HIS adoption decision. As such, this positioning is appropriate for addressing the need to extend the 'technology adoption' research in the ICT4D literature (Walsham 2017; Walsham and Sahay 2006).

Therefore, the broad research question of this study is:

How is the institutional structure of service ecosystems transformed following the introduction of HIS?

To address this broad research question, this study investigates the *mechanisms* of ecosystems' transformation and the *impact* of HIS introduction on the service ecosystem's structure. The overarching research question hence has two sub-questions:

1. *What are the underlying mechanisms of institutional transformation in the service ecosystems following HIS introduction?*
2. *What are the impacts of HIS introduction on the institutional structure of service ecosystems including actors' institutional logics, rules, resources, and practices?*

1.4 Research methodology

1.4.1 Research context

The study context of this thesis is the Indonesian public health ecosystem. Indonesia implements a decentralised socio-political system. With this system, the central government still has substantial power toward district government through standards, regulation, budgetary, and monitoring, while also provides all districts with a higher level of autonomy to manage governance and management of their socio-economic activities based on their settings, characteristics, strengths, and weaknesses (Rahmatunnisa 2015). The country is on an emerging state of public health transformation. It has implemented HIS initiative intensively in the last decade and it is estimated that a complete integrated system will be achieved by 2025. This context provides a fruitful and appropriate ground for this study since it offers: 1) an opportunity to investigate the broader perspective of service ecosystems through a multilevel investigation of HIS enabled transformation at macro, meso, and micro-level, 2) potential retrospective data sources regarding the past, current, and future state which represents the process of transformation, and 3) an open but regulated context of actors, diverse types of ICT resources, and institutional settings which are continually changing throughout the time. This study examines the macro-level which is represented by the Ministry of Health (MoH) and other related actors (e.g., WHO representative, IT consultant, academics, software vendors). Then, the embedded cases are represented by three different districts, in which meso-level is represented by the health district government and the micro-level is represented by Primary Health Care. The retrospective data of various HIS initiatives and transformation process are scoped from 2008 – 2017. Looking at various initiatives across the timeline in a retrospective way allows the researcher to examine the change and shift of actors and their relationship with the technology, as well as to maintain the consistency in studying the ecosystems rather than the ICT resources.

1.4.2 Data collection

The primary data collection techniques are interview and observation. A total of 36 interviews (32 individuals, 4 group interviews) was conducted, distributed almost evenly to the three districts, each of which lasted from 30 to 60 minutes. The interviewees ranged from program managers in selected divisions in district health government, data & information staff, officers, doctors, midwives, nurses, and patients. Observations were conducted on both routine (e.g., day-to-day operations and weekly meetings) and incidental events (e.g., training

and workshops) where the researcher's role was a complete observer. A total of 10 events (approximately 89 hours) were observed, producing field notes, photographs, and videos. The data collection process was conducted through a field study over six months from October 2017 to March 2018, during which the researcher directly involved in social activities as a way to have the "sensitivity to contextual metadata" in a qualitative study (Trauth 1997, p. 234).

1.4.3 Data analysis

Interview records and field notes were transcribed, translated, and then analysed. First, the sequence of events was identified and established, framed by four items: regulation, organisation, operation, and ICTs. These process diagrams (Langley 1999) helped the researcher to reflect the 'instances' of HIS introductions and their relationship with other events. Second, using nVivo 11 as the CAQDAS tool, the interviews were coded and analysed based on Miles et al.'s (2014) guideline for analysing qualitative data. Next, a series of qualitative textual data coding was conducted, followed by within-case and cross-case analysis to build comprehensive explanations of the emerging themes. Further samples of 'instances' were identified and combined with the results from step one, which produced the generative mechanisms of transformation. The emerging themes from within-case and cross-case analysis produced the contingencies of mechanisms and the impacts of HIS introduction on the structure of service ecosystems. The rigour and reliability of the research were established by adhering to the principles of reliability outlined by Yin (2018), maintaining dialogical reasoning (Klein and Myers 1999), and applying abduction-retroduction approach (Wynn and Williams 2012) for theoretical building validity.

1.5 Overview of the study's findings

This study reveals the mechanisms of transformation which explain how the ecosystem's structure changes following the introduction of HIS. The analyses identify two institutional forces that trigger the transformation, namely, coercive and agency-driven institutional forces. Three generative mechanisms are identified, namely, adoption and incorporation mechanism, breaking and making mechanism, and self-reinforcing mechanism. The contingencies of each mechanism are identified respectively. This study suggests that the institutional forces are merely the catalyst of transformation, while the outcomes of ICT enabled transformation depend on the generative mechanism of ecosystem's structure. While the source of initiative may come from either the central government or local actors, the subsequent transformation

process inevitably involves the same structural components. Based on these findings, two pathways of ecosystem's transformation are proposed: *enslaving* and *emergence pathways*.

The impact of the HIS introduction is investigated through the structural components of ecosystem: resource configuration, institutional rules, institutional logics, and practices. The relationship between HIS introduction and the transformation of each component is analysed, which suggests that each structural component changes in a distinct or unique sequence following HIS introduction. Further analysis reveals the specific role of practices in the process of ecosystem's transformation. The enactment of practices exercises and reinforces the ecosystem's structure, especially institutional rules and institutional logics, that determines the outcome of transformation.

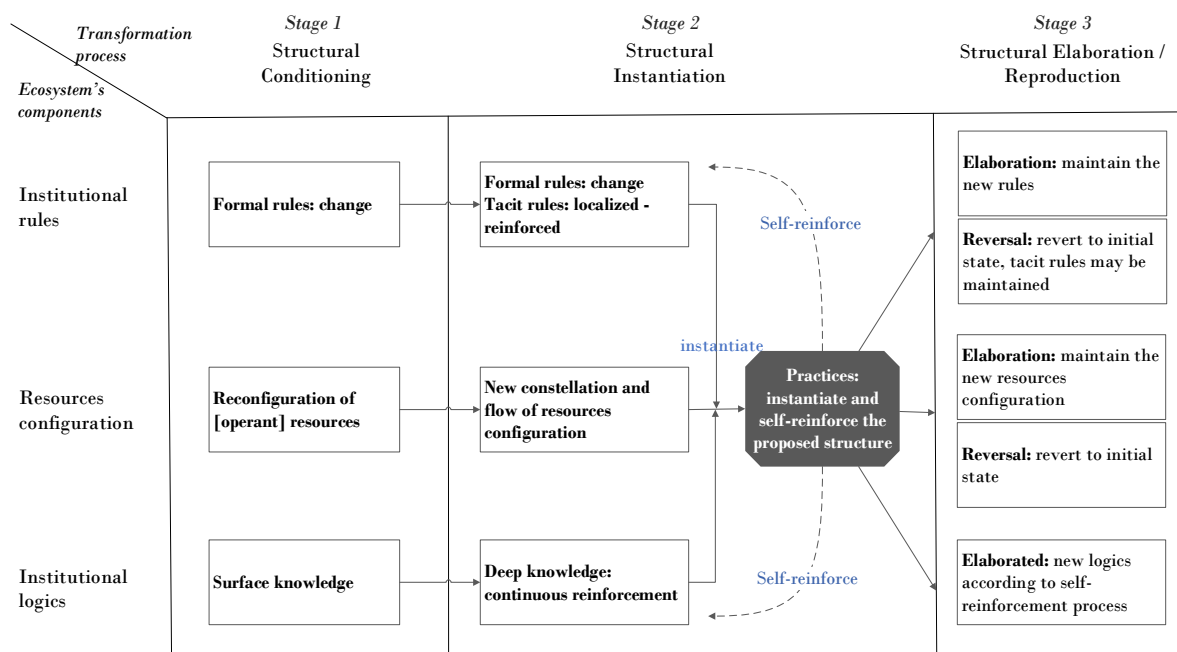


Figure 1-1 Stages of the transformation of service ecosystems' structure

Drawing on critical realist's three stages of social change (Archer 1995; Volkoff et al. 2007), this study proposes a model of HIS enabled transformation of service ecosystems (Fig. 1-1). The first stage, *structural conditioning*, depicts the initial structural activity in the ecosystem, particularly how the material components, such as resources or rules of the structure, respond to the institutional forces. The second stage, *structural instantiation*, delineates the way these structural components interact through the enactment of practices. At this stage, the practices are represented as the 'performative aspect' of a social system that instantiate the logics, rules, and resources as well as reinforce such structure. The last stage describes the outcome of structural instantiation, *structural elaboration* (i.e. transformation) as the successful outcome

or structural reversal as the unintended (i.e., failed) outcome, which explains the diverse outcomes of the transformation process.

This study contributes to both ICT4D and service literature. To the ICT4D literature, the pathways of transformation may offer a consolidation to the debate between top-down approach and bottom-up approach in the ICT4D literature (Boateng et al. 2008; Braa et al. 2007; Diniz et al. 2014; Leong et al. 2016; Madon 2005; Mahdi and Dawson 2007; Ramadani et al. 2018). Specifically, ICT enabled transformation is not solely determined by the agency who triggers the transformation, such as resourceful actors (e.g., donors) (Thompson and Walsham 2010), policymakers (Silva and Figueroa 2002), or social entrepreneurs (Srivastava and Shainesh 2015), but rather by the way the ecosystems' structure is exercised and established. Apart from this, the enslaving pathway contributes to our understanding of the reason for numerous failures of the top-down technological transfer in a complex context (Aanestad and Jensen 2011; Gera et al. 2015; Hayes and Westrup 2012; Madon et al. 2007; Sahay 2016), while the emergence pathway complements those earlier ICT4D studies highlighting importance of inclusion, engagement, and empowerment of the societal groups rather than simply pursuing technology advancement (Díaz Andrade and Doolin 2016; Walsham 2012).

To the service literature, this study offers new insights into the origins and lifecycle of practices and how they emerge in the ecosystem (Chandler et al. 2019; Lounsbury and Crumley 2007). This insight sheds light on the dynamic and evolving nature of ecosystem's structure that we have not adequately understood (Pohlmann and Kaartemo 2017). This study also presents empirical insights into the interplay between value co-creation practices with the structural viability of service ecosystems (Beirão et al. 2017; Frow et al. 2016; Peters 2016), especially on the importance of adequate change on institutional rules, resources, or actors' institutional logics in practices enactment.

1.6 Thesis structure

As shown in Fig 1-2 below, this thesis is structured as follows. Chapter 2 presents the literature review on the research field and the analytical lenses. The body of knowledge of Information Communication and Technologies for Development (ICT4D) is reviewed, followed by the identification of key research gaps in this field. This chapter then proceeds with a literature review and conceptual foundations of two analytical lenses: Service

Dominant Logic to conceptualise the public health service ecosystem, and generative mechanism to conceptualise the dynamics of service ecosystem's structure.

Chapter 3 presents the research methodology and design. It presents the study's philosophical stance, followed by the process and techniques of data collection, analysis, interpretation of findings, and how research rigour and validity are maintained throughout the study.

Chapter 4 presents the study's findings. It starts with the contextual background of the ecosystem studied in this research, including an overview of macro-level ecosystems, contextualisation of the institutional structure of the context (healthcare in Indonesia), and the background of the three selected districts. The chapter then describes the institutional forces, generative mechanisms, and the enabling/constraining factors of each mechanism. Finally, the chapter explains the impact of HIS introduction on the institutional structure of service ecosystems.

Chapter 5 discusses the interpretations of the findings to develop theoretical arguments and address the research questions. It consists of interpreting the impact of HIS introduction and the mechanism of HIS enabled transformation, and revisiting the research objectives. The chapter then discusses how the study's findings contribute to the ICT4D and service literature.

Chapter 6 presents a summary of the study. The chapter is concluded by explaining the study's limitations and future research avenues.

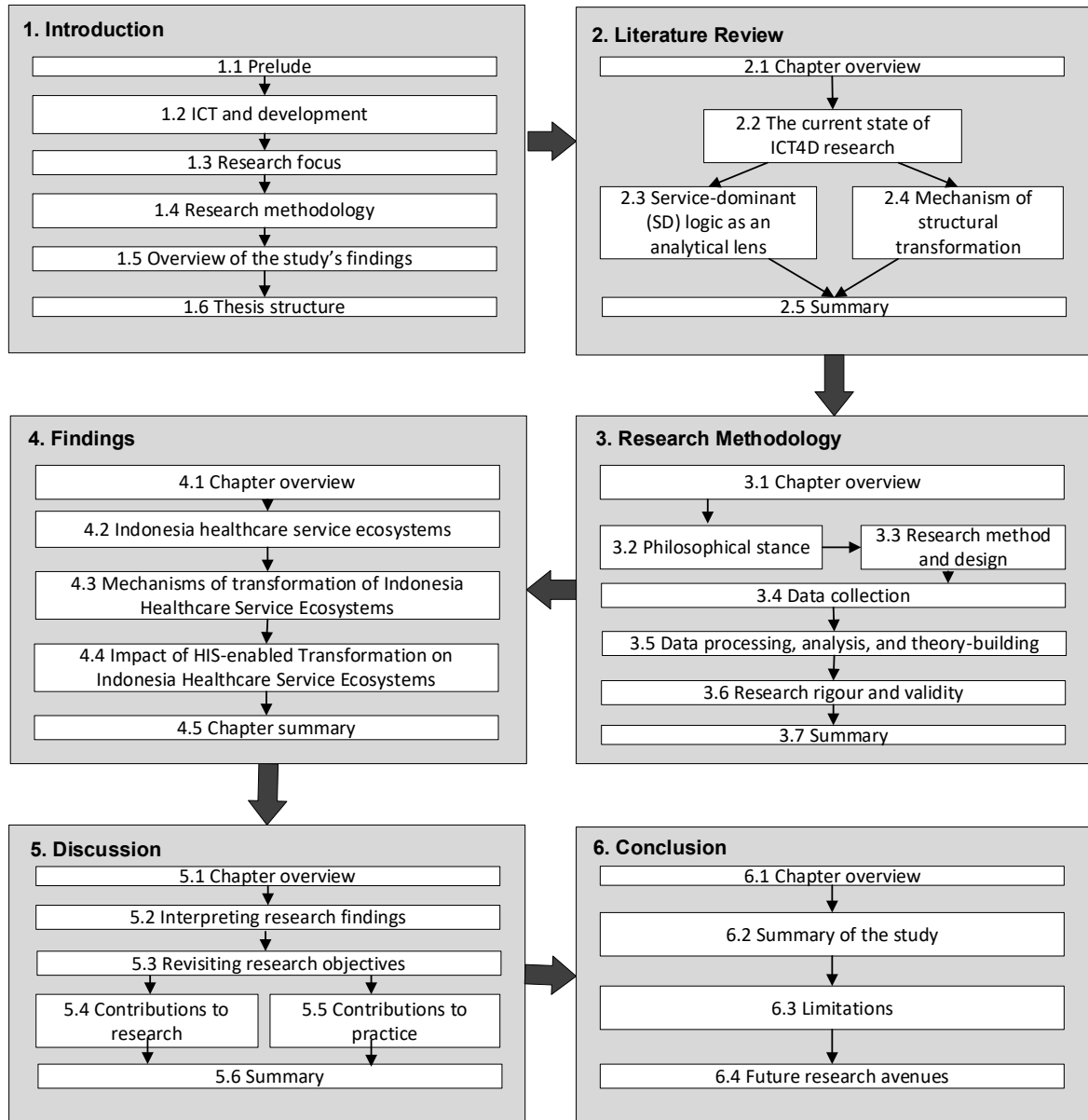


Figure 1-2 Thesis structure

2 Literature review

2.1 Chapter overview

This chapter reviews the body of knowledge of ICT4D to examine the landscape, the current progress of the field, the pertinent research gaps that motivate the present study, and the analytical lenses used to guide the analysis. The chapter is organized as follows.

Section 2.2 presents a systematic literature review on the three streams established in ICT4D research, which consists of general characteristics of each stream, the strengths and weaknesses of each stream, and the research gaps and challenges currently exist within the field. Then, the theoretical foundations from Service Dominant (SD) Logic are discussed (Section 2.3) as the analytical lens of this study to address the knowledge gaps identified from the literature review. Section 2.4 presents the theoretical foundations on the mechanism of structural transformation which serve as the second interrelated analytical lens used to analyse the dynamic of the ecosystem. Section 2.5 provides a summary of the chapter.

2.2 The current state of ICT4D research

2.2.1 Background

In the early years, ICT4D research was largely influenced by Rogers' (1962) Diffusion of Innovation (DOI) (Unwin 2009). Rogers explicated the diffusion as dissemination of innovation through certain channels until the social actors adopt such innovation and reach a stage so-called *the confirmation point*. IS literature adopted DOI's concept through Davis's (1989) Technology Acceptance Model (TAM), which was later extended to the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al. 2003). Though these theories are quite popular in the ICT4D literature, the nature of these theories are subject to criticism especially in the context of developing countries (Brown and Thompson 2011; Sahay et al. 2013). The central argument of this standpoint is the 'spreading' nature of innovation which implies the deterministic perspective of technology in socio-economic development in developing countries. Because the primary approach used in this stream is to measure members' response (e.g., acceptance, perception, use, experience), the role of the society is considered passive at a certain level. Further, the way these studies capture an

understanding of innovation in society is considered too instant that the research outcomes have limited explanations about the context to assess the likelihood of project sustainability (Sahay et al. 2013).

Indeed, there is growing discontent in such a standpoint since the interactions between social system and technology are widely regarded as bidirectional, rather than linear and deterministic (Brown and Thompson 2011; Hayes and Westrup 2012; Mengiste and Aanestad 2013; Sahay et al. 2013). A new standpoint emerges in the field that attempts to leverage the importance of understanding the social context in ICT4D research and observing its interplay with the technology. Further, in some cases, the role of social context could even be the determinant of the technological innovation particularly in the vulnerable groups who desperately need technology assistance for specific purposes, such as poverty reduction (Urquhart et al. 2008) or social inclusion (Díaz Andrade and Doolin 2016). The significance of social context later invited a new wave of ICT4D research.

Based on the preceding discussions, Avgerou (2008) classified ICT4D research into three streams: 1) technology transfer (how to catch up with advanced technology in developed countries), 2) social-embeddedness (how to construct new socio-technical structures), and 3) transformative ICT4D (how to create possibilities for marginalised groups). Table 2-1 presents Avgerou's classification of ICT4D research.

Table 2-1. ICT4D research streams (based on Avgerou (2008))

Streams	Description	Focus of the studies	Major theoretical lenses
Technology transfer	Catching up with the advanced technology in developed countries through transfer and adoption	Seeks to find the relevance of established IS research knowledge and good practice models (e.g. methods, analytical approaches, or theories) and adaptation in developing countries context	DOI, TAM, UTAUT, or established IS concept or best practices such as organisational change and IS management
Social-embeddedness	Constructing new socio-technical structures according to the given local social context and the constellation of actors	Seeks to comprehend the social situation where the technology takes place adequately	Social science rooted theories: Actor-Network Theory, institutional theory, complexity, social network
Transformative ICT4D	Creating possibilities for the improvement of living conditions in a marginalised group with deep socio-economic change	Focuses on the mechanism of leveraging the social context either by solving the vulnerabilities or by improving capabilities through the implementation of ICT	Human capital theories such as Coleman's social capital or Sen's Capability Approach

2.2.2 Methods of literature review

To gain a better understanding of the current state of ICT4D research, a systematic literature review was conducted. The literature review was conducted on ICT4D studies published in top-ranked IS journals in the last decade (2007-2019), from which 62 articles were selected. An in-depth analysis was performed through the selected articles, which was framed by Avgerou's three streams of ICT4D research. The researcher identified the characteristics of each stream (theoretical lenses, research methodology and level of analysis) as well as other components such as the demographics of studies, ICT artefacts, and research context.

The source pools were all eight IS senior scholar basket of journals (European Journal of Information Systems, Information Systems Journal, Information Systems Research, Journal of AIS, Journal of Information Technology, Journal of Management Information Systems, Journal of Strategic Information Systems, MIS Quarterly) and other notable IS outlets; Decision Support Systems, Information and Management, Information and Organization, and International Journal of Medical Informatics. To expand the source selection, other Q2-ranked IS journals based on SCImago journal indicator that publish ICT4D research were selected: Information Technology and People, Information Systems Frontiers, International Journal of Information Management, and The Information Society.

A combination of the search was performed using Scopus citation database by several keywords combinations of 'information technology', 'information systems', 'information and communication technologies', 'ICT', 'developing countries', and 'least developed countries'. In addition, some similar terms with ICT4D were used in searching process, which are ITID—Information Technologies and International Development (Dodson et al. 2013), ISDC—Information Systems in Developing Countries (Avgerou 2008), ICTD—Information and Communication Technologies for development (Avgerou 2010; Gomez 2013; Kenny 2014), and LSD—Least Developed Countries (Imran and Gregor 2010; William 2003). The combination of these keywords also considers the aforementioned duality of ICT4D studies by Brown & Grant (2010): ICT 'in developing countries and ICT 'for development'. Table 2-2 shows the keyword combination used in screening the articles.

Table 2-2. Keyword combinations

<i>ICT 'in Developing Countries'</i>			<i>ICT 'For Development'</i>	
<i>Title-Abstract-Keywords</i>				
"information system*", "information technolog*", "information and communication technolog*"	AND	"developing countr*", "least developed countr*"	OR	ICT4D, ICTD, ISDC, ITID

The identified articles were verified by reading the title, abstract, followed by full-text reading when the initial analysis of streams was conducted. The criteria of article exclusions are inductively established during the selection process as follows. Studies whose contributions are not in the ICT4D or leaning heavily to other topics were removed. Most of these excluded articles focus on software-systems development, knowledge management, strategic IS, or other disciplines such as the economy, development studies, and sociology. Next, the articles that do not focus on bridging the ICT and development in developing countries were omitted. In some cases, although the papers reported ‘in developing countries’ work, if the contribution of these articles is mainly outside the ICT4D field or general IS literature then they were excluded. Then, the most difficult part was to justify the suitability and relevance of the papers with the characteristics of the three discourses mentioned earlier. Many reviews or conceptual papers were omitted. The final dataset (62 articles) for further analysis was achieved after several rounds of reading and screening. The next section presents the results from the analysis the final dataset.

2.2.3 Streams of ICT4D research

Figure 2-1 presents the distribution of studies found in each of the three ICT4D streams. From homogenous data, technology-transfer stream dominated the field within the past decade (34 articles), followed by social-embedded stream (20 articles) and transformative stream (8 articles). This result confirms the relatively similar types of ICT4D research (Gomez 2013; Roztocki and Weistroffer 2009). Gomez (2013) highlights that in specialised ICT4D outlets, the *top-down approach* dominates the literature three times as much as the *bottom-up approach*. He defines the top-down approach as an ICT4D initiative where externally-defined solutions are enforced to be locally implemented, which resembles the Avgerou’s technology-transfer stream. On the other hand, with bottom-up approach, the local stakeholders have more influences in problem definition and articulation of solutions, which resembles the social-embeddedness stream.

An in-depth analysis of each stream is presented next to identify the characteristics, strengths and weaknesses.

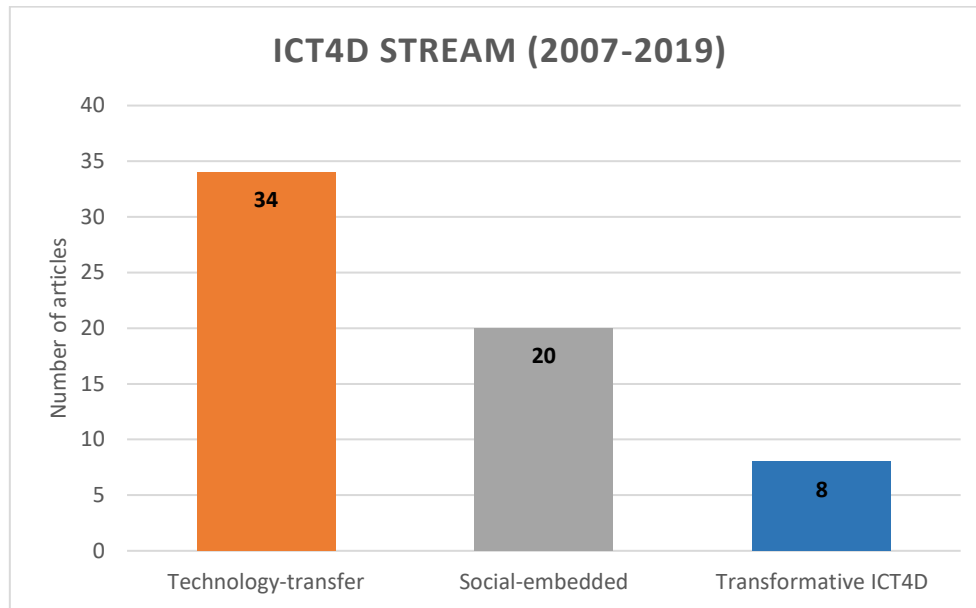
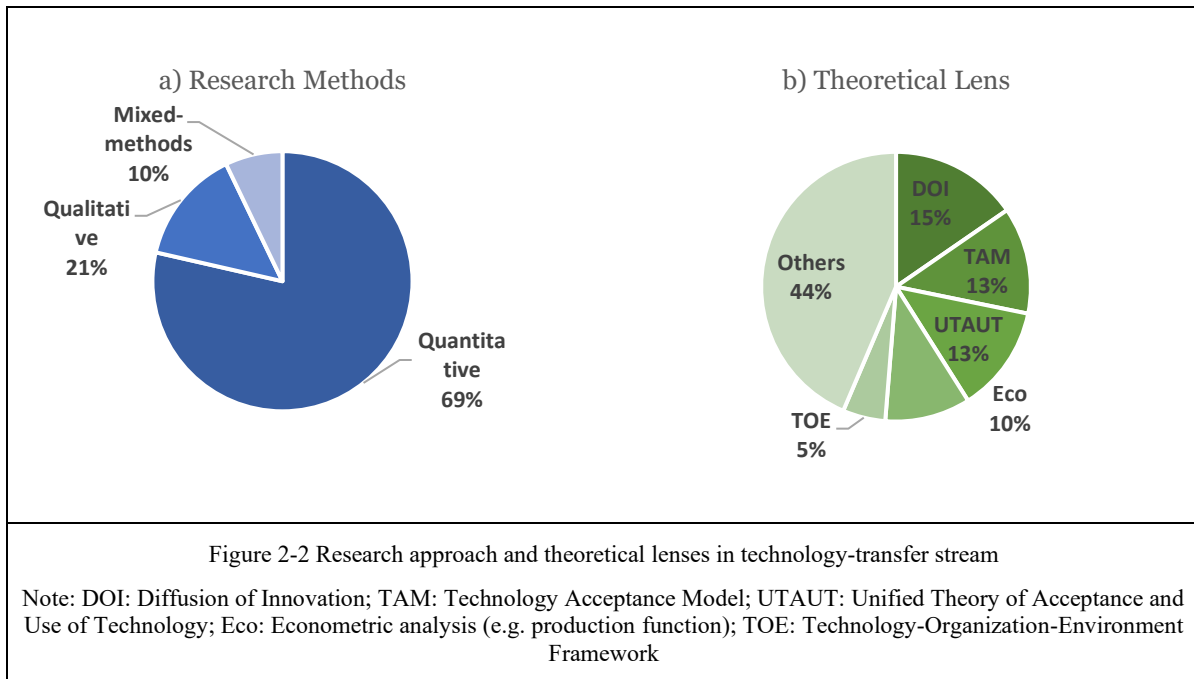


Figure 2-1 ICT4D streams in the past decade

2.2.3.1 Technology-transfer ICT4D

General overview

Despite the criticism on this traditional stream, the technology-transfer still dominates the field. This stream is considered useful in communicating ICT4D projects to non-IS entities in the macro-level such as vendors, NGOs, and government. Generally, the studies in this stream present the use and acceptance of the users' population as research outcomes or utilise econometric measurement on ICT impact for a prevalent conclusion. This sort of findings is, of course, more conclusive and definitive by the business, NGOs, or policymaker in macro-level rather than qualitative elaboration from bottom-level implementation. From researchers' perspective, the theoretical lenses, such as Roger's (1962) Diffusion of Innovation (DOI), the IS adoption theories such as Technology Acceptance Model (TAM) (Davis 1989) and the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al. 2003) offer practical guidelines for scholars. As shown in Figure 2-2, these theories have been widely used in the literature in the last ten years. The rest of the articles in this stream either developed their framework or used previously published models, such as Perceived eReadiness Model (Tan et al. 2007; Tan and Ludwig 2016), or Human-Organization-Technology fit model (Lian et al. 2014). In most cases, the authors use a broad perspective from development studies or digital divide as the theoretical lens of their ICT4D studies (Boateng et al. 2008; Madon 2000; Prakash and De' 2007; Spletstoeser 1998).



Overall, the majority of the studies in this stream utilise quantitative inquiry to investigate the phenomena of new ICT adoption in developing countries. The scholars conducted a survey involving users (citizen, consumer) (Alomari et al. 2012; Masters 2008; Mirchandani et al. 2008; Rana et al. 2015; Venkatesh et al. 2014) or company representatives (managerial or C-level) (Gupta et al. 2008; Kijisanayotin et al. 2009; Lee et al. 2011; Lian et al. 2014; Okoli et al. 2010; Tan et al. 2007) to get broad understanding of user perception, technology use, and organisations' readiness for the new ICT systems. These studies aimed to engage with introduction and penetration of new technology in developing countries such as Executive Information Systems (Arnott et al. 2007), public ICT (libraries, telecentre, cybercafes) (Gomez and Gould 2010), internet banking (Riffai et al. 2012), cloud computing (Lian et al. 2014; Sabi et al. 2016), e-government (Alomari et al. 2012; Gupta et al. 2008; Mirchandani et al. 2008; Rana et al. 2015; Venkatesh et al. 2014; Zarei and Ghapanchi 2008), and e-commerce (Datta 2011; Kurnia et al. 2015; Tan et al. 2007). Other topics found are the investigation of the availability of supporting systems in country-level to provide platforms for new ICT systems, such as national infrastructure and ICT policies (Dewan et al. 2010; Meso et al. 2009; Okoli et al. 2010) and human resources (Adam and Urquhart 2009). Several econometric analyses linking IT investment and performances (e.g., productivity or economic outcomes) were also identified in this stream (Dedrick et al. 2013; Lee et al. 2011; Meng and Lee 2007).

Strengths and weaknesses of technology-transfer stream

The strength of technology-transfer studies is their effectiveness in presenting a conclusive report about ICT4D projects to non-IS entities in the macro-level (e.g., vendors, NGOs, and government), as the study's findings are primarily about the degree of users' acceptance and general impact of ICT adoption. A study with a conclusion that ICT investment directly improves productivity in developing countries might be more expected by non-IS entities (Dedrick et al. 2013; Dewan et al. 2010; Lee et al. 2011). Similarly, a study that hypothesises the quality of web-design affects the consumer's intentions to use the e-banking (e.g. Riffai et al. 2012) may be important for vendor/developer.

However, technology-transfer stream is also somewhat limited because only measuring users' perception toward ICT without deeply investigating other stakeholders' concerns might fail to reveal any possible conflicting situation (e.g., government's support, resources availability) that hinders successful adoption (Currie and Guah 2007; Findikoglu and Watson-Manheim 2016; Madon et al. 2007). This is prevalent since most studies in this stream limited their analysis to a single level (see Table 2-3 for a full list of the studies). Further, the studies in this stream offer inadequate explanations about the distinct characteristics of developing countries which determine the likelihood of project sustainability (Braa et al. 1995; Sey and Ortoleva 2014). The analytical lenses, which are mainly based on technology-deterministic theories (DOI, TAM, UTAUT), economic value perspective (e.g., Transaction Cost Economic, production value), or software engineering perspective, are not designed to engage with deep socio-technical exploration (Madon 2009; Walsham 2017).

Furthermore, the domination of technology transfer research stream might be responsible for the persistence of a debate regarding conceptualizing "development" in ICT4D (Heeks 2010; Qureshi 2015; Sahay 2016; Walsham 2012; Zheng et al. 2018). The development in this stream is frequently associated with instrumental targets achievement, since this stream focuses on ICT adoption and its direct impact based on instrumental measures (Zheng et al. 2018), such as productivity and cost-efficiency (Dedrick et al. 2013; Lee et al. 2011). On the other hand, there has been an increasing proposition to define "development" in ICT4D as societal transformation, much similar to social-embeddedness which acknowledges the complex social factors influencing the development that objectively put the ICT as embedded disruption of natural social evolution (Avgerou 2010; Heeks 2010).

Table 2-3 Technology-transfer ICT4D studies 2007-2019

Article	Analytical Lens	Research approach	Level of Analysis	ICT	Research Context	Country
(Meng and Lee 2007)	Catch-up theory	Quantitative	Country	Total investment in ICT	Firms' IT investments	China
(Arnott et al. 2007)	Systems development	Qualitative	Organisation	Executive Information Systems (EIS)	EIS in case of four companies in Thailand	Thailand
(Tan et al. 2007)	Perceived eReadiness Model	Quantitative	Organisation	E-commerce	B2B in SMEs	China
(Mahdi and Dawson 2007)	Organisational change	Mixed	Multilevel	General classification of ICT	Introduction of e-banking in Sudan	Sudan
(Mirchandani et al. 2008)	Diffusion of innovation (DOI); Technology Acceptance Model (TAM)	Quantitative	Individual	E-government	Perception toward e-government	Thailand, Indonesia
(Zarei and Ghapanchi 2008)	System architecture	Qualitative	Organisation	E-government	G2G public administration	Iran
(Gupta et al. 2008)	Unified Theory of Acceptance and Use of Technology (UTAUT)	Quantitative	Organisation	E-government	E-Government adoption	India
(Masters 2008)	Diffusion of Innovation (DOI)	Quantitative	Individual	Internet	Use of internet by General Practitioners	South Africa
(Kuriyan et al. 2008)	Systems development	Qualitative	Community	Computer kiosk	Introduction of computer kiosk	India
(Park et al. 2009)	Technology Acceptance Model (TAM)	Quantitative	Organisation	Digital library systems	Digital library in various institutions	Survey toward Africa, Asia, and Latin America
(Lin 2009)	Process and Production Function (Value Analysis)	Quantitative	Country	Total investment in ICT	IT expenditure at country level	Group of Developing Countries according to OECD
(Meso et al. 2009)	National Information Infrastructure (NII)	Quantitative	Country	National Information Infrastructure (NII)	National information infrastructure	Middle and low income countris by World Bank and UNDP
(Kijisanayotin et al. 2009)	Unified Theory of Acceptance and Use of Technology (UTAUT)	Quantitative	Organisation	Health Information Systems	ICT in the community health centre	Thailand

Article	Analytical Lens	Research approach	Level of Analysis	ICT	Research Context	Country
(Dewan et al. 2010)	Diffusion of Innovation (DOI)	Quantitative	Country	PC; internet; computer	Computer and internet expenditure	Group of Developing Countries according to OECD
(Okoli et al. 2010)	Information Technology Transfer (ITT)	Quantitative	Organisation	E-Business; E-Commerce	ICT infrastructure and e-Business	Latin & Sub-Saharan
(Gomez and Gould 2010)	Own framework	Mixed	Individual	Public access computer	Public ICT-internet café, library, internet centre	25 countries (online survey)
(Datta 2011)	Diffusion of innovation (DOI); Technology Acceptance Model (TAM)	Quantitative	Multilevel	E-commerce	Surveys on 172 users on e-commerce	172 users from 37 countries
(Lee et al. 2011)	Process and Production Function (Value Analysis)	Quantitative	Organisation	Computer	IT investment in firm-level	China
(Pick and Azari 2011)	Process and Production Function (Value Analysis)	Quantitative	Country	General classification of ICT	Use of internet, PC, and mobile phone	55 developing countries according to World Bank
(Riffai et al. 2012)	Unified Theory of Acceptance and Use of Technology (UTAUT)	Quantitative	Individual	Internet banking	Adoption of online banking	Oman
(Alomari et al. 2012)	Diffusion of innovation (DOI); Technology acceptance model (TAM)	Quantitative	Individual	E-Government	Citizen perceptions toward e-government	Jordan
(Dedrick et al. 2013)	Process and Production Function (Value Analysis)	Quantitative	Country	Total investment in ICT	Computer and internet expenditure	Group of Developing Countries according to OECD
(Venkatesh and Sykes 2013)	Social network	Quantitative	Community	Internet kiosk	Hospital's adoption of cloud computing	Taiwan
(Lian et al. 2014)	TOE (Technology-Organization-Environment) framework; HOT-fit (Human-Organization-Technology fit) model	Quantitative	Organisation	Cloud computing	Use of government portal by rural citizens	India
(Venkatesh et al. 2014)	Personality theory	Quantitative	Individual	E-government	Citizen perceptions toward e- government	India

Article	Analytical Lens	Research approach	Level of Analysis	ICT	Research Context	Country
(Rana et al. 2015)	Unified Theory of Acceptance and Use of Technology (UTAUT)	Quantitative	Individual	E-government	B2B e-commerce adoption	Indonesia
(Kurnia et al. 2015)	Multi-theories: TOE (Technology-Organization-Environment) framework; Institutional Theory; National Culture Theory (NCT); Resource Dependence Theory (RDT); Diffusion of Innovations (DOI)	Qualitative	Organisation	E-commerce	Cloud computing in universities	Several countries in Sub-Saharan Africa region (not mentioned in detail)
(Sabi et al. 2016)	Technology Acceptance Model (TAM)	Quantitative	Organisation	Cloud computing	Public ICT-internet café, library, internet center	25 countries (online survey)
(Ahmad and Khalid 2017)	Technology Acceptance Model (TAM)	Quantitative	Individual	mGovernment	Government: mobile app for government	UAE
(Hoque and Sorwar 2017)	Unified Theory of Acceptance and Use of Technology (UTAUT)	Quantitative	Individual	mHealth	Healthcare; mHealth system	Bangladesh
(Wang et al. 2019)	A framework on top-management support	Quantitative	Organisation	Cloud computing	Adoption of cloud computing in firms	China
(Imran and Gregor 2019)	IT mindset related to IT adoption	Mixed	Individual	General classification of ICT including e-Gov	IT mindset of government officials in public sector	Bangladesh
(Tassabehji et al. 2019)	Contingency value approach	Quantitative	Individual	e-Government	Use of digital public services by individuals	Ethiopia, Nigeria, South Africa
(Mlay and Sabi 2019)	Framework on ICT intervention and individual habits	Quantitative	Individual	General classification of ICT	ICT usage of university students	Uganda

2.2.3.2 *Social-embedded ICT4D*

General overview

In general, social-embedded studies attempt to resolve the lack of in-depth explanation of the social context of ICT4D in technology-transfer stream. Some of the studies in this stream focus on exploring the micro-level characteristics such as infrastructure, level of literacy, or language barriers, and then propose a bottom-up solution of ICT (Barjis et al. 2013; Dey et al. 2011). Other studies extend the bottom-up approach by exploring micro-level and macro-level characteristics simultaneously to explore the tangled relationship, hierarchical positions, interests, and concerns of all stakeholders (Madon et al. 2007; Mengiste and Aanestad 2013). Table 2-4 presents a full list of the studies.

Consequently, studies in this stream broaden the scope of analysis especially by linking the social context situation at micro-level with related actors' interests at macro-level by conducting multilevel unit of analysis. This approach is significant because it considers multi-actors concerns toward ICT introduction to reveal whether the project is fully supported in any possible way (e.g., resources, regulation, political power). Seven studies were found in the literature that use a multilevel unit of analysis (Bernardi et al. 2017; Brown and Thompson 2011; Gao 2007; Hayes and Westrup 2012; Lin et al. 2015; Madon et al. 2007; Njihia and Merali 2013; Puri et al. 2009).

The qualitative approach (including qualitative case study, ethnography, critical research, and action research) appears to be the most popular approach in this stream, followed by quantitative studies. General reviews, theoretical framework papers, and research notes are grouped as a conceptual approach, which is third-placed. The qualitative descriptive studies also found in this stream (e.g., describing experiences, project evaluations, best practices) which are as popular as the articles published in specialised ICT4D journals (Gomez 2013).

Multilevel unit of analysis is found to be an emerging trend in this stream. Multilevel unit of analysis examines the interaction between societal levels to understand the holistic perspective of ICT implementation (e.g., examine macro-sociopolitical factor affecting local context adaptation of ICT) (Avgerou 2010), which offers a broader understanding of ICT4D (Lin et al. 2015; Madon et al. 2007). Multilevel unit of analysis offers an approach to understand multi-actors' concerns in regard to ICT. These studies are supported by a proper theoretical lens or analytical frameworks, ranging from complexity science (Braa et al. 2007), institutional theory (Brown and Thompson 2011; Miscione 2007), Actor-Network Theory (ANT) (Gao

2007), critical realist's morphogenetic approach (Njihia and Merali 2013) and postcolonial theory (Lin et al. 2015).

Strengths and weaknesses of social-embedded stream

The strength of the social-embedded stream is in its ability to explore the complexity of the context of ICT4D. Unlike the technology-transfer stream, social-embedded research engages with a deeper investigation of the social system and the interplay between actors and technology. Further, the studies in this stream acknowledge the importance of the socio-technical characteristic of developing countries since most of these studies utilise social science theoretical lenses (e.g., social capital, institutional theory) rather than technology-oriented concepts and theories (e.g., TAM, IS management).

However, conducting social-embedded research might be more challenging for the researchers in terms of justifying the significance of theoretical contribution. It requires a thoughtful selection and interpretation of the contextual data collected during field study that may be abundant (Hayes and Westrup 2012). Further, the researchers are usually required to take a "painstaking study" (Madon 2009, p. ix) to completely understand the complexity of the context. It might become a major issue since finding and establishing access and resources for research in the developing countries as well as getting trust, and unbiased information from participants are quite challenging (Lin et al. 2015).

Prior studies in this stream also have another shortcoming of lacking actionable recommendation for improvement of ICT4D projects since they only dealt with the 'status quo' by interpreting the phenomena without significant practical implications. A groundbreaking approach was demonstrated by a critical realism study (Njihia and Merali 2013), as the authors uncovered the in-depth understanding of each level of the societal actors and provided valuable insights on creating a sustainable project. Nevertheless, this thesis argues that it is important to explore multilevel actors including top-level (where project initiators such as government, NGOs, and vendors own the resources and take policy making) and the bottom-level (where the ICT is implemented) (Avgerou 2008; Madon et al. 2007).

Table 2-4 Social-embedded studies 2007-2019

Article	Analytical Lens	Research approach	Level of Analysis	ICT	Research Context	Country
(Miscione 2007)	Institutional theory	Qualitative	Community	Telemedicine	Telemedicine project in Amazon	Peru
(Gao 2007)	Actor-network theory (ANT)	Qualitative	Multilevel	Network infrastructure	Standardisation of network infrastructure	China
(Prakash and De' 2007)	Development and Social change	Qualitative	Organisation	E-government	Impact of land records management	India
(Madon et al. 2007)	Evaluation studies	Qualitative	Multilevel	Health information systems	HIS in public health	India
(Puri et al. 2009)	Participatory IS design	Qualitative	Multilevel	Health information systems	HIS in public health	India
(Brown and Thompson 2011)	Institutional theory	Qualitative	Multilevel	E-government	e-Gov in Jamaica Customs Department	Jamaica
(Dey et al. 2011)	Systems usability	Qualitative	Individual	Mobile technology	Farmers' use of mobile telephony	Bangladesh
(Hayes and Westrup 2012)	Social context	Qualitative	Multilevel	Mobile banking	Mobile banking adoption	Kenya
(Barjis et al. 2013)	Own framework	Qualitative	Community	Patient monitoring system	Patient monitoring system	South Africa
(Njihia and Merali 2013)	Morphogenetic	Qualitative	Multilevel	E-government	Public sector ICT adoption	Kenya
(Mengiste and Aanestad 2013)	Strauss social capital	Qualitative	Country	Health information systems	Health Information Systems	Ethiopia
(Lin et al. 2015)	Postcolonial theory	Qualitative	Multilevel	Computer; internet	Introduction of computer and internet to aboriginal village	Taiwan (Aboriginal Village)
(de Brito et al. 2016)	Social network	Quantitative	Multilevel	Telecentre	Infrastructure and ICT intervention toward ICT skills	Brazil
(Bernardi et al. 2017)	Frame theory	Qualitative	Multilevel	IS policy	Healthcare; policies in information systems in healthcare	Kenya
(Dobson and Nicholson 2017)	Institutional theory	Qualitative	Individual	General classification of ICT	Small and Medium Enterprises: institutionalization of ICT	Mexico
(Holeman and Barrett 2017)	Sociomateriality	Qualitative	Community	TempTracker	Healthcare: vaccination for rural areas	Kenya
(Kelly 2018)	Cultural historical activity theory	Qualitative	Community	General classification of ICT	Evaluation of NGO in ICT4D	India

Article	Analytical Lens	Research approach	Level of Analysis	ICT	Research Context	Country
(Palvia et al. 2018)	Capability approach	Qualitative	Individual	General classification of ICT	ICT infrastructures and services	Pakistan
(Slavova and Karanasios 2018)	Activity theory and institutional logics	Mixed	Multilevel	Various ICT artefacts	ICTs perception and use by smallholder farmers	Ghana
(Gebre-Mariam and Bygstad 2019)	Critical realist' morphogenetic approach	Qualitative	Country	Health management information systems	Electronic Health Management Information Systems	Ethiopia

2.2.3.3 Transformative ICT4D

General overview

Studies in the transformative ICT stream especially dealt with vulnerabilities in the marginalised groups. The studies mainly explain the ‘how’ aspect of ICT-enabled transformation in such groups. In most cases, the role of researchers was not to discuss the appropriateness of technology (as in social-embedded); rather, the in-depth process of how ICTs entangle particular vulnerabilities emerged in the groups. This premise is useful to justify whether a paper is classified as transformative or social-embedded research stream. Miscione (2007), for example, that even though the context of this research is an isolated group in a remote location in Amazon, the focus of the research is the preference of social actors in the design of telemedicine system (which is the core characteristic of social-embedded stream), rather than how telemedicine transforms or improves local health. Thus, the paper is categorized as a social-embedded study.

In brief, most of the studies in the transformative stream use qualitative inquiries as their approach (Adam and Urquhart 2009; Díaz Andrade and Doolin 2016; Srivastava and Shainesh 2015), or illustrative case studies to promote their framework (Urquhart et al. 2008). Action research also shows the significant contribution of this stream to ICT4D field, particularly the extensive initiative of UiO Health Information Systems Program (HISP) (Braa et al. 2007; Sahay et al. 2013). Most of the studies in this stream mainly focus on community-level as their unit of analysis. The study by Venkatesh et al. (2016) or Heeks and Ospina (2019), on the other hand, employ mixed methods both quantitative approach using longitudinal data and qualitative exploration for a deeper understanding on how internet kiosk intervenes the legacy custom and myth on mother and infant health and how ICTs contributes to community’s resilience. A longitudinal study appears to be a significant advance that broadens the research as it involves the in-depth process of transformation according to a longer span of the time of examination. Table 2-5 below presents the studies in this stream.

Table 2-5 Transformative ICT4D studies 2007-2019

Article	Analytical Lens	Research approach	Level of Analysis	ICT	Research Context	Country
(Braa et al. 2007)	Complexity science	Qualitative	Country	Health information systems	HIS in public health	South Africa, Ethiopia, Thailand
(Urquhart et al. 2008)	Coleman’s social capital	Qualitative	Community	General classification of ICT	Reducing poverty by creating	Sri Lanka, Indonesia, Malaysia,

Article	Analytical Lens	Research approach	Level of Analysis	ICT	Research Context	Country
					possibilities with ICT	Laos, Thailand
(Adam and Urquhart 2009)	Social capital	Qualitative	Organisation	IT human capital (skills)	ICT skills for workers in the tourism sector	Maldives
(Sahay et al. 2013)	Latour's circulating reference	Qualitative	Country	Health information systems	Health Information Systems	India, Kenya, Sierra Leone
(Srivastava and Shainesh 2015)	Service Dominant Logic (SDL)	Qualitative	Community	Telemedicine	ICT for rural healthcare	India
(Díaz Andrade and Doolin 2016)	Sen's Capability Approach	Qualitative	Community	Telecentre	ICT for social inclusion of refugees	Refugees in NZ
(Venkatesh et al. 2016)	Social epidemiology and network	Mixed	Community	Internet kiosk	Internet kiosk for expectant infants' mother	India
(Heeks and Ospina 2019)	Resilience framework	Mixed	Community	General classification of ICT	ICT in community's resilience	Costa Rica

Strengths and weaknesses of transformative stream

Transformative ICT4D stream inherits the strengths of the social embedded stream. It engages with a deep social condition to promote ICT enabled transformation. The role of researchers is not to discuss the appropriateness of technology (as in social-embedded), rather, the in-depth process on how ICTs entangle particular vulnerabilities emerged in the groups. Moreover, this stream does not take a more extensive account of socio-political and economic circumstance in the study (Avgerou 2008). Rather, it concerns with a deep social change by creating possibilities from ICT, which indicates that this stream is highly-contextual and dependent to specific vulnerabilities or capabilities in the marginalised groups (Avgerou 2008 see p. 136). Consequently, the studies might only work in a narrow and specific context as they do not seek to broaden the investigation. This may explain why most of the studies in this stream engage with community-level as their unit of analysis.

2.2.3.4 Summary of ICT4D research streams

Based on the result of the systematic literature review presented above, the characteristics of the three streams in ICT4D research are identified. Table 2-6 summarises the key

characteristics of each stream. The next section outlines the research gaps in the field across the three streams.

Table 2-6 Comparison of ICT4D streams

Properties	Technology-transfer	Social-embedded	Transformative
Research methods	Mainly quantitative	Qualitative	Qualitative
Theoretical lens (tendency)	IT Acceptance and Adoption theories (e.g. TAM, UTAUT), and Econometric measurement of IT Impact	Social science perspective (Actor-Network Theory, institutional theory), and a critical realist (e.g., morphogenetic)	Social capital and capability approach
Level of analysis	Single level: user (individual), organisation, or country	Multilevel analysis	Country-level, Community-level
Means of development	Diffusion and acceptance through ICT use and impact	Creation of new social practices based on a complex social system that enable and constrain the new ICT	Resolving vulnerabilities and leveraging capabilities

2.2.4 Identification of research gaps

The extensive literature review above shows that each stream has its strengths and weaknesses in constituting the body of knowledge of ICT4D. However, several areas have not been addressed adequately in the prior research, which are identified and explained through three domains as follows.

2.2.4.1 Conceptualisation of resources and value

Technology transfer stream is heavily influenced by the diffusion, adoption, acceptance, and the investment of ICT. Technology-transfer stream posits that the outcome of development is determined by ICT resources acquisition and diffusion (e.g., Dedrick et al. 2013; Riffai et al. 2012; Venkatesh and Sykes 2013). The dominance of technology-transfer stream indicates that ICT4D projects are mainly about acquiring and deploying the ICT as resources (e.g., hardware, software), hoping for significant value to improve the state of developing countries. ICT resources are conceptualized as goods and the process of value creation is regarded as a mono-directional process based on value production chain posited by goods-dominant logic. Consequently, the connection between ICT resources and the development outcome tends to be deterministic/functionalistic. This is prevalent since ICT4D research is largely influenced by traditional IS value research, which considers resources as the source of value (see Grover and Kohli 2012). For instance, the traditional IS value research sees that the investment on

ICT resources (input) will enable capabilities (process) which in turn create value by improving organisational performances (output) (Ray et al. 2004). Such conceptualisation of resources and value undermines the role of contextual factors which facilitate the creation of value, such as adequate coaching and training (Kahouei et al. 2015) or reliable power and electricity (Gera et al. 2015).

While the social embeddedness and transformative streams perceive the outcome of ICT4D depending on the process of institutionalisation or the creation of new socio-technical practices, most of them focus solely on the users of ICT (Brown and Thompson 2011; Dey et al. 2011; Madon et al. 2007). In this regard, recent scholars have suggested accounting for the multi-actors' role since users are not the sole actors responsible for the outcome of ICT4D (Grover and Kohli 2012; Lempinen and Rajala 2014).

2.2.4.2 Perspective on users and stakeholders

The focus on adoption, acceptance, and investment in the technology-transfer stream may oversimplify the human factors and social setting in ICT and development. The deterministic perspective of ICT and development in technology transfer may also overlook the role of actors (including users and stakeholders) as well as the contextual settings. While this stream has identified how the human affords the technology, it tends to neglect the dynamics of the relationship between technology and actors, which continuously changes over time (Mignerat and Rivard 2009). This is somehow restricting our role in advancing ICT4D since what matters most is the development of actors' capacity in the developing countries so they are more prepared to utilise technology and even develop the solution by themselves. In other words, putting an emphasis on technology only results in personifying the technology to fit within the context. This is a misnomer since the context is unique and evolving. Several scholars have suggested that a shift in paradigm is required, from technology transfer (which is focused on technology) to technology translation and learning (which focuses on the actors) (Braa et al. 1995). Therefore, the objective of ICT4D is "altering the context, not technology" (Diniz et al. 2014).

The dominance of technology-transfer stream also indicates that prior ICT4D research might study users and stakeholders in a narrow perspective since it mainly focused on their acceptance toward ICT. This perspective perhaps fails to account the synergy, collaboration, and synchronous intention and commitment toward the adoption of ICT among all stakeholders across all levels within the society. Thus, it may cause an incomprehensive

understanding of the likelihood of project sustainability (Madon et al. 2007). For example, ICT4D research needs to explore the entire stakeholders' concerns and perception toward ICT as well as to uncover "conflicting institutional logic" (Findikoglu and Watson-Manheim 2016) between micro-level adoption and macro-level socio-political situation (Madon et al. 2007). A nation-wide Health Information Systems, for instance, will have a higher chance of failure if it is implemented mainly for the favour of the government without significant participation from health workers in micro-level (Gera et al. 2015).

The social-embedded stream, on the other hand, provides a better understanding of users and stakeholders because it engages with deeper and broader social actors following ICT introduction. It extends the technology-transfer stream that mostly deals with a restricted scope of analysis. While transformative stream also provides a deep social transformation through ICT, it is highly-contextual and dependent on specific vulnerabilities or capabilities in the marginalised groups (Avgerou 2008). However, prior social-embedded research has several drawbacks, ranging from inadequate analytical lenses (Hayes and Westrup 2012; Madon et al. 2007; Puri et al. 2009), methodological limitation (Brown and Thompson 2011), and inherent deficiency of interpretivist research paradigm (Lin et al. 2015; Njihia and Merali 2013). Thus, a more comprehensive study supported by appropriate theoretical lens and research paradigm is needed.

2.2.4.3 Perspective on the social structure

The role of exploring the social structure in social embeddedness stream is restrictive since most studies solely aim to identify the unique characteristics of the local actors. The orientation is still the technology, leading to 'matchmaking' between the contextual setting with the appropriateness of technology. While some social embeddedness studies have proposed the bottom-up approach of technology design and development, the applicability will be unfeasible due to the inherent resource constraint in the local context. Local actors then still depend on the resourceful actors at the macro-level. Therefore, the primary objective to employ a holistic perspective by investigating the relationship between multiple actors across organisations or institutions, from micro-level to macro-level. Therefore, it allows the warrant of resource exchange that contributes to the sustainability of the use of ICT in the context which in long term will contribute to the development.

Similarly, though previous social-embedded studies have acknowledged the importance of explicating the social structure of developing countries, how ICT transforms the social system

holistically is still unclear. Recent studies have identified the unique components of social structure in developing countries (Barjis et al. 2013) such as culture, perception, political motives, or institutional rules (Sey and Ortoleva 2014). For examples, Madon et al. (2007), Puri et al. (2009), and Hayes and Westrup (2012) explore the factors and processes across all societal levels to propose an integrated strategy for ICT enabled transformation. However, these studies have limitations in repeatability as they explore the phenomena using general approaches that heavily rely on researchers' experience and subjectivity (evaluation studies, participatory, and contextualist). On the other hand, Gao's (2007) study emphasises the importance of multilevel analysis to better understand multi-actors' perspective toward nation-wide ICT infrastructure in China. This study, however, did not account for the process and impact of societal transformation as it mainly focused on the standardisation of technology. While Brown and Thompson (2011) have looked into socio-technical impact following ICT, the study is somewhat limited because it is restricted to policy maker (macro-level) as the primary driver of institutional factors (top-down). Since the study does not significantly explore the firms' concerns as the micro-level actors, it neglects the bottom-up institutional reproduction that may occur in a complex social system (Aanestad and Jensen 2011).

From a comprehensive literature review as above, several research gaps have been identified. The gaps range from a restricted perspective that ICT value is merely about the acquisition of such resources, the incomplete depiction of the attributes of actors, and the incomprehensive account of the social structure. A different perspective is needed that serves as the analytical lens to guide or inform the findings in this exploratory study. Table 2-7 below summarizes the key research gaps identified in the field of ICT4D.

Table 2-7 Summary of research gaps in ICT4D

No	Research Gaps	Descriptions	Related ICT4D stream
1	Inadequate conceptualisation of resources and value in ICT4D research	<ul style="list-style-type: none"> ICT4D mainly about the acquisition of ICT resources The deterministic process of ICT resources [investment] to the development outcome is unviable 	Technology-transfer stream
		<ul style="list-style-type: none"> Overemphasise the role of ICT in value creation and development Lack of processual explanation of how context and actors co-create value from ICT 	Technology-transfer stream, social embeddedness, and transformative stream

No	Research Gaps	Descriptions	Related ICT4D stream
2	Incomplete depiction of the attributes of actors (e.g. users and stakeholders)	<ul style="list-style-type: none"> Putting emphasis on the technology 'configuration' rather than the actors' development Limited to exploring the actors' attributes related to their acceptance and use of ICT 	Technology-transfer stream
		<ul style="list-style-type: none"> The lack of a systemic perspective of ICT and development 	Social-embeddedness and transformative stream
3	Incomplete understanding of the dynamics of social structure and its relationship with technology	<ul style="list-style-type: none"> Inadequate depiction of the role of social settings and structure 	Technology-transfer stream
		<ul style="list-style-type: none"> The unique setting is perceived as a static and constant rather than dynamic and evolving How the context is evolving and how it might relate to the ICT enabled development is understudied 	Social-embeddedness stream
		<ul style="list-style-type: none"> Lack of broader perspective on how to entangle the locals challenge through multi-actors resources and supports 	Transformative stream

2.3 Service-dominant (SD) logic as an analytical lens

Service-dominant (SD) logic (Vargo and Lusch 2004, 2008, 2016) is a meta-theory which is originally used to obtain a holistic and systems' perspective of the market (Chandler and Vargo 2011), and was later extended to investigate the phenomena of the society (Akaka and Vargo 2015). In general, SD logic views society as an interconnected network of resources-exchanging actors to co-create value, which removes the restricted perspective of the dyadic provider-consumer relationship. For over a decade, SD logic has emerged as a transdisciplinary meta-theory that not only it transformed marketing research, but also substantially advanced the fundamental principles of other disciplines, such as public administration (Osborne et al. 2016), conflict and social movement (Skålén et al. 2015), and information systems (Alter 2010; Lusch and Nambisan 2015). In ICT4D research, SD logic also has become increasingly useful as the analytical lens (Barrett et al. 2015). For instance, it helps the stakeholders in orchestrating the resources required to minimise service disparity (Srivastava and Shainesh 2015). However, it has not reached its full potential since previous studies mostly engaged with a narrow context or simple actors' relationships (Akaka and Vargo 2015).

SD logic is built upon eleven foundational premises (FPs), which are used to study a theoretical construct called service ecosystems (Vargo and Lusch 2016). Service ecosystem is defined as *a complex, self-adjusting system of resource-integrating actors connected by shared institutional arrangements and mutual value creation* (Vargo and Lusch 2016). Among eleven foundational premises, five of them are axioms that establish the core of SD logic. In ecosystems, SD logic views service as the fundamental basis of exchange (FP 1, axiom 1). The beneficial impact (i.e., *value*) is regarded as *co-created* outcomes resulted from multi-actors' practices enactment, rather than proposed and intended to only one actor (e.g., government) (FP 6, axiom 2). It implies that value can only be created when the resources are integrated with other resources, hence every owner of other resources are also resource integrators (FP 9, axiom 3). Since integrating resources depends on other stakeholders, value is determined by the context which explains why different contexts may exhibit different outcomes (FP 10, axiom 4). Last, from SD logic perspective, the structure of the social system is depicted as *institutions* which drive, coordinate and facilitate value co-creation (FP 11, axiom 5). Although some premises in SD logic are contextually specific for business or economy studies (such as FP2 and FP5), which might be irrelevant to this study, the core of SD logic (5 axioms) and other premises are considered useful and potentially give novel perspective in ICT4D. Table 2-8 presents foundational premises including axiomatic FPs of SD logic.

Table 2-8 Foundational Premises (FPs) of SD logic (Vargo and Lusch 2016)

Foundational Premise & axioms	Statement
FP1 (axiom 1)	Service is the fundamental basis of exchange
FP2	Indirect exchange masks the fundamental basis of exchange.
FP3	Goods are distribution mechanisms for service provision
FP4	Operant resources are the fundamental source of strategic benefit
FP5	All economies are service economies
FP6 (axiom 2)	Value is co-created by multiple actors, always including the beneficiary.
FP7	Actors cannot deliver value but can participate in the creation and offering of value propositions
FP8	A service-centred view is inherently beneficiary oriented and relational
FP9 (axiom 3)	All social and economic actors are resource integrators.
FP10 (axiom 4)	Value is always uniquely and phenomenologically determined by the beneficiary.
FP11 (axiom 5)	Value co-creation is coordinated through actor-generated institutions and institutional arrangements.

For this thesis, SD logic offers a suitable analytical lens as it brings the novel perspective of value which has been redefined in both its definition and the process of its creation. It also acknowledges the significant role of actors and institutional context as the determinant of value

creation, rather than the acquisition or the ‘presence’ of ICT resources (Srivastava and Shainesh 2015). However, it is important to note that SD logic does not necessarily guide this study’s direction, or to confirm the empirical findings. Rather, it provides the researcher with the *logic*, *worldview*, or *theoretical lens* (Pohlmann and Kaartemo 2017) in conducting the research. The next section discusses SD logic’s views related to ICT and social transformation.

2.3.1 Relating SD logic foundations with ICT4D research gaps

2.3.1.1 SD logic view on resources and value

SD logic view on the value

SD logic views value as co-created outcomes resulted from multi-actors’ participation (Vargo and Lusch 2016). This implies that all actors in the social systems may gain and contribute to value consciously or unconsciously (Vargo and Lusch 2008, 2016), according to the constellation of resources that are involved during the moment of resource integration (Akaka et al. 2012; Edvardsson et al. 2011). This view can be useful in studying ICT-enabled transformation because nowadays ICT systems are operated in an interconnected network across multilevel social systems rather than a standalone application system. This perspective may have an important implication to ICT4D that the value of ICT is relational and mutually co-created, rather than proposed by or intended to only one group of actors (e.g., users in a remote area, government or policymakers). Further, it can offer a novel perspective to prior ICT4D research (or general IS value research) that sees value as a mono-directional process that adapts value production chain from goods-dominant logic (Grover and Kohli 2012).

A failed ICT4D initiative caused by lack of coaching, frequent power outage, or workers’ job uncertainty introduced at the beginning of Chapter One (Gera et al. 2015; Sahay 2016) exemplifies that the value of ICT can only be created when multiple actors and beneficiaries, according to their resources, are included. This example also suggests that the value of ICT is not represented by how advance the feature, hardware, or technical specifications are. Consequently, the rather narrow perspective which considers the users as the main and sole determinant of the success ICT enabled transformation might not be appropriate. Even though contextual factors, such as culture and policy, have been recognised in the literature, they are usually acknowledged as supporting factors in value creation. In this case, SD logic may be useful since it posits the unique settings as the context of value co-creation (see FP 10). Another possible implication from SD logic is the position of value as the central perspective in the transformation into which the stakeholders’ resources are recombined and integrated.

SD logic view on resources

Unlike goods dominant logic, SD logic does not consider value as the output of a particular ‘process’ held by resources owner. SD logic removes the restricted role of ‘producer’ (resource owner and value provider) or ‘customer’ (recipient and consumer of value) by emphasising the role of network structure of actors. SD logic views each actor as having a potential role to become a provider and a consumer simultaneously since it relies on resource integration and exchange activities (FP 1). Thus, all social and economic actors are resource integrators (FP 9) (Vargo and Lusch 2008).

This view may offer a better perspective of ICT4D research in two ways. First, it can improve ICT4D research by broadening the sources of resources. While prior research tend to restrict the origins of resources to government or funding bodies, SD logic extends the perspective that the resources can be originated from public sources (e.g., communities, state-owned companies’ CSR), private sources (e.g., insurers and foreign investors), or other entities (Vargo and Lusch 2011). Therefore, the sustainability of ICT4D project will not solely depend on the continuity of the funds, but also the support from other stakeholders.

Second, it offers a fresh perspective to goods-oriented logic that sees ICT as a resource for creating competitive advantage. As discussed earlier, this traditional perspective might lead to a misconception that merely acquiring ICT (e.g., hardware, software) will improve the condition in developing countries. Conversely, SD logic argues that knowledge and skill (i.e., operant resources) have a more crucial role in today’s dynamic world (Akaka and Vargo 2014). SD logic also suggests that ICT are not only tangible or physical resources (i.e., operand resources¹), but also can be intangible resources. For instance, the role of ICT in the telemedicine system is regarded as an operant resource that facilitates other operand resources such as clinical knowledge and health records (Kleinschmidt et al. 2016).

2.3.1.2 SD logic view on users and stakeholders

From the perspective of SD logic, value is uniquely determined by the users and stakeholders (FP 10/axiom 4). SD logic emphasises the importance of use and context. From the SD logic perspective, actors in a service ecosystem do not gain value solely from exchanging resources.

¹ operant resources: resources can act on other resources to provide benefit (e.g., knowledge, technology).

operand resources: resources on which an operation or act is performed (e.g., materials, products). A further discussion on the role of ICT as both operant or operand resource can be found in Nambisan (2013) and Lusch and Nambisan (2015)

Instead, they gain value based on their benefit from using it (so-called *value-in-use*). This premise is important as it distinguishes the service from goods where the value is represented by purchasing cost (so-called *value-in-exchange*). This view is relevant to ICT4D. For example, when an NGO grants a set of internet kiosk facility, the grantees (e.g., community) have not yet acquired the value according to the amount of the grants used to acquire such facility. Instead, they gain value based on their benefit from using it (i.e., *value-in-context*) where they integrate it with other resources, including knowledge and skills to transform their life. Consequently, an ICT4D initiative should be viewed beyond the intention (e.g., perception) to introduce new technology but also how it contributes to the transformation of the social context as well as how other stakeholders provide resources to ensure project sustainability. This view also offers a better perspective to ICT4D initiative as it explains why the same ICT may create different outcomes in different contexts (e.g., districts, nations).

2.3.1.3 SD logic view on the social structure

SD logic invokes the ontological perspective of the interdependent and duality of actors' action and structure to explain the structural change occurrence (Koskela-Huotari et al. 2016; Koskela-Huotari and Vargo 2016; Vargo et al. 2015; Vargo and Lusch 2016). SD logic depicts the structure as institutions (Sitaloppi et al. 2016; Vargo et al. 2015; Wieland et al. 2016) and the actors' action as practices (Mccoll-Kennedy et al. 2015). Institution is defined as humanly devised rules, norms, and values, establishing a social structure that drives or constrains the organisations or individuals' lines of action (DiMaggio and Powell 1983; Scott 2008). These organisations or individuals are regarded as actors (Wieland et al. 2016) who enact the routine of actions as practices (Feldman and Orlikowski 2011). In service ecosystems, a series of interrelated rules, norms, and values across multilevel context defines the notion of *institutional arrangements* (Vargo et al. 2015), which adapts Herbert Spencer's viewpoint that the social systems are a series of institutional subsystems.

2.3.2 Institutional structure of health service ecosystems

Social science disciplines (organisation studies, behavioural studies) have long depicted the process of the construction of our social systems. 'Structuralists' scholars (New 1994), including Giddens (1984), Bhaskar (1975), and DiMaggio and Powell (1983; 1991), have advocated the existence and the transformability of the social structure. In particular, their viewpoint primarily aims to explicate the interplay between agency and the social structure and how it might relate to the reproduction and elaboration of the society (King 2010).

Giddens (1984) defines agency as the ongoing actors' action situated by three 'modalities'; facilities (e.g., technology), norms (e.g., codes of conduct), and interpretive schemes (e.g., perception, past experience). Social structure is then defined as a set of *rules* and *resources* that coordinates these modalities and *actors' practices*. Giddens' concept on rules resembles the definition of institutions: cultural-cognitive, normative, and regulative components, coexisting with practices and resources, that guide human behaviour, regulate interrelationships, and maintain the meaning of our life (Scott 2008). The concept of institutions, however, varies that "no single and universally agreed definition of an 'institution' in the institutional school of thought." (Scott 1995, p. 235). A broader and overarching concept of social structure based on Giddens (1984) and Orlikowski (2000) is adapted since it accounts for all components previously mentioned which are resources, rules, actors, and practices. Figure 2-3 below illustrates the conceptualisation of the four components of the institutional structure of service ecosystems.

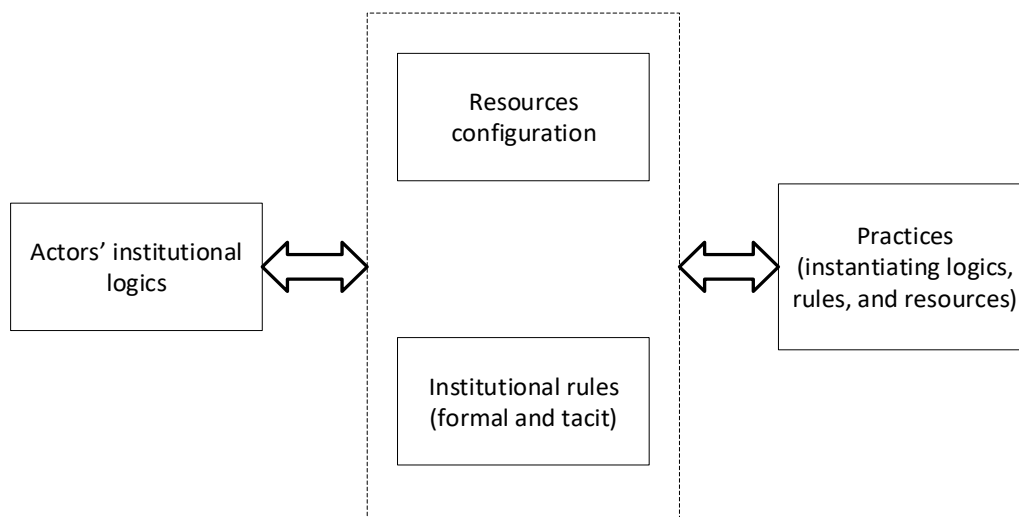


Figure 2-3 The components of social structure (adapted from Giddens 1984; Orlikowski 2000)

The depiction of the social structure in Figure 2-3 shows four components of the institutional structure of the ecosystem: actors' institutional logics, resource configuration, institutional rules, and practices. These structural components are used as the abstract conceptualisation of the institutional structure of the service ecosystem in this study (Table 2-9).

Table 2-9 Summary of institutional structure components observed in this study

Components	Description and example	Reference
Actors' institutional logics	Actors' background that situates their activities Examples: perception, assumption, skills, knowledge, past experiences	(Giddens 1984; Orlikowski 2000)

Components	Description and example	Reference
Rules	The 'signposts' that regulates actors' activities, behaviours, or interrelationships Examples: (organisational) structure, metrics, language, regulation	(Scott 1995, 2008)
Practices	The routinised activities enacted to maintain the continuity of their existence Examples: promotive care, preventive care, curative care, program planning, monitoring, and evaluation	(Mccoll-Kennedy et al. 2015; Orlikowski 2000)
Resources	The configuration or combination of resources used during the enactment of practices Examples: the combination of resources to conduct health program planning	(Henfridsson and Bygstad 2013)

The important role of social structure into the service ecosystems arises from a realisation that the way humans exchange resources and interact to co-create value is guided by shared rules, norms, and beliefs (Peters et al. 2016). However, while many studies have discussed how actors are enabled and constrained by institutions (Mele et al. 2018; Pop et al. 2018; Sajtos et al. 2018), very few studies investigate their dynamics (Lounsbury and Crumley 2007). Social structure of service ecosystems is merely regarded as the coordinating mechanism, posited as static and constant rules and norms in regulating the value co-creation. Therefore, investigating the transformation of a service ecosystem through the introduction of ICT requires an additional lens that explicates the nature of the change to see the mechanism of structural transformation. The next section briefly discusses the underlying foundation of mechanism in IS research and the lens used in this study.

2.4 Mechanism of structural transformation

The service literature currently has not established the groundwork of the theoretical foundations to investigate the dynamics of service ecosystem's structure (Pop et al. 2018). Therefore, there is a need for an adequate foundation to explain the pertinent questions: *Can the social structure change? If so, how can it be explained?* To acquire sufficient analytical lens to explore this area, the researcher thus incorporates a more established foundation from IS and management literature, the causal mechanism of socio-technical transformation, as briefly discussed below.

2.4.1 Causality as the foundation of mechanism

Causality deals with how we can explain the events in human affairs, the causes of those events, and the relationship between them (Avgerou 2013; Markus and Robey 1988; Markus and Rowe 2018). Research on causality produces an explanation of the *mechanism* responsible for the creation of such events. A wide range of mechanisms exists in the literature employing various epistemological stances and typologies of theoretical outcomes. In the sociology discipline, the mechanism has different stances that determine our point of views of our world. Markus and Rowe (2018) suggest the variety of perspectives of causality that affect the way we see the mechanism (Avgerou 2013; Markus and Rowe 2018), which are mainly divided into three *basic positions*: metaphor, mechanism, and misnomer.

The first basic position is that the causality is merely a *metaphor*. The scholars in this position argue that the causality is unobservable, metaphysical, and non-scientific. The causality, therefore, represents a hypothetical association of certain conditions (e.g., cause and effect) of which the real relationship between them will remain as a black box. This ontological position is widely known as the Humean principle. Markus and Rowe (2018) suggest that in IS, research falls into this position is mostly held by poststructuralists who tend to adopt positivist paradigm. A typical finding of this type of research is in the form of directional association. For instance, the greater the number of ICT expenditure, the greater the improvement of the nation's Gross Domestic Product.

The second basic position is that the causality is a *mechanism*, that is, it *does* happen in the real world. The causality accounts for the real materials or social processes connecting antecedents to consequences under certain conditions. In IS, this position is taken mostly by structuralists and critical realists who seek to uncover the 'black box' by exploring the structural components involved within the context (Van de Ven and Poole 1995). To illustrate, a typical finding of this research is an explanatory theory about the real mechanism; how actors' initiatives alter the conventional mindset, or how certain policies (as a 'certain condition') enable the creation of new practices. Research taking the mechanism position might produce an explanation, for instance, how the stakeholders utilise the increasing ICT expenditure to optimise supply chain process nation-wide. And further, how it may explain the government's incentives offered to private sectors enable organisations to implement supply chain management systems in their end-to-end process.

The third basic position takes causality as a *misnomer*. It suggests that causality is about how meanings and human belief are manifested and enacted in social practices and interactions. Thus, it argues that the essence of human affairs cannot be oversimplified through simple unidirectional and deterministic relationship (i.e. *misnomer*), due to the uniqueness, dynamic, and complexity in people interactions. This explains why this stance is mostly used in critical or interpretive research (Avgerou 2005; Walsham 2005) and unfortunately is context-specific and not generalisable (Markus and Rowe 2018). From the example above, research in this point may produce a critical perspective of the phenomena, for instance, that the increasing use of nation-wide information systems is perceived by the local actors as a threat to information privacy. The summary of causality ontology is presented in Table 2-10.

Table 2-10 The perspectives of causality (Markus and Rowe 2018)

Perspective of causality	Description	Illustrations from the IS field
Directional association <i>(causality is a metaphor)</i>	Causality is depicted as a metaphor for a logical association. Causality represents a hypothetical association of certain conditions. The black box remains as Hume or Kant “believed that the causality cannot be directly observed.	<ul style="list-style-type: none"> The greater the number of ICT expenditure, the greater the improvement of the nation’s Gross Domestic Product
Causal mechanism <i>(causality as a mechanism)</i>	Causality refers to a mechanism that connects antecedents to consequences. Causality accounts the real materials or social processes that connect antecedents and consequences under certain conditions	<ul style="list-style-type: none"> Stakeholders utilise the increasing ICT expenditure to optimise supply chain process nation-wide. The government provides incentives to private sectors that implement SCM systems in their end-to-end process.
Constitutive causality <i>(misnomer – causality is about how meanings are enacted in social interactions)</i>	Causality is related to a ‘human belief’ manifested in the enactment of social practices and interactions Mostly used in interpretive or pure critical. The essence of human affairs is argued to be oversimplified through causality.	<ul style="list-style-type: none"> Increasing use of nation-wide application systems is perceived by the local actors as a threat to information privacy.

This thesis takes the second perspective—the causal mechanism. As discussed in Section 2.2, the current gap in ICT4D research addressed in this study is the lack of an in-depth explanation of the socio-technical structure in the ecosystem. With SD logic as a lens to conceptualise the structure of the ecosystem (to address the second research question), the mechanism is argued to be the most appropriate and relevant standpoint to explain such structural change, which then can answer the first research question of this study. The researcher takes a viewpoint that

the actual subject matter—the ICT and the socio-technical structure of ecosystem—is concrete (Pentland 1999). Specifically, this thesis adopts the views of the structuralists (Bhaskar 1975; Giddens 1984; Powell and DiMaggio 1991) that although humans do not create the structure, their actions instantiate it as well as reproduce and transform it (New 1994). In other words, human activities (i.e., agencies) are both enabled and constrained by the institutions, while at the same time they are able to transform them (i.e., institutional entrepreneurs) (Powell and DiMaggio 1991) although it might end up with an unexpected and unintentional outcome (New 1994). While the structure might be difficult to observe directly, yet we can still observe the effects and then postulate the most approximate explanation of it (Bhaskar 1975; Tsang 2014; Wynn and Williams 2012).

2.4.2 Mechanism-based research and generative mechanism

The logic behind mechanism-based research (Hedström and Swedberg 1998) is how to adequately explain the transformation of socio-technical structure (Avgerou 2013; Gregor 2006; Mingers 2004). While the instances of structural transformations are more accessible and can be observed almost directly, the mechanism of those transformations is considered as a black box where researchers attempt to uncover them (Aaltonen and Tempini 2016). Mechanism-based research thus typically seeks to identify the in-sequence pattern of events that connect the identified antecedents and consequences of the observed phenomena (Avgerou 2013; Pentland 1999). However, such pattern of events/constructs is not the mechanism of structural transformation yet, as they do not “explain the underlying process that generated the patterns [...] that draw on the structural characteristics of the system” (Pentland 1999, p. 718). Such structured entities possess causal powers, that when they are released, they will act as the *generative mechanism* that is responsible for triggering the transformation. Since the generative mechanism is considered as the deepest layer of the structure (Pentland 1999; Zachariadis et al. 2013), identifying them may potentially provide an adequate answer to the dynamics of the structure of service ecosystem.

Pentland (1999) distinguishes the sequence of events from the generative mechanism by conceptualising the surface structure and the deep structure. The sequence of events is located at the surface structure, normally extracted from narration from interviewees, field notes during observations, or published materials in internet archives. On the other hand, the generative mechanism is located at the deep structure, which is associated with the generative structure that is responsible for generating those events. In a similar tone, the generative mechanism is regarded as the motors (Van de Ven and Poole 1995) or “gears in some social

machinery” (McGrath 2013, p. 363). These ‘motors’ explain the diverse events or outcomes in a situated context, which occurred in the surface of the complex socio-technical structure. A metaphor by Pettigrew (1997) offers the concept of the generative mechanism as the overarching ‘motor’ of organisational transformation:

“...we are studying some feature of organisational life not as if it represents one stream in one terrain, but more like a river basin where there may be **several streams all flowing into one another**, dependent on one another for **their life force** and shaping and being shaped by varieties of terrain each constraining and enabling in different intensities and ways” (Pettigrew 1997, p. 340, emphasis added)

The metaphor implies that the explanation it seeks focuses on the force rather than generalising the pattern of stream flows. A mechanism cannot be presented as a single sequence form (e.g., $A \rightarrow B \rightarrow C$) because such internal mechanism might produce a different sequence of events in different context or time (Pentland 1999). Such a fixed sequence is considered accurate since “deterministic law is unlikely in a social setting” (Hedström and Swedberg 1998, p. 8). In other words, a mechanism does not determine a linear cause-effect relationship (Avgerou 2013), rather it explains how “its existence would generate the observed phenomenon of interest” (McGrath 2013, p. 10).

The generative mechanism is used as an analytical lens because it offers a broader view of the mechanism of social change through an overarching concept of change rather than the context-specific processual model (McGrath 2013). The relationship between ICT and social change in the empirical world can be manifested through various forms with a context-specific sequence of events. However, these ‘randomness’ “can potentially point towards the same generative mechanism” (Dooley and Van de Ven 1999, p. 366). Conversely, the generative mechanism can explain the diverse outcomes resulted from similar ICT interventions (McGrath 2013, 2016). Generative mechanism of social transformation is also applicable for various level of contexts including organisational-level (e.g. Volkoff et al. 2007) or country-level (e.g. Henfridsson and Bygstad 2013). Finally, this lens is in line with the researcher’s philosophical stance on critical realism (presented later in Ch. 3).

2.4.3 Generative mechanisms in IS research

The generative mechanism research in the IS discipline is considered limited (McGrath 2013; Mingers 2004). This may be caused by a misunderstanding that generative mechanism is a specific concept of the critical realism philosophical stance, while the IS discipline is

dominated by positivism and interpretivism (Dubé and Paré 2003; Walsham 1995). Regardless, the generative mechanism does not necessarily represent a specific research paradigm, as several IS research are causal although they do not state it explicitly (Avgerou 2013). As shown in management literature, the generative mechanism is widely used to explain the emergence of a new structure or practice without being necessitated to adopt a certain point of philosophical stance (Anand et al. 2007; Smets et al. 2012).

Prior research has identified various generative mechanisms related to ICT and its social system. Unfortunately, the locus of prior IS research on the generative mechanism is mainly on the dynamics and evolution of IT infrastructure, less on the deep socio-technical structure where it ideally should be (McGrath 2013). Henfridsson and Bygstad (2013), for example, identify the generative mechanism of “how and why digital infrastructure evolves over time.” (Henfridsson and Bygstad 2013, p. 907). This approach oversees the significance of the role of actors while also limits the evolutionary process of social context, since the “actors and the broader social and institutional contexts are necessary ingredients in developing an understanding of the complex trajectories of digital innovation” (Nambisan 2018, p. 105).

Self-reinforcing mechanism (and its derivations)

Self-reinforcing mechanism is regarded as a well-known mechanism in diffusion research (Henfridsson and Bygstad 2013). The mechanism refers to the recursive action of the structure of feeding itself (Bygstad 2010; Henfridsson and Bygstad 2013). This mechanism can be considered as a composite mechanism as it can be derived into various mechanisms (Bygstad 2010; Bygstad et al. 2016) or ‘effects’ (Schreyögg and Sydow 2011). Schreyögg and Sydow (2011) describe that the self-reinforcing mechanism can be manifested into four patterns or ‘effects’:

- 1) Coordination effects—a more efficient interaction resulted from rule-guided behaviours in organisations.
- 2) Complementary effects—combination or synergy of resources or practices that produce better outcomes.
- 3) Learning effects—the productivity resulted from the institutionalised operation – where actors have acquired skills to perform the tasks.
- 4) Adaptive expectation effects—the adoption of new [product or services] based solely on mimetic force.

In addition, a self-reinforcing mechanism is also regarded as a basic process that is embedded in all generative mechanisms. Henfridsson and Bygstad (2013) posited that the three different generative mechanisms—innovation, adoption, scaling—of the evolution of digital

infrastructure, are all self-reinforcing process. Thus, even though self-reinforcing has been mixed as both process and mechanism, it can be inferred that self-reinforcing mechanism is a composite or meta-mechanism that can take different forms in reality. The three generative mechanisms below, for example, are built by the self-reinforcing process (Henfridsson and Bygstad 2013):

- 1) Adoption mechanism—This mechanism is related to the recursive effect between new service adoption and more resources investment. The more users adopt a new service, the more vendors allocate the resources (e.g., infrastructure) which subsequently allows for more service offers.
- 2) Innovation mechanism—This mechanism is related to the emergence of new product or services from the recombination of resources, which is primarily driven by business or vendors.
- 3) Scaling mechanism—This mechanism is related to the expansion of digital infrastructure to new entities, such as through web services integration.

Mechanisms related to individual and collective actions

Previous studies also discuss how we can explain the dynamics of individual actors and their relationship with the whole social system. Hedström and Swedberg (1998) suggest the three mechanisms by which the individual actions and social systems co-reproduce: 1) Situational mechanism – how a structure as a whole enables and constrains its components below (macro-micro), 2) Action-formation mechanism – how actors' beliefs and opportunities lead to a specific action (micro-level), 3) Transformational mechanism – how components at the micro-level interact with each other to generate a certain outcome at the macro-level (micro-macro). Vast IS research employing or adapting these mechanisms exist in the literature (Avgerou 2013; Devaraj and Kohli 2003). These mechanisms can explain what shape or trigger the actions of individual actors that potentially affect and constitute the whole social structure (Avgerou 2013).

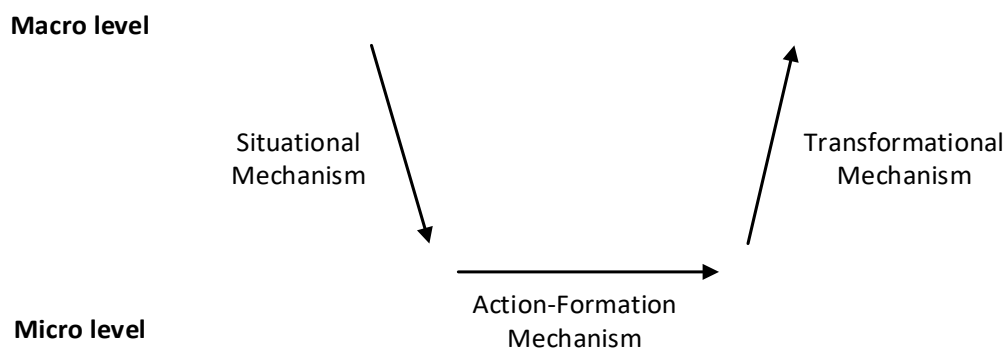


Figure 2-4 Hedström and Swedberg's (1998) social mechanisms

Another example of a generative mechanism is by examining the interactions of structural components that lead to the current events. For example, Anand et al. (2007) identify the ‘generative elements’ and propose the ways they collaborate by which the several mechanisms are formed. They define generative mechanisms as ‘motors’ that explain the pathways of new practice creation in the organisational context. The generative elements account for the professional expertise, socialised agency, core competence and organisational resources that are combined in several ways to enable new practices creation.

Table 2-11 Examples of generative mechanism in the literature

#	Generative mechanism	Description	References
<i>Related to the social system</i>			
1	Self-reinforcing mechanism	The recursive action of the structure of feeding itself	(Bygstad 2010; Henfridsson and Bygstad 2013; Schreyögg and Sydow 2011)
	• Coordination effects	A more efficient interaction resulted from rule-guided behaviours in organisations	
	• Complementary effects	Combination or synergy of resources or practices that produce better outcomes	
	• Learning effects	The productivity resulted from the institutionalised operation – where actors have acquired skills to perform the tasks	
	• Adaptive expectation effects	The adoption of new [product or services, etc] based solely on mimetic force	
2	Adoption mechanism	The recursive effect between new service adoption and more resources investment. That is, the more users adopt a new service, the more vendors allocate the resources which subsequently allows for more service offers	(Henfridsson and Bygstad 2013)
3	Innovation mechanism	The emergence of new product or services from the recombination of resources which is primarily driven by business or vendors	(Henfridsson and Bygstad 2013)
4	Scaling mechanism	The expansion of digital infrastructure to new entities, such as through web services integration	(Braa et al. 2007; Henfridsson and Bygstad 2013; Sahay et al. 2013)
<i>Individual – collective actions mechanism</i>			
5	Situational mechanism	How a structure as a whole enables and constrains its components below (macro-micro)	Hedström and Swedberg (1998)
6	Action-formation mechanism	How actors’ beliefs and opportunities lead to a specific action (micro-level)	Hedström and Swedberg (1998)
7	Transformational mechanism	How components at the micro-level interact with each other to generate a certain outcome at the macro-level (micro-macro)	Hedström and Swedberg (1998)

2.5 Summary

This chapter presents the literature review on ICT4D and the theoretical lenses from service literature and mechanism literature. In the ICT4D literature, studies in the past decade are reviewed based on the three streams of ICT4D research. The characteristics, strengths, and weaknesses of each stream are discussed and then lead to the identification of three knowledge gaps in the body of knowledge of ICT4D related to the conceptualisation of value and resources, users and stakeholders, and the social structure. Then, conceptual foundations of Service Dominant Logic are discussed particularly on how their foundational premises and the theoretical construct of service ecosystem can inform this study. This chapter then outlines the unresolved issue of the dynamics of the service ecosystem by highlighting the concept of generative mechanism.

The next chapter presents the methodology of this study, which is designed to pursue the objectives and to answer the research questions.

3 Research methodology

3.1 Chapter overview

Chapter 3 describes the research methodology including the research design. It presents the study's philosophical stance, followed by the processes and techniques of data collection, analysis, and interpretation. This chapter is divided into seven sections. It starts with the philosophical stance of research (Section 3.2) that underlines the methodological choice and the type of theory generated from this study. Section 3.3 describes the case study design, cases selection, and their justification. In Section 3.4, details of data collection technique are explained. Section 3.5 describes the technique used to process the data and subsequently the methods used to interpret the findings. Then, it is concluded with explaining how rigour and validity aspects are maintained throughout the research (Section 3.6) and chapter summary (Section 3.7).

3.2 Philosophical stance

Before designing the fieldwork and planning the procedures for collecting and analysing data, researchers need to be conscious of the philosophical stance they take (Hassan et al. 2018). This stance helps them review the importance and significance of their research, and further "ensure their work is rigorous and insightful [...] to improve the quality of the work itself" (Hassan et al. 2018, p. 1). The diversity of philosophies underlining social science research, including Information Systems (IS) research, is well-known and always expanding throughout the time (Cecez-Kecmanovic 2011; Dubé and Paré 2003; Mingers 2004; Orlikowski and Baroudi 1991; Walsham 1995). This diversity emerged from the various stances taken by the researchers on the ontology (the form and nature of reality that can be known about) and the epistemology (the nature of human knowledge toward such reality) of social science (Guba and Lincoln 1994).

In the IS discipline, the philosophical stances emerge from three established research paradigms; 1) positivism, 2) interpretivism, and 3) critical realism (Mingers 2001, 2004; Orlikowski and Baroudi 1991). Positivism views the objective reality as its ontological stance. It perceives the general law as a part of the nature of our world, thus the researchers' role is to

find the causality between observed variables or constructs to generate patterns or relationships as new knowledge. These patterns or relationships heavily depend on the regularities in the empirical world, which explain why surveys, experiments, or archival data analysis are the preferred methods for this paradigm. Interpretivism, on the other hand, objects the regularities in social sciences and argues that the reality is socially-constructed based on local values or meanings. Therefore, the role of researchers is to explore and interpret the values or meanings that constitute local practices. The generated knowledge is, therefore, contingent on the subjective interpretation of the involved parties (Gephart 2004) which explains its relativist stance (Tsang 2014). The researchers are normally required to interact deeply with the phenomena through case studies or ethnography.

Critical realism (Bhaskar 1975; Bygstad et al. 2016; Wynn and Williams 2012) concurs with positivism on the objective reality but perceives it as stratified. It views the complete reality, especially in social sciences, is inaccessible to any human due to our limited capacity to observe it. Therefore, critical realist argues that research is primarily on the ‘empirical domain’, and the best we can do is to generate the most approximate explanation of the reality acquired from the findings on ‘empirical domain’. These approximate explanations are acquired from both interpreting the findings and revisiting the current knowledge (i.e., literature). Unlike positivism, the knowledge generated by critical realist is mainly explanatory rather than prediction. Table 3-1 summarises these three research paradigms in IS.

Table 3-1 IS research paradigms and their characteristics (Tsang 2014)

	Positivism	Interpretivism	Critical realism
Ontology	Objective reality	Subjective reality based on humanly constructed-knowledge; multiple realities possible	Objective but stratified (i.e., domains of the real, actual, and empirical) due to limited direct access of human
Epistemology	Finding patterns or relationships that can predict general law of studied phenomenon	Interpreting the phenomenon, framed with subjective meaning to construct knowledge	Iterative approach (i.e. retrodution) of interpreting data and abducting existing knowledge to find the most approximate explanations
Methodology	Relies on hypothetico-deductive approach using quantitative methods such as surveys, experiments, and archival data analysis	Qualitative methods primarily case studies, ethnography	No preference on research methods

Considering the broad research question addressed in this thesis—*How is the institutional structure of service ecosystems transformed following the introduction of ICT?*—this research adopts critical realism as the paradigm (Bhaskar 1975; Easton 2010; Mingers 2004; Sayer 1992; Smith 2006; Tsang 2014; Wynn and Williams 2012) for two reasons. First, the research aims to explore the process and mechanism of transformation which involves the ‘how’ and ‘why’ questions about the phenomenon (Heeks 2002; Skålén et al. 2015). This implies that it does not seek to find causal relationships between constructs as posited by the positivism paradigm. The research question also expects rich explanations rather than predictive theory (as in positivism), since social transformation is a complex process that comprises multiple aspects such as networks of actors, social attributes, technical artifacts, and their combinations (Bygstad et al. 2016). As described earlier, a critical realist research generates an explanatory theory that takes into account multiple aspects including the use and misuse of IS along with power, motive, and interaction within the social structure (Wynn and Williams 2012).

Second, the research engages with an in-depth exploration of a complex social structure in a healthcare ecosystem. It explores a case of nation-wide HIS project in Indonesia which is an appropriate and rich context to address the knowledge gap on the need for broader and holistic research described in Chapter 2. In line with the research objective and context, it is argued that the broader transformation process and mechanism are better explained by critical realism studies (Henfridsson and Bygstad 2013; Njihia and Merali 2013; Strong and Volkoff 2010), which comprehensively consider both chronological apprehension and multilevel unit of analysis. Critical realism research generally reflects on the historical process that constitutes the current setting of the phenomenon (Njihia and Merali 2013). Thus, it emphasises that social structure is continuously emerging, instead of ‘emergent’ as commonly described in interpretive stance. Critical realism also strengthens typical interpretivist ethnographic studies through “tracing the causal powers of structural relations” (Decoteau 2017, p. 73).

Critical realism is still considered as an emerging paradigm in IS, since to date the IS discipline is dominated by positivism and interpretivism paradigm (Dubé and Paré 2003; Mingers 2004; Walsham 1995). A brief description of critical realism approach is discussed below.

Critical realism approach

Unlike positivism or interpretivism, critical realism does not have any specific preference in data analysis and theoretical building (Tsang 2014). This is considered as a way to tackle the issues pertaining to the lack of rationality in a strong/pure interpretivism, and the lack of

empirical relevance in the positivism (Smith 2006). Accordingly, most of the empirical critical realist case studies combined the *inductive* data analysis and theory building in strong interpretivism (such as in a grounded theory technique (e.g. Strong and Volkoff 2010)), with *deduction* approach posited by positivism (Eisenhardt 1989; Yin 2018). In this regard, this study follows the principle of analysis from the critical realism perspective (Wynn and Williams 2012), by relying on established qualitative data processing and analysis by Miles et al. (2014) and Saldaña (2009) for within-case analysis, and subsequently empirical corroboration by adopting stacking comparable cases for cross-case analysis (Miles et al. 2014; Yin 2018).

Critical realist IS research develops theory inductively from data as well as abductively corroborate it with current knowledge from literature (Bygstad et al. 2016; Volkoff et al. 2007; Volkoff and Strong 2013; Williams and Wynn 2018; Wynn and Williams 2012). This approach, defined as *retroduction*, represents the ontological nature that the reality is objective and independent of human's knowledge and that our capabilities in observing the 'reality' are limited. Critical realist acknowledges the existence of social structure that guides the human actions in the empirical domain (Bygstad et al. 2016). The human actions are defined as *events*, generated in certain *mechanism* and shaped by certain *contingencies* associated to the context. Conducting a case study research is a way to identify empirical events in a natural context with specific contingent conditions from which the scholars seek to deepen the domain to gain a theoretical understanding (Tsang 2014). Figure 3-1 below illustrates the relationship between socio-technical structure, events, contingent conditions, and their mechanisms in critical realism (Sayer 1992; Tsang 2014).

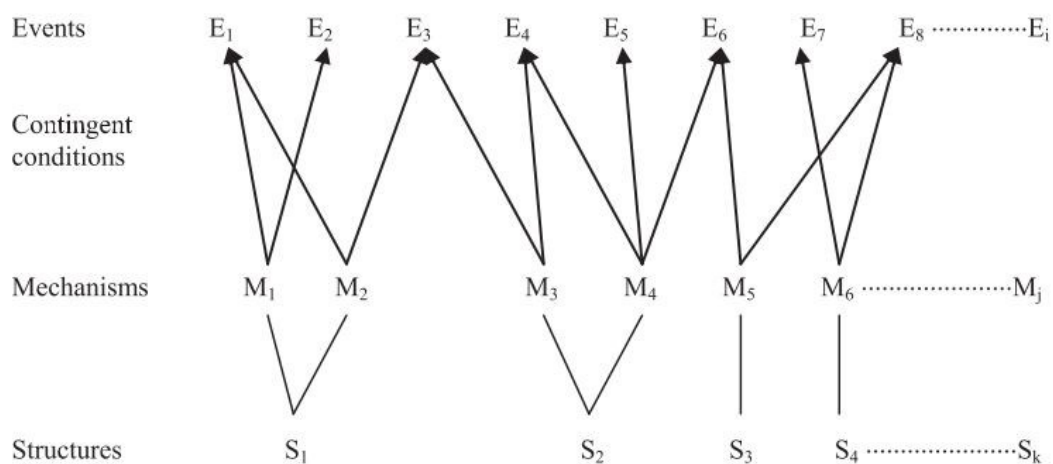


Figure 3-1 Critical realist view of case study (Sayer 1992; Tsang 2014)

3.3 Research method and design

Case study (Yin 2018) with qualitative approach is used in this study. This method allows the researcher to conduct an in-depth investigation in a natural setting and builds a comprehensive representation of the phenomenon of interest (Miles et al. 2014). Case study is regarded as a useful approach for novice social science researchers as it allows them to “get up close to the case being studied” (Yin 2018) and is “useful for investigating broad and complex phenomena that are insufficiently explored” (Keutel et al. 2013, p. 256). The qualitative approach, on the other hand, enables the researchers to explore rich descriptions from the informants’ point of views (Miles et al. 2014) so a complete story of the events can be produced (Pentland 1999). The choice of this method is also aligned with critical realism paradigm which suggests the researchers to study the social phenomena in an open system (Bhaskar 1975; Easton 2010; Wynn and Williams 2012). Through case study, the researcher can identify events related to HIS enabled transformation in the empirical domain, which subsequently allows the researcher to synthesise the mechanism of structural transformation happened in the real domain associated with those events (Strong and Volkoff 2010).

3.3.1 Multiple case study design

This study employs a multiple case study design (Yin 2018). As a critical realist research, this study seeks to find the most approximate explanation of the reality. Certainly, identifying the transformation is challenging since it is often unobservable and not directly accessible. Therefore, this study argues that the mechanism of socio-technical reproduction and transformation in developing countries could be comprehensively explained by looking at different cases with different outcomes. As such, the researcher then can obtain a comprehensive understanding of the ‘empirical domain’ in a broader perspective so the explanatory knowledge of the ‘reality domain’ could be generated (Bhaskar 1975; Wynn and Williams 2012). Undoubtedly, looking at several cases can offer different insights and enable a good exercise on the empirical domain to gain a good grasp of the reality of socio-technical transformation (Lapointe and Rivard 2011).

A multiple case study also offers a better perspective for ICT4D research. For decades, ICT in developing countries is significantly constrained by the state of resources and unique socio-cultural settings (Braa et al. 1995). In this regard, Barrett et al. (2015) suggest that conducting research in various contexts with different characteristics (in terms of resources, actors, and institutions), can lead to a comprehensive understanding of the process of transformation.

Indeed, Indonesia has a wide range of regional characteristics, ranging from ethnicity, language, technological readiness, in which the disparity is becoming larger since decentralisation in 1997. The decentralisation brings a unique power structure that gives the local government a higher autonomy in program design and manifestation, resulting in diverse institutional rules across districts (Wahid 2004; Walsham 1993).

3.3.2 Cases selection

This study selected the Indonesian healthcare ecosystem as its case. The macro-level was represented by the Ministry of Health (MoH). Then, the embedded cases were represented by three different districts, in which the meso-level was represented by the health district government and the micro-level was represented by Primary Health Care. The macro, meso, and micro-level were merely the abstractions of healthcare ecosystem to enable the exploration of institutional arrangements (Vargo and Lusch 2016) and bottom-up and/or top-down mechanisms (Bygstad et al. 2016). This also allowed the researcher to observe the context as a dynamic and evolving structure reconfiguring itself from top-down or bottom-up interaction with nested-levels in the lower layers (Chandler and Vargo 2011). The case descriptions are presented in Chapter 4, while in this chapter they are named as District A, B, and C.

This study used the *maximum variation cases* (Flyvbjerg 2006) as the method for case selection. It explored a variety of cases with a significant variant (and similarities) of the setting; events, resources, HIS introduction outcome, or established healthcare process (i.e., institutions). The choice of this method is thus aligned with Barrett et al.'s (2015) suggestion that the disparity on resources and institutional settings involved in ICT introduction plays an important role in providing context for empirical investigation since it offers rich insights into the pattern of innovation process. In a similar tone, Miles et al. (2014) suggest that the cases should not be selected based on representativeness (i.e. replication logic), but are driven by study's objectives. Prior studies show that the *maximum variation cases* provide better and more comprehensive explanatory findings. Lapointe & Rivard (2011), for example, selected three unlike hospitals "to maximise variation and allow comparison" (p. 469) in exploring IT resistance in healthcare context. Based on similarities and variations of cases characteristics, the researchers had the opportunity to gain a deeper explanation in a different array of combinations, such as ICT with the same type of hospitals, hospitals with the same implementation outcome, or hospitals with different software. As such, case selection for this study was conducted "in the sense of allowing one to gain certain insights that other

organisations would not be able to provide” (Siggelkow 2007, p. 20), which is “often a great way to motivate a research question” (p. 21).

3.4 Data collection

This study collected multiple sources of data. The primary data sources were interviews, field notes, and photographs, where secondary data sources were published materials and document/archival artifacts. A wide array of data sources enables empirical corroboration (Wynn and Williams 2012) that supports internal validity through triangulation (Yin 2018). The interview was not the sole primary source due to its proneness to bias (Myers and Newman 2007) from which the generated theory will simply be a “retrospective of image-conscious informants” (Eisenhardt and Graebner 2007, p. 28).

3.4.1 Primary data sources

3.4.1.1 *Semi-structured interviews*

The first primary data source for this study are interviews. Interview is a common or well-accepted source in case study research as it offers an efficient way to generate empirical data, especially when the objective involves episodic phenomenon (Eisenhardt and Graebner 2007). *Purposive sampling* was used to select key actors who were believed to be able to provide insightful opinion (Merriam and Tisdell 2015). This approach underlines the main purpose of generating “specialty rather than average opinion” (Merriam and Tisdell 2015, pp. 96–97). In details, two techniques of purposive sampling were used: *maximum variation sample* and *convenience sample*. *Maximum variation sample* was used to seek “maximum range of characteristics of the people [...] to show a variety of instances of phenomenon” (p. 97). Thus, this approach, defined as the two-tier sampling (Merriam and Tisdell 2015), is in line with *maximum variation case* (Flyvbjerg 2006) used in selecting the cases. *Convenience sample* was only an alternative where certain people were unreachable. This technique was applied in selecting two participants; an interview with district’s secretary instead of its head (District A), and an interview with lower-level staff (secretary) instead of the head of a committee of Indonesian Medical Association. However, the chosen participants were still considered adequate to provide relevant answers.

Table 3-2 Distributions of interviews across each district

Level of context	Interviewees (#personal interviews)		
Macro-level	<ul style="list-style-type: none"> Center of Data and Information, Ministry of Health, managerial-level (1) Public Health Division, data and program (1) Member of Doctor Association (1) WHO representative (1) National IT consultant (1) IT vendor, C-level (1) Center of Excellence (CoE) for HIS in Indonesia, head (1) Total interviews: 7 (all personal interviews)		
	<i>District A</i>	<i>District B</i>	<i>District C</i>
Meso-level	<ul style="list-style-type: none"> Secretary of district health government (1) Local IT consultant (1) Data and information division (2 personal interviews, 2 group interviews) 	<ul style="list-style-type: none"> Mother & child division (1) Infectious disease division (2) Primary healthcare management division (1) Data and information division (1 personal interview, 1 group interview) 	<ul style="list-style-type: none"> Immunization (mother & child) division (1) Data division (1, group) Local IT consultant (1)
Micro-level	<ul style="list-style-type: none"> Midwife (1) Nutritionist (1) Nurse-data officer (1) Patient (1) 	<ul style="list-style-type: none"> Data and information staff (1) IT officer (1) Midwife (1) Nurse - Tuberculosis officer (1) Mother & child (immunization) (1) 	<ul style="list-style-type: none"> Head of PHC (1) Midwife (1) Registration (1, group) Data officer (1) Immunization (mother & child) staff (1)
	Total interviews (districts):		
	10 (8 personal interviews, 2 group interviews)	11 (10 personal interviews, 1 group interviews)	8 (7 personal interviews, 1 group interview)

The interviews were designed as semi-structured, where the questions were open-ended, conducted in the natural environment as preferred by the participant. The questions are essentially related to major ICTs introduction (success or failure) in recent years, the process of institutionalisation of those ICTs (including regulation), and the use and impact of those ICTs (see Appendix B for the list of interview questions). At the macro-level, 7 interviews were conducted; one with a managerial-level government official in the Center of Data and Information, Ministry of Health, one with a data and program officer in Public Health Division, Ministry of Health, one with a Member of Indonesian Medical Association (who declared that his opinion did not represent the Association), one with a WHO representative,

one with a national IT consultant, one with an IT vendor representative (the biggest market share of PHC IS in Indonesia), and one with a Center of Excellence (CoE) for HIS in Indonesia from academics.

Table 3-3 Participants at the macro-level

ID	Position	Role description
ID01	WHO staff	External entity who provides advice on nation healthcare system
ID02	Program manager in MoH (data and information)	Head of subdivision in MoH related to data and information of nation health system. Responsible for development of nation-wide HIS.
ID03	Program manager in MoH (public health division)	Program manager who is responsible of data and information of public health division in MoH
ID04	C-level IT vendor	Chief Marketing Officer of the largest e-health provider in Indonesia
ID05	Officer in National Doctor Association	the A doctor who held a position in National Doctor Association
ID06	National IT Consultant	Nation-level HIS consultant currently working with MoH

In District A, a total of 10 interviews were conducted. In detail, six interviews were conducted at the meso-level of this district; one with a secretary of district health government agency, one with a local IT consultant, and four interviews with data and information division representatives (two personal interviews, two group interviews). At the micro-level, four interviews were conducted; one with a midwife, one with a nutritionist, one with nurse/data officer, and one with a patient.

Table 3-4 Participants in District A

ID	Position	Role description
AR01	Secretary of Health District Government	Deputy of health district government who held responsibilities on district's health policy and program
AR02	Local IT Consultant	Provides training, develops Standard Operating Procedures and application systems manual
AR03	Head of Data and Information Division, Health District Government	Responsible for district health information systems including data reporting, dissemination, and its supporting ICT application systems
AR04	Staff of Data and Information Division, Health District Government	Responsible for data aggregation, formatting, and data input (immunisation and TBC)
AR05	Data and Information Division in Province Government	Hold responsibility for province-level data and information. The interview focused on the higher-level perception of Anakranti's health system
AR06	Public Health Division & Chief of District HIS (ad-hoc team)	District-level staff hold is appointed as ad-hoc manager for planning, development, and management of District HIS (SIKDA)
AR07	Midwife in PHC	Provides day-to-day mother & child health care services especially delivery as well as data reporting
AR08	Nutritionist in PHC	Provides day-to-day mother & child health care services especially pregnant nutrition and infant growth development as well as data reporting

ID	Position	Role description
AR09	IT system operator and nurse	A nurse who is appointed as IT system operator in a PHC
AR10	Patient	A patient in a PHC

In District B, a total of 11 interviews were conducted. At the meso-level of this district, six interviews were conducted; four with non-IS stakeholders (mother & child division, infectious disease division, primary healthcare management division), two with data and information division representatives (one personal and one group interview). At the micro-level, five interviews were conducted; one with data and information division officer, one with data (IT) officer, one with a midwife, one with a Tuberculosis officer, and one with a patient.

Table 3-5 Participants in District B

ID	Position	Role Description
BT01	Head of Primary health care division, Health District Government	Responsible for standardisation and monitoring of all PHCs in the district
BT02	Head of Family Health Division, Health District Government	Responsible for all programs related to family health (Mother, Child, Nutrition); promotive, preventive, rehabilitative
BT03	Head of Contiguous Disease Division, Health District Government	Responsible for all programs related to contiguous disease; promotive, preventive, curative, and rehabilitative
BT04	Staff of Contiguous Disease Division, Health District Government	Responsible for data aggregation, formatting, and data input (Tuberculosis)
BT05	Staff of Program and Monitoring Division in District Government	Division's staff who hold responsibility for planning, development, and monitoring District HIS
BT06	Head of Program and Monitoring Division in District Government	The head of a division who holds responsibility for planning, development, and monitoring District HIS
BT07	Head secretary in PHC, ex-Head of Program and Monitoring Division in District Government	The head secretary in PHC who is responsible for day-to-day activities in PHC. She is an ex-Head of Program and Monitoring Division in District Government
BT08	Nurse and IT operator in PHC	A nurse who is also appointed as IT operator a PHC
BT09	Midwife in PHC	Provides day-to-day mother & child health care services especially pregnant nutrition and infant growth development as well as data reporting
BT10	Data clerk and nurse	A nurse who is appointed as a data clerk in a PHC
BT11	Patient	A patient in a PHC

In District C, 8 interviews were conducted. At the meso-level of this district, three interviews were conducted; one with immunization (mother & child) division, one with data (functional) division (group interview), and one with IT consultant. At the micro-level, five interviews were conducted, one with the head of PHC, one with a midwife, one with registration staff (group interview), one with data officer, one with immunization (mother & child) staff.

Table 3-6 Participants in District C

ID	Position	Role / objective
CL01	Staff of Mother & Child Division, Health District Government	Responsible for all programs related to Mother & Child; promotive, preventive, curative, and rehabilitative
CL02	IT operator and data clerk	Responsible for data aggregation and occasionally assist technical problem reported by PHC
CL03	Local IT consultant	Provides training, develops Standard Operating Procedures and application systems manual
CL04	Midwife in PHC	Responsible for data aggregation, formatting, and data input (Tuberculosis)
CL05	Data clerk and nurse in PHC	A nurse who is appointed as a data clerk for immunization in a PHC in the district
CL06	Head of PHC	Holds responsibility for planning, management, and evaluation of programs and resources in PHC
CL07	Staff of Disease Control and Monitoring in PHC	A staff of Disease control and monitoring who also collect and report all related data
CL08	Admission and medical record staff	A group of staff who receive patients' admission, retrieve [hardcopy] medical records, and forward to the suitable room
CL09	Treasurer and IT operator	A treasurer who is also appointed to collect and report all PHC data to send it to district government

Most of the interviews were conducted in Bahasa Indonesia except one in English (the WHO Indonesia's representative). The interviews make a total of approximately 23 hours recording (38' on average). The length of the interviews varied based on the criticality of the interviewee's insights related to the information the researcher aimed to explore. After few sessions of interviews and observation, the researcher wrote field notes on what to asks and whom to ask, which make some interviewees were asked certain types and specific questions to discuss which were initially not designed in the original interview protocol. This study involved a broad space of context from micro-level to macro-level actors, which made the general lists of questions initially written in the planning phase were required to be specified to each participant. Nonetheless, the researcher attempted to keep the research objectives were being addressed in each interview while also avoided the subjectivity during interview.

Most of the interviews at the micro-level were conducted in each of the interviewees' workplace, while top-level district government (meso-level) and macro-level actors were mostly conducted in an arranged schedule and a place according to their prior suggestion. There was also a couple of interviews during the observation on HIS training, workshop, or monthly-meeting. Each interview was audio recorded, and subsequently copied and stored in cloud space according to cloud storage specification approved by University of Melbourne Ethics Application.

3.4.1.2 *Field notes and observations*

The second primary data sources for this research are field notes and observations. Observation was conducted on both routine and incidental events based on the suggestions of the national and local consultants. The researcher's role was an observer, that the field study was conducted without any active involvements or intention to intervene on projects or daily activities in the field. Access and approval were gained through an official request submitted to the district's regulator (see Appendix A for detail). The observations were conducted to gain insights on the structural components such as the cognitive capacity of the actors, the development of standard operating procedures, the inter-organization relationship, and the important issues arising during the meeting on HIS implementation at each level.

A total of 10 events across the accumulated 15 days (approx. 89 hours²) were observed. At the macro-level, two observations were conducted; one on five full-day conferences and workshops and one on a half-day workshop. In District A, four workshops and one internal meeting across 7 days were observed. In District B, however, the observation was only conducted at the micro-level, because at that time no agenda was suitable to perform any observation, thus interviews were more intensified. In District C, one meeting and two events of training/workshops were observed. The output of these observations were videos, photographs, and field notes.

The field notes consist of two types of contents. The first are notes on unrecorded interviews or informal discussion with colleagues, actors, of which the researcher wrote key information regardless it will be useful later or not. During the fieldwork, the researcher gained an understanding that unique, important, and intriguing insight often came in a natural setting. The 'pure gold' often came after the interview ended and when both parties moved to friendly and casual talks, making the researcher immediately reached his app and enlisted all non-sensitive but important insight emerged in that natural situation.

The second are notes about natural setting observed during fieldwork. This includes micro-level actors' use of computer and mobile phone which unveil their technology literacy or possible issue with the language barrier. The field notes also describe the current findings/understanding (what I learned so far), what to find next, and who can provide such

²One full-day training / workshop has approximately 6 effective hours (9am-4pm), while half-day workshop is counted 3 hours. Internal meeting is counted approximately 2 hours each.

information. This especially was applicable during the discussion about multilevel setting where clarifications were needed, either top-down or bottom-up. Thus, it represents the use of theoretical sampling as a principle in this exploratory journey (Eisenhardt and Graebner 2007). The field notes were written using Evernote[®] (mobile app) and notebook. In major occasions, the researcher wrote them immediately in Evernote[®] app at the moment they were freshly captured, and then detailed further in Ms Word[®]. The notes were then expanded (Miles et al. 2014) (see Appendix E) which produce 35 pages of write-ups (see Section 3.5.1.1).

From an ethnographic perspective, observations played an important role in this qualitative research (Trauth 1997). For example, one important milestone in identifying potential cases was the researcher's direct observation on a national workshop performed before starting fieldwork and data collection (October-November 2017). In this all-week workshop, the researcher was involved in all formal activities as well as informal social agenda such as lunch, dining, and night tour, where the researcher gained important insights, created networks, accesses, contacts, formal procedures needed to pursue, as well as inputs on how this research might be suitable to undertake. Thus, the researcher had established the contact as the first objective of the case study (Yin 2018).

All of the social activities were repeated throughout the fieldwork, from coffee shop conversation when we discussed the management politics involved in the country's HIS initiative, the daily walks around relaxed and peaceful atmosphere of District C when the researcher gained an impression about the people's attitude toward change and technology, and to an unexpected meeting with 'Captain America', who was avoided by the staff for being 'know-it-all', which on the contrary was a golden treasure who gave the researcher some important insights on 'what is going on'. By socialising, the researcher was questioning his assumption, collecting metadata, and sharpening his research goal (Trauth 1997).

3.4.1.3 Photographs

Photographs have been acknowledged as useful sources for social research, since they show concrete representations of events and contexts (Schwartz 1989). They revoke or trigger the researcher's visual memory of the event, which are helpful in interpreting and understanding the meaning of the primary data sources (i.e., interview transcript). These photographs complement field notes taken during workshop and training sessions, healthcare service provision in primary health care, existing HIS and infrastructure. A total of 98 photos and 39 minutes of video were collected. The researcher to some extent found them useful in data

analysis. For example, during an observation in a micro-level PHC, the researcher and some actors discussed data visualisations presented on the wall and discovered that certain visuals are meaningless and may even mislead visitor's interpretation. Photographs taken during this activity evidently became an instantiation of a nation-level consultant's input in the previous informal discussion about the current skill and knowledge of micro-level actors.

3.4.2 Secondary data sources

The secondary data sources for this study are published and unpublished materials such as media and internal documents. These sources were regarded as secondary data source since we cannot rely solely on them because of the potential issues with their authenticity and accuracy (Merriam and Tisdell 2015). The unpublished material includes the national grand design of HIS or government and vendor internal data and documents. These media were copied and accessed through permission by participants, such as current recorded applications and the prevalence of diseases. List of documents and other secondary data is presented in Appendix D of this thesis.

Tahun Anggaran	Pagu			Realisasi	
	DAK	Sharing	Jml	Jml	%
2009	7,346,000,000	734,600,000	8,080,600,000	8,062,082,072	99.77
2010	7,603,490,910	760,349,091	8,363,840,001	8,348,102,000	99.81
2011	5,205,900,000	520,590,000	5,726,490,000	5,598,076,900	97.76
2012	7,633,700,000	763,370,000	8,397,070,000	8,183,106,500	97.45
2013	6,166,390,000	616,639,000	6,783,029,000	6,727,494,285	99.18
2014	8,943,590,000	894,359,000	9,837,949,000	7,781,606,777	79.00
2015	7,338,410,000	733,841,000	8,072,251,000	6,284,062,340	77.85
2016	31,985,496,000		31,985,496,000		
2017					
2018					

Bagian Program dan Pelaporan Dinas Kesehatan

Figure 3-2 Sample of annual health budget (2009 – 2016) published in District C

The second type covers published materials such as the international report on the country health, official reports, or information usually published in each PHC or district government office. Bureau of Statistics of Indonesia (Indonesia: Badan Pusat Statistik – BPS) is a reliable source and open to the public, who also has a specific website for every province and district. To maintain the anonymity of the districts, the researcher only provides a nation-level website <https://bps.go.id/>. The website provides sufficient data such as demographics, humanity

(education), general indicator of health status (e.g., life expectancy), or economic setting. Detailed data on district's health normally can be accessed from each regional health government website, most of which were unfortunately limited, incomplete, or unavailable. Each province/district health government has its own website which ideally provides a downloadable annual report of health status of the respective province/district. The reports typically include data on primary health care, health workers, and hospitals coverage. Finally, the Ministry of Informatics provides a brief overview of the country and regional ICT characteristics such as internet and media communications.

3.5 Data processing, analysis, and theory-building

3.5.1 Qualitative data processing

3.5.1.1 Data preparation

Miles et al. (2014) stress the importance of data pre-processing before conducting analysis. This is especially applicable to textual data (interview transcripts, field notes, and documents). The researcher, therefore, collected all field notes either from notebooks or Evernote® and wrote-ups respectively to the related case. The interview recordings were transcribed. 70% of recording is transcribed by the researcher himself, while the other 30% was transcribed by a professional transcriber with a confidentiality agreement. The transcriptions were in its original language, Bahasa Indonesia, except for one interview in English. The transcriptions include word emphasis, interviewees' body language (e.g., laughing, exclaiming, shouting), and noticeable actions (e.g., showing a document, mimicking). Not all verbatim data were transcribed. Body languages and noticeable actions are selected and coded only if they potentially invoke researcher's visual memory of the moment to aid data analysis. Participants' gestures, humming, or stuttering, which is considered unimportant or even distracting, were not coded. A total of 321 pages of transcriptions were produced. Once the transcriptions were finished, the researcher prepared them by renaming, re-listening, for checking possible errors for the sake of easiness and validity of the analysis. After this pre-processing step was finished, the transcriptions were imported to the QACDAS tool (nVivo 11).

Data preparation were also applied to other data sources. The raw field notes were expanded as they usually contain abbreviations, sketch, and fragmented sentences that did not present a complete story of the captured moment. Selected raw field notes (hard copy and mobile text apps) were rebuilt into expanded write-ups (Miles et al. 2014). These expanded write-ups

contained 35 pages. On the other hand, photographs and videos, which were mostly taken by mobile phone, were transferred to the PC where data analysis was mostly conducted. These media were sorted and grouped based on the cases. Only selected media were imported to nVivo, mainly based on whether these certain photographs or videos were useful in triggering the researcher's visual and audio memory related to the transcriptions as a way to complement the analysis. As such, the principle of data triangulation was maintained throughout the analysis (Yin 2018).

However, given that the majority of the data were textual data which provide authenticity and reliability of the findings, the researcher needs to focus on describing the technique used to process and analyse these *words* which is presented in the following section.

3.5.1.2 *Disassembling data*

Having an overwhelming large number of words, a qualitative researcher needs to *disassemble* the data into a 'chunk of evidence' (Yin 2018), or codes (Miles et al. 2014; Saldaña 2009). Though the scope and focus of the case study had been designed, the actual data collected during the fieldwork was still inevitably overloaded. Thus, disassembling the data to find evidence adequately addressing research questions is indispensable. In a form of words, these chunks of evidence were defined as *codes*, that "prompts or triggers for deeper reflection on the data's meanings" (Miles et al. 2014, p. 58). The process of disassembling them is defined as coding where certain data segments were tagged or labelled, enabling the researcher "to retrieve the most meaningful material, to assemble chunks of data that go together, and to further condense the bulk into readily analysable units" (Miles et al. 2014, p. 58).

However, there are different approaches to generating knowledge from these codes. An established approach to data analysis is to have an initial 'smaller' research question and then "identify evidence that addresses the question" (Yin 2018). Miles et al. (2014) recommend creating "a provisional start list" of "deductive coding" that represents conceptual framework, problem areas, or key concepts related to the study in data analysis (p. 64). However, the researcher chose not to adopt them, and rather to conduct a pure inductive coding in the first cycle, much similar to the grounded theory strategy as it follows the exploratory nature of this study. The idea is to be open with field data without predetermined designed coding as performed by previous critical realist studies (e.g., Volkoff et al. 2007). Though the researcher had gained an understanding of the phenomenon from the fieldwork, aided by the theoretical sampling and field notes, the analysis was kept open without any prior assumption of the

findings. Thus, the first step of induction was maintained, which concurred with critical realism research (Bygstad et al. 2016; Strong and Volkoff 2010; Volkoff and Strong 2013). Nonetheless, Yin (2018) appreciates inductive coding used in grounded theory strategy as it often produces new concepts that are surfaced from bottom-up data analysis. The technique is also suitable for novice researchers who are less familiar with and less understanding of their own field of study (Yin 2018). Similarly, Miles et al. (2014) approve that this approach is “better grounded empirically” as well as potentially “uncovered an important local factor” (p. 64). As Gioia et al. (2012) emphasise, “advances in knowledge that are too strongly rooted in what we already know delimit what we can know” (p. 16).

In the first cycle of coding, the texts were coded into data chunks using nVivo 11. Among 25 techniques available for coding (Miles et al. 2014), the researcher mainly used *descriptive, in vivo, and evaluative coding*. In vivo was prioritised as it uses participants’ own language, thus it is independent of the researcher’s interpretation or possible inaccurate descriptive coding. Descriptive code was used to assign a basic topic to a certain phrase or passage in which none of the words could represent the whole idea. Last, evaluative coding was used in conjunction to descriptive and in vivo coding where the researcher states his subjective interpretation of the data by assigning both emotional and evaluative passage in order to capture an impression, value, or experience of the participants. The overall coding process from disassembling, reassembling, to emergent themes is illustrated in Figure 3-3.

“Coding is analysis” (Miles et al. 2014, p. 57), which implies that during this activity the researcher did not only perform a mechanical work (of data coding) but also build his deep reflection on the data. Therefore, aside from tidying and ensuring the consistency in the coding process, the researcher had begun abstracting and identifying the potential findings emerged from the data. The codes in the first cycle had the form of a single term or a phrase (approx. 3-4 words). To ensure consistency of the codes, the naming convention was identified in order to group codes, thus avoiding different meaning from the same words or phrases across the three cases. Further, as suggested by Miles et al. (2014), a directory of codes was created and continuously updated during this process to maintain clarity and reliability of this time-consuming process (p. 67).

3.5.1.3 *Reassembling data*

The outcome of data disassembling is “a summary of segments of data” (Miles et al. 2014, p. 78). The researcher then *reassembled* those segments into emergent themes to gain a higher level of conceptualisation. To aid the process, the researcher referred to the following types of themes that usually emerged in a qualitative data analysis (Miles et al. 2014): a) categories (e.g., rules, objective); b) causes and explanations (e.g., inadequate supports); c) relationship among people (e.g., collaboration); and d) theoretical construct (e.g., rules, logics). However, it is important to note that the process of disassembling and reassembling was performed in loop. The themes were continuously changing through several iterations, mainly after a general sense of how the findings address research objectives had been obtained.

The researcher acknowledges that working on categorising the first level coding into emergent themes was “an inferential process” (Miles et al. 2014, p. 70) that involved the researcher’s cognitive judgment. Thus, the researcher was required to constantly review the emergent understanding of the findings. This was conducted iteratively as researcher’s understanding was continuously emerging during the process which requires him to move back and re-do the process. Consequently, the emergent themes were continuously set to unfreeze as they were frequently reconfigured throughout the process.

In the end, the outputs of this inferential/iterative process were emergent themes grouped into events, contingencies (of generative mechanisms) and impacts (on each ecosystem’s structure). These themes were analysed to build theoretical arguments according to research objectives which is described as follows.

3.5.2 **Data analysis**

Once the emergent themes were established, the next challenge was how to employ analytic techniques to produce empirical findings. A variety of established analytic techniques could be used, such as pattern matching, explanation building, or logic model (Yin 2018). The objective of this analysis is to “specify possible relationships between categories [...] developed in your focused coding” (Charmaz 2006, p. 63) performed in within-case and cross-case analysis for theory generation and “to see evidence through multiple lenses” (Eisenhardt 1989, p. 533).

The researcher combined thematic analysis (Miles et al. 2014; Saldaña 2009), *case-oriented* and *variable-oriented* cross-case analysis (Miles et al. 2014), and critical realist’s approach on data analysis (Bygstad et al. 2016; Wynn and Williams 2012). Similar to previous critical

realist studies (e.g., Bygstad et al. 2016; Henfridsson and Bygstad 2013; Volkoff et al. 2007), thematic analysis was used to group the pattern codes from the previous steps (disassembling and reassembling) into emergent themes. The emergent themes were analysed and continuously updated in a series of iterative cycles between within-case and cross case analyses (Yin 2018). The whole process of data analyses and theory building can be divided in three steps: identification of events and empirical instances of transformation, identification of generative mechanism, and identification of contingencies and impacts.

3.5.2.1 Identification of events and instances of transformation

In the first step, the researcher conducted a process analysis and identified key events and the associated ecosystem's components. The objective was to establish high-level process diagrams (Langley 1999) and empirical 'instances' of transformation (see examples of the use of this instances in Henfridsson and Bygstad 2013; Srivastava and Shainesh 2015). Key events were identified from the pattern codes (interviews) and the secondary data. These events were linked with the ecosystem's components, which are defined into macro-level rules, organization, operation, ICT artefacts (for process diagrams), and institutional rules, resources configuration, actors' institutional logics, practices (for empirical instances of transformation). The process diagrams were useful for the researcher to obtain a broad understanding of the chronology of HIS introduction and non-ICT process in each district. On the other hand, the empirical instances provide a deeper layer of HIS enabled transformation that later were used in the *retroduction* of generative mechanism. The process diagrams are presented in the background of the cases (Section 4.2.3), while the instances of transformation are presented in Table 4-5 in Chapter 4 (Research findings).

The purpose of this process and events analysis is to understand "how things evolve over time and why they evolve in this way" through "events, activities, and choices ordered overtime" (Langley 1999, p. 692). Identifying process is considered difficult, since scholars often deal with multiple entities with ambiguous boundaries, and involve constantly changing relationships and interpretations in an unclear timeline, duration, and relevance (Langley 1999). In IS, the process is a context-specific sequence of events that indicates the specific logics used to explain emergent organisational structure that acknowledges the role of necessary conditions in a particular setting of IT implementation (Markus and Robey 1988). Therefore, critical realism is more appropriate to explain this process since it proposes the underlying generative mechanisms that are responsible of generating this sequence of events.

3.5.2.2 Identification of generative mechanisms

In the second step, the researcher identified and analysed the generative mechanisms. Introduced earlier by Wynn and Williams (2012), Bygstad et al. (2016) further elaborate on the steps of conducting retroduction in IS research in order to identify the generative mechanisms. The principle of retroduction implies that the scholars combines abductive and inductive approach. Therefore, during the identification of generative mechanisms, the researcher went through a number of iterations between the candidate mechanisms from the empirical data and the existing mechanisms from the literature as abductive analysis. The inductive analysis includes the identification of *concrete outcomes* (i.e., impact) of HIS introduction, abstracted into the four structural components of service ecosystems including actors' institutional logics (e.g., initial perceptions toward the initiatives, current attitude toward the role of HIS, and their usage experiences), resources configuration, institutional rules (e.g., process of standardisation, changes on rules), and public health practices. The researcher identified the interrelationships between the events, the concrete outcomes (i.e., the empirical events), the structural component of ecosystem, and the 'human-technical components' (i.e., ICT artefacts) to identify the candidate mechanisms of transformation. The retroduction represents a constant comparison between themes emerged from data and possible alternate explanation from the literature (Mingers et al. 2013).

3.5.2.3 Identification of contingencies and impacts

In the third step, the researcher conducted cross-case analysis to identify the contingencies (of mechanism) and the impacts through *case-oriented* and *variable-oriented* cross-case analysis (Miles et al. 2014). The contingencies and impacts were mainly based on the emergent themes from nVivo data codings. Figure 4-7 and Figure 4-9 in Chapter 4 present the construct map of these emergent themes. The results of cross-case analysis of these emergent themes are presented in a table in each respective section (see Tables 4-6, 4-7, 4-8 for examples).

The cross-case analysis aims "to see process and outcomes across many cases, to understand how they are qualified by local conditions, and thus to develop more sophisticated descriptions and more powerful explanations" (Miles et al. 2014, p. 79). Conducting cross-case analysis as the final step is consistent with critical realist paradigm who various explanations on how emerging socio-technical structure was formed. Cross-case analysis, therefore, is consistent with the choice of case selection method of this study (*maximum variation cases*) in building the comprehensive understanding of the contingencies (e.g., enabling and constraining factors)

and providing rich explanations. While this technique is somehow similar with a *replication strategy* (Yin 2018), it is important to note that the matching process is not aimed to falsify one to another case, but rather to seek an explanation of why it is different rather than to nullify the finding (Wynn and Williams 2012).

3.5.3 Theory building

The final step is to generate theoretical understanding of the overall study to address the broad research question. In line with the retroduction approach, the researcher sought to generate archetype knowledge by combining empirical findings (inductive) with existing knowledge in the literature (abductive). Accordingly, the empirical findings were framed by the critical realist' three moments of structural change (Archer 1995; Volkoff et al. 2007) to generate a theoretical model of ICT enabled service ecosystem transformation. This retroduction approach concurs with the philosophical stance of critical realism on the existence of objective reality which is stratified from empirical domain. Therefore, the research findings represent the phenomenon in empirical domain based on which the most approximate explanation of the reality was proposed in this thesis (Bhaskar 1975; Wynn and Williams 2012).

3.6 Research rigour and validity

Research rigour and validity were established in three ways. First, this study maintained the consistency of ontological-epistemological-methodological approach. The critical realism (as philosophical stance), multiple case studies (research design), and qualitative inductive data analysis are aligned with each other (Miles et al. 2014; Tsang 2014; Wynn and Williams 2012). By ensuring this consistency of philosophical stance and methodological choice, “information systems (IS) researchers ensure their work is rigorous and insightful”, which also “improve the quality of the work itself” (Hassan et al. 2018, p. 1).

Second, the reliability (Yin 2018) was established by maintaining case study protocol, multiple data sources, record management and careful transcribing (Silverman 2001). The researcher re-listened to all the transcriptions, used CAQDAS for data records and analysis, and utilized secure cloud storage for data storage. Research rigour (Klein and Myers 1999) was established by maintaining three aspects: contextualization, abstraction – generalization, and dialogical reasoning. Contextualization was organized by a deep reflection on the historical background of HIS introduction in Indonesia through documents and regulation study and informal social activities with participants. Abstraction–generalization was maintained by employing

theoretical lens to analyse and interpret the empirical findings. Finally, dialogical reasoning was established by a constant reflection on the empirical data that have been collected so far associated with the study's objectives as well as maintaining the objectivity as a researcher during the field study.

Third, theoretical building validity aspect was established by following critical realism principles of data triangulation during construct-building in the data analysis (Pentland 1999; Zachariadis et al. 2013) and empirical corroboration (Wynn and Williams 2012) between the stories and events found in empirical domain and the interrelated structural components of service ecosystem (e.g., impacts and mechanisms). These approaches ensure the *comprehensiveness* and *parsimony* of the emergent theory since they are originated from empirical findings and corroborated by the literature. Table 3-7 summarises the relevant aspects of rigour validity and strategies used in this study.

Table 3-7 Establishing research's rigour

Category	Tests	Tactic	Research phase	References
Case study rigour and validity	The rigour of qualitative and inductive research	Adhered the principles of interpreting data: <ul style="list-style-type: none"> Contextualisation: critical reflection on historical background of HIS introduction in Indonesia Abstraction and generalisation: uses SD logic and generative mechanisms in informing the findings Dialogical reasoning: possible adjustment of preconception (e.g. actors' legitimacy institutionalisation of HIS) 	Data collection, processing and analysis	(Klein and Myers 1999)
	Reliability	<ul style="list-style-type: none"> Developing case study protocol Transcribing and documenting interview audios Using CAQDAS for record and analysis (nVivo 11), and secure cloud storage for data storage. 	Data collection and analysis	(Yin 2018)
Theoretical building validity	Comprehensiveness	Similar to retrodution, the two-ways approach for theoretical findings: what's in the data (interpretive-based) and what's not in the data (literature-based)	Data processing and analysis	(Whetten 1989; Wynn and Williams 2012)

Category	Tests	Tactic	Research phase	References
	Parsimony	Summative validity – identifying events or constructs in other sites that corroborate the findings (cross-case analysis)	Data processing and analysis	(Pentland 1999; Zachariadis et al. 2013)

3.7 Summary

This chapter has described the research methodology and design. The choice of critical realism as the philosophical stance has been presented and justified. The chapter has explained the multiple case study research design, including case selection strategy. Techniques for data collection have been presented. Subsequently, methods, techniques, and tools for data processing, analysis, and theory building. The chapter has been concluded with how research rigour is addressed.

4 Research findings

4.1 Chapter overview

This chapter presents the study's findings. The findings in each section are presented in a top-down structure from the conceptual level to a less abstract level. The constructs and empirical evidence are presented in a cross-case analysis form to simplify for the reading and to avoid repetitions. Such results heavily relied on inductive analytical thinking as a bottom-up discovery process from within-case analysis to cross-case analysis guided by the research objectives: identifying the mechanism of the transformation of service ecosystems' institutional structure and the impact of Health Information Systems (HIS) on this institutional structure.

The chapter proceeds as follows. Section 4.2 presents the contextual background of the ecosystem studied in this research, including an overview of Indonesian healthcare service ecosystems, re-description of the institutional structure of the context, and the background of the three selected districts. Section 4.3 presents the institutional forces triggering the transformation and identification of the candidates of the generative mechanism of institutional transformation, elaborated by the enabling/constraining factors. Section 4.4 elaborates the impact of HIS on each component of the institutional structure of ecosystems. Finally, Section 4.5 summarises the chapter.

4.2 Indonesia Healthcare Service Ecosystems

4.2.1 Country's profile

The developing country selected in this study is Indonesia. Since the political turmoil led to a revolution in 2007, the fourth most populated country in the world adopted decentralisation socio-political system that provides all districts with a higher level of autonomy in governance and management of their socio-economic activities. With over hundreds of ethnicities, the decentralisation enables the local government to manage their district based on its settings, characteristics, strengths, and weaknesses. Nevertheless, the central government still has substantial power in top-down enforcement through standards, regulation, budgetary, and monitoring (Jati 2012; Rahmatunnisa 2015).

All of those settings instil a complex relationship and arrangement between the central and district-level government. The current President's vision of "Indonesia One Data" (see Appendix C) implies the needs for advanced integrated application systems as well as a mature and established business process in the district and micro-level. This vision is initiated based on a WHO assessment³ on the underlying indicators of health information systems in Indonesia in 2007. Most of the key indicators related to health information systems, including resources, data sources, and information products, are assessed as 'not adequate', while the score on data management is 'not adequate at all'. A follow up initiative taken through WHO-Indonesia collaboration strategy (2007-2011) therefore aims to "strengthen and institutionalise information systems with an emphasis on the district level, including better monitoring and use of data"⁴. This strategy indicates that fixating the processes and organisations is as equally critical as the advancement of HIS applications and infrastructure.

In Indonesia, Health Information Systems (HIS) has been defined as one of the core foundations of the national health system⁵. Information systems inevitably play a significant role in sustainability and innovation of healthcare sector in this archipelago country populated by over 260 million inhabitants. Thus, the government has established the binding regulations, from the initial Ministry of Health (MoH) regulation No 511 in 2002 on HIS, to recent amendments including PP (Presidential Law) No 46, 2014 on Health Information Systems, or Ministry of Health Regulation No 46, 2017 on National e-Health Strategy (see Appendix C).

Another major event set in the nation was the introduction of the universal healthcare scheme called The Indonesian National Health Insurance System (Indonesia = *Jaminan Kesehatan Nasional-JKN*) in 2014. The program entails mandatory social-based healthcare coverage with an affordable premium, ranging from Rp 25.500 to Rp 80.000 (approx. AUD 2.50 - 8) per month. The introduction of this scheme marked a significant improvement of the healthcare budget and expenditure of the country. Even though the regulation⁶ obliged the government to allocate at least 5% of the nation's budget for healthcare, it was only realised in 2015 (see Fig. 4-1), which had increased rapidly by an average 2.5% from 2014 to 2017.

³ Health Metrics Networks, Indonesia Health Information System Review and Assessment, Center for Data and Information, Ministry of Health of Indonesia, 2007

⁴ Strategy 1, action 3: 1.3, WHO country cooperation strategy 2007-2011, Country Office for Indonesia

⁵ Peraturan Pemerintah Nomor 46 Tahun 2014

⁶ Undang Undang No. 39 Tahun 2009

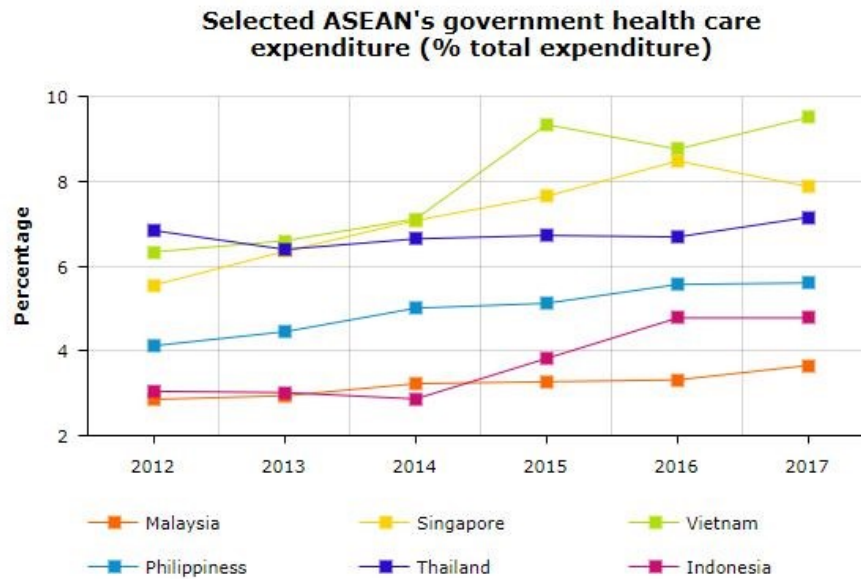


Figure 4-1 Indonesia's expenditure on healthcare compared to selected ASEAN countries (compiled from <https://www.consultancy.asia>)

The introduction of this scheme has a significant impact on the role of Primary Health Care (PHC), by which they are posed as the gatekeeper of the lifecycle of public health, including promotive, preventive, and basic curative care. To assure the healthcare provision at the operational level is standardised, MoH introduced PHC accreditation system⁷ by which each PHC is assessed and examined for at least every three years in nine assessment areas comprising their leadership & management, patient-oriented clinical service, and public health management. In this regard, PHC now also have a chance to be restructured as a Local Public Service Agency (Indonesia: *Badan Layanan Umum Daerah* - BLUD) where they are given the privilege to manage their resource as well as conducting programs and business to improve their services⁸. This led to an inevitable restructuring of PHC where they can provide certain healthcare provision to increase their revenue. For instance, PHC now can provide inpatient care for specific treatments/diseases. This restructuring has a major impact on HIS, especially in terms of flexibility in acquiring supporting resources for HIS including the software, infrastructure, and IT-dedicated staff. Overall, Table 4-1 below summarises the characteristics of the healthcare ecosystem of Indonesia.

⁷ Peraturan Menteri Kesehatan Nomor 75 Tahun 2014 and Peraturan Menteri Kesehatan Republik Indonesia Nomor 46 Tahun 2015

⁸ Ministry of Domestic Affairs' Regulation (Permendagri) No. 61/2007

Table 4-1 Overview of the country⁹

Indicators	Value (2016)														
Population	258 million														
National health budget	9.1 billion AUD														
External donors' funding for healthcare	78 million AUD														
Global health index rank	95 th out of 148 countries														
Human Development Index (HDI)	70.18														
Life expectancy	70.90														
ICT Development Index World Rank	115 th out of 175 countries														
Networked Readiness Index – NRI (2016)															
Country rank = 73 (out of 139)															
<p>Selected Networked Readiness Index (NRI) Pillars</p> <table border="1"> <caption>Estimated data for Selected Networked Readiness Index (NRI) Pillars</caption> <thead> <tr> <th>Pillar</th> <th>Score (0-6)</th> </tr> </thead> <tbody> <tr> <td>Infrastructure</td> <td>3.5</td> </tr> <tr> <td>Skills</td> <td>3.5</td> </tr> <tr> <td>Business Usage</td> <td>2.5</td> </tr> <tr> <td>Government Usage</td> <td>2.5</td> </tr> <tr> <td>Economic Impacts</td> <td>2.5</td> </tr> <tr> <td>Social Impacts</td> <td>3.5</td> </tr> </tbody> </table>		Pillar	Score (0-6)	Infrastructure	3.5	Skills	3.5	Business Usage	2.5	Government Usage	2.5	Economic Impacts	2.5	Social Impacts	3.5
Pillar	Score (0-6)														
Infrastructure	3.5														
Skills	3.5														
Business Usage	2.5														
Government Usage	2.5														
Economic Impacts	2.5														
Social Impacts	3.5														

4.2.2 Contextualising the structure of ecosystem

Contextualisation, or known as ‘theoretical re-description’ in critical realism, is needed to abstract the cases to create the boundary of analysis (Wynn and Williams 2012). Based on the conceptualisation of ecosystem’s structure presented in Chapter 2 (see Section 2.3.2), the structure of Indonesia healthcare service ecosystems is briefly re-described based on the four

⁹ Compiled from various sources: “Indikator TIK Kemkominfo 2016”, “Profil Kesehatan Indonesia 2016”, “Laporan Tahunan Kemkominfo 2016”; The total expenditure for health in 2016: <https://www.kemenkeu.go.id/rapbn2019>; Global health index: The Legatum Prosperity Index™ Rankings 2016

structural components: actors' institutional logics, institutional rules, healthcare practices, and resources configuration.

Actors' institutional logics

Actors enacted their activities based on their institutional logics built by their skills, knowledge, assumptions, and expectations. It is influenced by training or previous experiences. These logics are part of our social systems since these components situate actors' action in the form of either tacit or explicit knowledge. In Indonesia's healthcare ecosystem, actors' institutional logics are largely influenced by training on HIS and their exposure to ICTs such as the internet, social media, and mobile applications.

Institutional rules

In this study, norms are considered as part of 'institutional rules', in order to propagate the tacit and explicit rules exist in the service ecosystems. Rules and norms can be in various forms. For example, Pop et al. (2018) exemplify nine types of institutions in the healthcare ecosystem, especially in the pharmaceutical industry. The tacit forms can be exemplified into culture and beliefs, while the explicit forms can be exemplified into organisational structure, metrics, language, Intellectual Property (IP) rights, legislation. Some of these types of institutions are applicable to the context of the ecosystem of Indonesia's healthcare.

- *Metrics*—Each public health program organised by the district government and PHC has a number of Key Performance Indicators (KPIs). In contiguous disease division, for instance, one of the KPIs is the number of Tuberculosis patients covered and treated by district's PHC.
- *Language*—Language regulates and homogenises the technical terms in the ecosystem so that all actors have standardised language. For example, the practices in public health are explicitly stated in a standard form named Operational Definition (Indonesia: *Definisi Operasional*). It defines terms and process of health care. In maternal health care, the stages of pregnancy visits are defined into four 'visits' (Indonesia: *Kunjungan 1, 2, 3, 4* or coded as K1, K2, K3, K4). The treatment procedure and reporting format for each 'visit' (e.g., K1) are regulated to create a universal nation-wide language.
- *Structure*—This rule regulates the 'anatomy of organisations' and the vertical/horizontal relationships amongst organisations or individual actors. In the context of Indonesian public health, the structure of control is ideally coordinated

through an area-based system. For example, PHC X has an area of control to villages A, B, and C. Normally, this PHC will assign one coordinator of cadres for each village through satellite health service (e.g. integrated one-stop service, Indonesia = *Posyandu*) who will then establish a chain of command from the head of neighbourhood area (Indonesia = *Rukun Warga*).

- *Legislation*—Public health is one of the primary domains of government priorities in developing countries. It is positioned as the second objective of the Sustainable Development Goals (SDGs) by the UN. In Indonesia, it is regulated by the Ministry of Health, who create a wide array of regulation through the ministry's regulation (Indonesia = *Permenkes*).

Practices

Practices delineate routinised activities in healthcare. Practices of healthcare in Indonesia comprise four core processes: promotive, preventive, curative, and rehabilitative. PHCs normally are responsible for promotive, preventive, and basic curative, while more serious curative and rehabilitative treatments are handled by hospitals¹⁰. In a PHC, each public health process has various programs which are organised by different divisions, such as village-based mass-immunization and pregnancy classes for expecting mothers. There are also processes related to public health management including program planning, monitoring, and evaluation.

Resources configuration

Besides situated by rules and institutional logics, actors enact their practices by using a specific configuration of resources. The combination or configuration resources become the entity investigated in the transformation of social structure (Henfridsson and Bygstad 2013). For example, innovation is defined as the creation of new products and services that causes the *recombination of resources*. Thus, deployment of a communication artefact (e.g., email or Whatsapp®) is acknowledged as an alteration of the resource configuration, and implementation of a more complex HIS artefacts *does* alter the overall constellation of resource configuration within the service ecosystem.

¹⁰ In Indonesia, while at the operational level the PHC and hospitals are coordinated by district-level government, they are in a separate line of hierarchical structure due to different General Directorate in MoH's body of organization.

4.2.3 Background of the cases

4.2.3.1 Excellent transformation: District Anakranti

Demographic and health profile¹¹

District Anakranti (pseudonym) is located in a small, non-main island of Indonesia. The district is populated by >600,000 residents (BPS 2016) which result in approximately 600 density ratios (residents/km²). The residents' occupation is dominated by agriculture (26.09%), from which agriculture, plantation, and fishery are the main contributors of gross regional domestic product (PDRB) by 20.92% (BPS 2016), followed by tourism and transportation/warehousing/ construction. The district's income per capita is Rp 17.32juta/person (approx. 1,700AUD) per 2015 which is below the national average (Indonesia's GDP >US\$3,000).



Image 1 One of PHC in District Anakranti

¹¹ Accessed from Badan Pusat Statistik (Center Bureau of Statistic) for the District Anakranti. Center Bureau of Statistic has a dedicated website for all provinces and districts in Indonesia. The web source for District Anakranti is kept confidential so as the district itself. The national web for Center Bureau of Statistic is <http://www.bps.go.id/>

District Anakranti is still facing a shortage of health care facilities and resources¹². The 17 units of Primary Health Care currently providing services to the local citizens have not satisfied the minimum *PHC-total residents* ratio (1: 36,000 vs 1: 30,000 national standard). It also suffers from a shortage of medical workers, especially doctors, with the current ratio is 1.9 per 100,000 inhabitants versus ideal ratio at 6 doctors per 100,000 inhabitants¹¹. Image 1 shows the picture of one of the PHC in this district where the researcher conducted the field study. A district-scale hospital (type C) is currently operating in the district, with an additional basic-level hospital recently built within the district. With regards to its inhabitants, this district has a Human Development Index of 64.62 (2015), placed 4th out of the 10 districts in the province, while the life expectancy of the district's residents is 65.4. This short life expectancy indicates its low public health development index as this district was grouped as one of the districts with Health Problem in 2007 though it has shown significant progress within the last decade.

Health Information Systems (HIS) in District Anakranti

Health district government has focused on HIS since 2008 which was later handled by a dedicated organisational unit of Data and Information in 2009. This stand-alone unit is working right under the Head of Health District Government, which is uncommon in Indonesia since most of health districts government embed the data and information function to other divisions such as Program, Evaluation, and Monitoring. This unit works closely with all PHC within the district for data verification, validation, and reporting, which from 2014 has fully been undertaken electronically.

The core application system for PHC, which is the Primary Health Care Information System (henceforth: PHC IS) is e-Puskesmas. This application provides a complete PHC IS application features; to record, digitise, and optimise all Primary Health Care process and data from admission, health service provision, pharmacy, and cashier. Accordingly, this application can provide PHC's data to the district government, and to some extent the Ministry of Health, for planning, monitoring, and evaluation purposes. District Anakranti currently operates e-Puskesmas in all 17 units of PHC. Other application systems are SITT (reporting system for Tuberculosis), SIHA (reporting system for HIV), Ms Excel[®], email and WhatsApp[®] as the

¹² "Profil Kesehatan Kabupaten Anakranti 2015", published in 2016, downloaded from its Health's District website. A complete list of documents (as secondary data) is presented in Appendix D)

primary communication channels for the incident report or technical assistance of its application.

Table 4-2 Selected ICTs in District Anakranti

ICT	Description	Level	Year active
<i>Core Application</i>			
SIKDA	PHC IS, an offline application system based on Ms Access®	PHC	2011
SIKDA Generik	Online PHC IS built and managed by Ministry of Health (free)	PHC – district – central (integrated)	2014 – 2015
e-Puskesmas and e-Posyandu	Online PHC IS built by a private vendor. Each PHC subscribes with a monthly payment	PHC – district – central (integrated)	2016 – now
<i>Program-based applications and other ICTs</i>			
SITT, SIHA, Sismal	Reporting system for Tuberculosis, HIV, and Malaria, the offline application systems based on Ms Excel® built by Ministry of Health	PHC and district	2010 – now
e-posyandu	Reporting system for field health workers providing health care services in villages (Posyandu)	PHC	2016 – now (limited PHC)
Ms Excel®	Locally customised macro-application for Mother & Child Care reporting system	PHC and district	2012/2013 – now
Email & WhatsApp®	Communication channels currently used for incident report and technical assistance from vendor or peers	All level	<i>undescribed</i>
pCare	A record management system for national healthcare coverage database	All level	2014 – now

*ICT: the list does not cover all currently operating applications. It only lists the discussed ICTs during field study.

Key HIS-related events in District Anakranti

Establishment of dedicated data and information unit

The key events shaping the current setting of HIS and environment in this district can be traced back to the year 2007. In 2007, through Government Regulation No 41 2007, the central government reorganised the organisational structure of province and district government. In this regulation, Data and Information Division in all districts around the country needed to be restructured and merged with other division. In other districts, Data and Information Division typically is put under the Planning and Development Division. However, at that time, the district Anakranti's health government proposed to keep Data and Information function through a dedicated and standalone unit of organisation. The intention was strongly related to HIS strengthening in the district as they wanted a focused and dedicated unit working specifically to handle health data and information as well as their supporting system. The proposal was approved by the province and central government that the health district since that time had the so-called Unit of Data and Information.

“The Head [of health district gov’t] thought that there must be one who manages the data, it cannot only be attached elsewhere [to other division] ... with specific tasks and functions” (AR03)

HIS artefacts: from MoH-driven to district-driven

Since 2008 to date, various software and system have been introduced to the district, including the software from MoH such as PHC IS (i.e. SIKDA) and program-based application such as SIHA (for HIV reporting), SITT (for TB reporting), Sismal (for Malaria reporting). PHC IS (SIKDA) failed, while the program-based applications were kept as standalone and offline reporting systems. The district subsequently was looking for a new PHC IS and finally purchased and implemented a new system from a private vendor using a subscription-based pricing model. The decision was made solely internal, bypassed the provincial authority who was still looking for a new software package, and central government (MoH) who was still struggling with operating support for SIKDA.

Restructuring of PHC

District Anakranti is one of the few districts in Indonesia who has restructured their PHCs as BLUD in an early date. Approved in 2014, the decision of the restructuration is on the discretion of district government based on the proposal from the health district government. As BLUD, PHC, though they remain as non-profit oriented organisations, were given flexibility in allocating and managing the budget as well as conducting programs and businesses to improve their services.

"The Head of [Health District Gov't] only proposed, but [the decision] was made by the Regent at that time. We saw it as an opportunity for PHC."
(AR03)

The restructuring gave flexibility as well as responsibility to PHC in managing their resources and services. However, the program and process are still controlled by the health district government. The implication is seen in various resource provision for data and information, for example, phone credit for easier communication for field health workers, acquisition of IT interns, and further procurement of computer for every room in some PHCs. Several PHC in this district accomplished the ‘paripurna’ (plenary) accreditation as the highest rank of this scheme, inviting various stakeholders around Indonesia to conduct a site visit to this district, which indicates a high level of healthcare service they provide. Figure 4-2 below depicts the key events that occurred in District Anakranti over the last ten years.

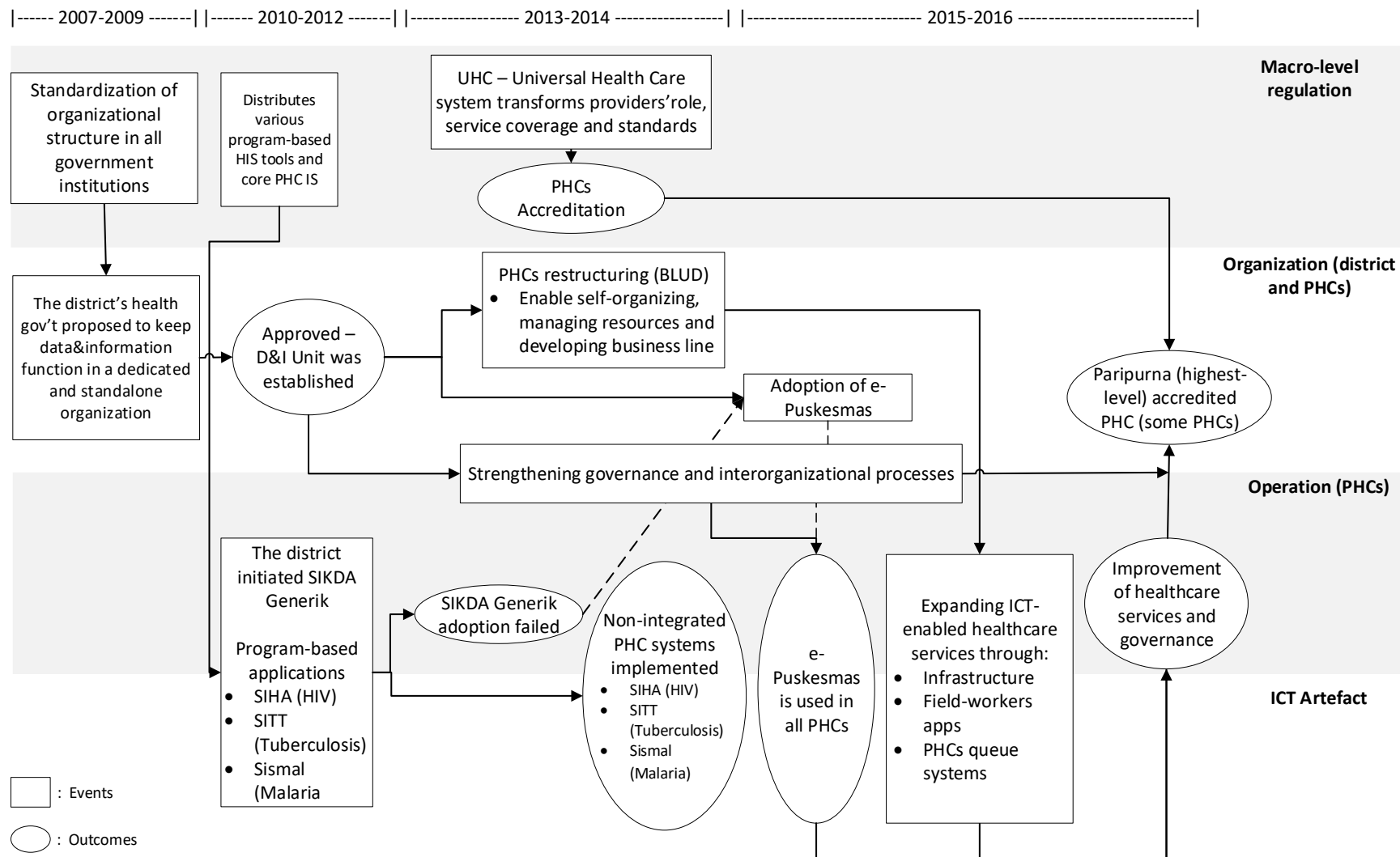


Figure 4-2 Key events in District Anakranti

4.2.3.2 *Moderate transformation: District Bungatanjung*

Demographic and health profile

District Bungatanjung is a small and emerging city located in one of the main islands in Indonesia. The district is populated by over 2 million inhabitants with approximately 10,000 density ratios (residents/km²), which makes this city one of the top 15 most dense cities in Indonesia. As a rapidly growing city, it has a relatively high Gross Regional Domestic Product at AUD 5,300 in 2016¹³. However, the city suffers from a high GINI ratio (0.4), making it one of the highest ratios within the province.

The main problem in District Bungatanjung is a significant shortage of its public healthcare facilities. This city only has 35 PHCs, which make their role as the main gatekeeper of healthcare is difficult. Each PHC serves thousands of patients every week. Such an overload of patients becomes a classic excuse of the health worker for evading data input and resisting new technology. During an observation in a PHC in this district, while the researcher was quite amazed by the large number of patients, one of the staff told the researcher that that was not even a typical situation they regularly face.

“This is Saturday’s [the large number of patients]. See later on Monday; it will be like a marketplace” (BT08).

From the community’s perspective, this situation causes a large portion of the population uses private institutions for healthcare services, such as private clinics and hospitals. This situation, though in practice should be acceptable, induces a perplexing situation for the district government especially in terms of public health control. In managing public health, the district government is responsible throughout the complete loop of the system from promotive, preventive, curative, to rehabilitative. If a large portion of the population is not in the system and the current ICT systems are inadequate for inter-organizational data exchange, it is very challenging for the district government to control.

Health Information Systems in District Bungatanjung

The core application for PHC (PHC IS) in this district is called SIMPUS. This system was originally distributed by the Ministry of Health, which later was customised by a local vendor to fit their needs. The cost of operation of SIMPUS is relatively cheaper than e-Puskesmas.

¹³ Accessed from Badan Pusat Statistik (Center Bureau of Statistic) for the District Bungatanjung. The web source is kept confidential so as the district. The national web for Center Bureau of Statistic is <http://www.bps.go.id/>

SIKDA was also introduced to this district as a pilot project. However, the district chose to use SIMPUS since they faced difficulties in getting support from the MoH during technical difficulties while the latter application is fully supported by the local vendor.

“It was difficult. Our colleagues felt that when they had [technical] trouble, they cannot get instant help from them. They (the colleagues) want such that when there is a trouble, there is an on-call help.” (BT07)

Other application systems used in this district is SITT (the similar reporting system for Tuberculosis), SIBIMA (locally customised application intended for midwives), SIPO (supply chain management system), and communication systems such as email and WhatsApp®. Other programs or divisions in district-level also own specific application systems such as hospital IS, IS for hajj, or SMS gateway for queue system.

Table 4-3 Selected ICTs in District Bungatanjung

ICT	Description	Level	Year active
<i>Core Application</i>			
SIKDA Generik	Online PHC IS built and managed by Ministry of Health (free)	PHC – district – central	2014 (pilot)
SIMPUS	Online PHC IS built by the local vendor. Most of PHC only utilise front-end module (patient admission)	PHC – district	2014 – now
<i>Program-based applications and other ICTs</i>			
SITT	Reporting system for Tuberculosis, an offline application system based on Ms Excel® built by Ministry of Health	PHC and district	2010 – now
SIBIMA	Locally customised application intended for midwives	PHC	Currently pilot test
SIPO	Online IS for medicines and health equipment	PHC – districts	2014 – now
Email & WhatsApp®	Communication channels currently used for an incident report and technical assistance from vendor or peers	All level	

Key HIS-related events in District Bungatanjung

Unlike District Anakranti, there is no dedicated organisation responsible for HIS in this district. This function is embedded in the Program, Evaluation and Monitoring Division. PHC have been restructured to BLUD in 2016. None of the PHC in the district that gained a 'paripurna' rank for accreditation to date. In term of the ICT artefacts, the program-based applications (e.g. SIHA, SITT) was introduced in the same period with other districts (2011-2012) since they were mandatory reporting systems enforced by MoH. SIMPUS was used incrementally, initiated from a pilot project in one PHC in 2011, to an incremental deployment from 2012. At the district-level, various applications were developed by each division since 2015 resulting in a total of 16 non-integrated applications currently active in the district.

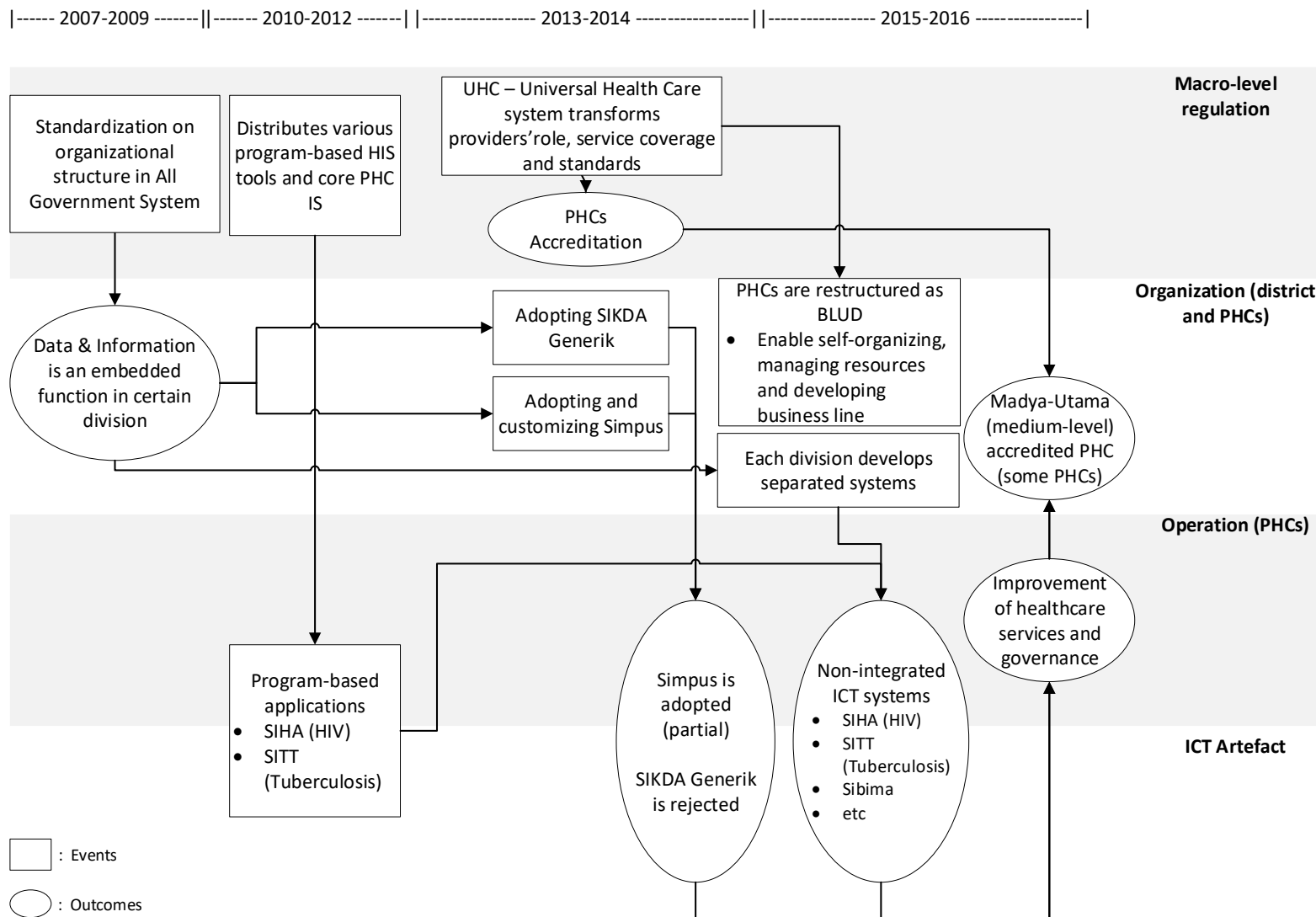


Figure 4-3 Key events in District Bungatanjung

4.2.3.3 *Poor transformation: District Cintolamo*

Demographic and health profile

District Cintolamo is a rural area located on a small, non-main island in Indonesia. The district is populated by >1.1 million inhabitants (2016), with 725 density ratios (total/km²). The residents mainly work in agriculture and fishery (46%), which are the primary contributor of gross regional domestic product (PDRB) by 27.90% (BPS 2016), followed by trading and service (17.9%). This district is still struggling with its socio-economic situations. The rate of unemployment is considered high (6.5%), and 26.1% of its inhabitants are categorised as poor. The district's income per capita was Rp 16.04juta/person (approx. 1,580AUD) (2016), which is far below Indonesia's average (BPS 2016¹⁴).

The availability of healthcare facilities in this district is insufficient. It has a total of 29 PHCs (1:39,000 ratio), which needs additional PHCs since over 91% of total visits to health facilities in this district is to PHCs. However, the availability of health workers is considered adequate. The district is supported by 174 general practitioners, though it still lacks specialists. With a relatively low Human Development Index (63.7), and life expectancy (64.7), this remote district still “needs direct support from central government” (*Head of the health district government, recorded through a field note*).

Health Information Systems in District Cintolamo

By the time of the researcher's fieldwork, there is no fully functioning PHC IS in District Cintolamo. The district has attempted to deploy SIKDA in 2008, which became a failure after unresolved technical problems distracted healthcare provision.

ICTs in District Cintolamo are currently limited to reporting applications and communication channels (Table 4-4). Specific programs, like HIV/AIDS, TBC, Malaria, and immunisation, are using macro-application Ms Excel[®]. The reports are then submitted to the district government, which later are compiled by the district government to be submitted to the Ministry of Health. Data clerk in PHC currently is utilising email and Whatsapp[®] for submitting a monthly report to the district government.

¹⁴ Accessed from Badan Pusat Statistik (Center Bureau of Statistic) for the District Cintolamo. The web source is kept confidential so as the district itself. The national web for Center Bureau of Statistic is <http://www.bps.go.id/>

Table 4-4 Selected ICTs in District Cintolamo

ICT	Description	Level	Year active
<i>Core Application</i>			
SIKDA	PHC IS, an offline application system based on Ms Access®	PHC	2008
SIKDA Generik	Online PHC IS built and managed by Ministry of Health (free)	PHC – district – central (integrated)	2018 (planned)
<i>Program-based applications and other ICTs</i>			
SIHA, SITT	Reporting system for HIV/AIDS and Tuberculosis, an offline application system based on Ms Excel® built by Ministry of Health	PHC and district	2010 – now
SP2TP	Reporting system for public health programs and any related activities in PHC. The system is used in district-level government where the data source is collected every month in manual (hardcopy) form from each PHC	District-level	2007/2008 – now
Ms Excel®	Locally customised macro-application for immunisation reporting system, including for local area monitoring (Indonesia: Pemantauan Wilayah Setempat)	PHC and district	2012/2013 – now
Email & WhatsApp®	Communication channels currently used for an incident report and technical assistance from vendor or peers	All level	unidentified
pCare	A record management system for national healthcare coverage database	All level	2014 – now

Key HIS-related events in District Cintolamo

Data and information function in District Cintolamo is similar to District Bungatanjung as it is embedded in Secretariat Unit, especially in Program and Reporting sub-Division. PHCs are under complete control of district government (non-BLUD). As shown in Fig. 4-4, the overall structure of the organisation was remained unchanged for both district and PHC-level in the last ten years, especially that PHC have not yet granted restructuration as BLUD.

The district has attempted to adopt SIKDA to their PHC. The system was operating for a few years until it was grounded due to an unresolved technical problem. Subsequently, the PHC operations, including patients' admission and management, are reverted to manual-based for over four years until now. Meanwhile, other program-based applications are kept in use including SIHA, SITT, or Sismal as offline-based systems, while the generated reports from these systems are sent by email to the district officers. Currently (2017 as the field study was undertaken), the district-level government has shown a willingness to use SIKDA generik, the free-to-use application system from MoH for PHC IS.

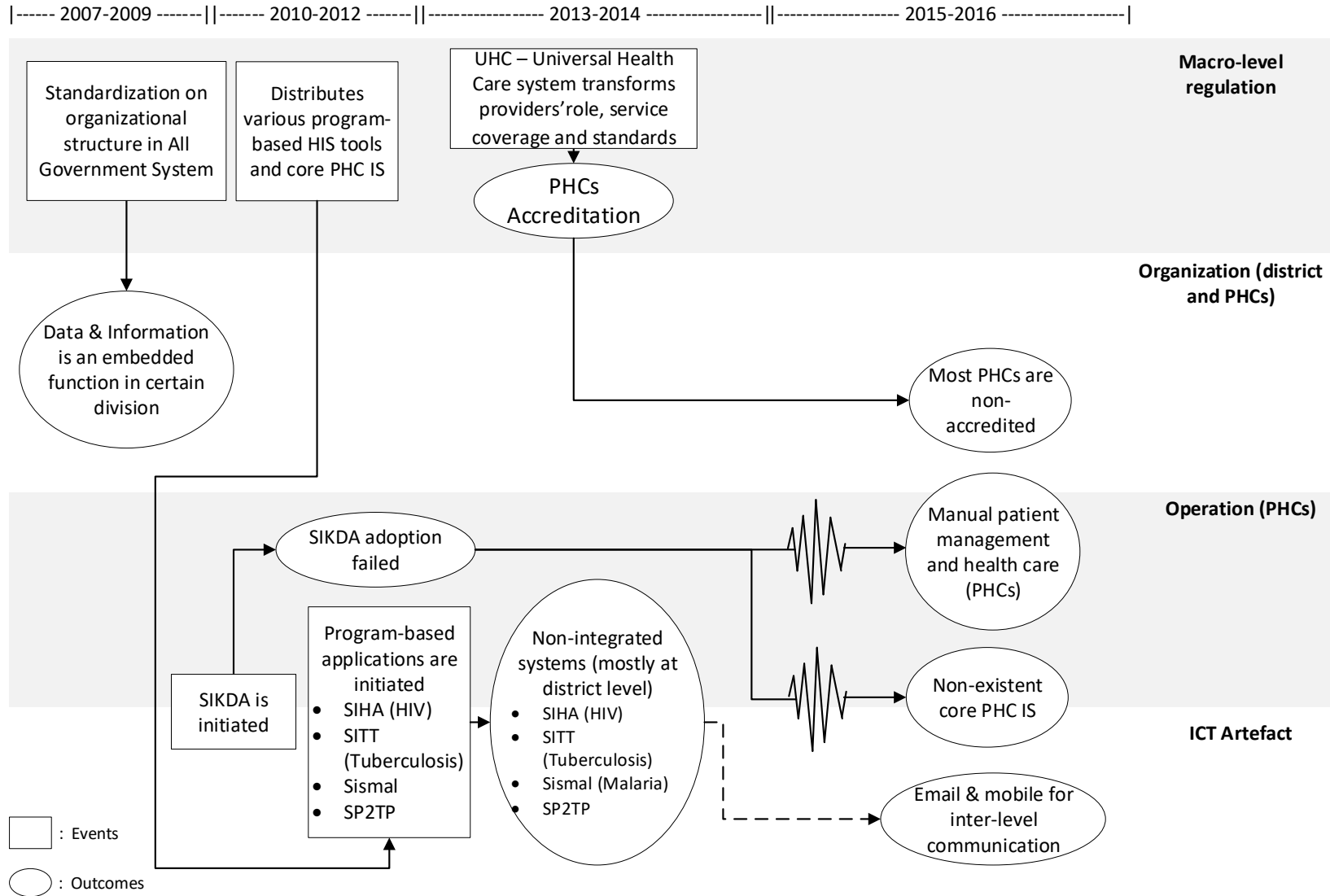


Figure 4-4 Key events in District Cintolamo

4.3 Mechanisms of transformation of Indonesia Healthcare Service Ecosystems

Mechanism of transformation explains how the ecosystem's structure changes following the introduction of HIS. Three broad themes emerged from the analyses to explain the complete process of transformation. First, the *institutional forces* act as a catalyst that triggers the structural change in every instance of transformation. Second, the structural change takes a certain type or scenario of the *generative mechanism* associated with its triggering force. Third, each type or scenario of generative mechanism then undertake the *self-reinforcing mechanism* to exercise and establish the new structure. This subsection is presented and organised according to these themes, along with the contingencies that enable or constrain the mechanism. Table 4-5 presents the instances of the transformation identified from analysis.

4.3.1 Institutional forces

4.3.1.1 Coercive institutional force

The first trigger of transformation is the coercive institutional force. Coercive institutional forces are originated from macro-level enforcement, typically manifested into formal rules that enforce new practices at meso and micro level. These enforcements are accompanied by a change on resource reconfiguration (such as by deploying new infrastructure), a change on local rules (e.g., new standard operating procedures), and a change on local actors' institutional logics (e.g., seminar or workshops).

Coercive institutional forces on HIS enabled transformation are important in the Indonesia public health ecosystem. Since the ecosystem is a government regulated context, formal rules (Appendix C) are important catalysts which both trigger and control the movement at the lower levels. In most cases, actors at meso and micro-level are caught in the status quo that hinder them to initiate a change, as one of the local consultants said:

“I say, that being civil servants are being accustomed to existing ways. So, when a new influence [change] is introduced, it will take a really long time to make them get used to it. Because [they] are already inside the comfort zone with everything.” (CL03)

Table 4-5 Instances of HIS enabled transformation

Instances of HIS enabled transformation	District			Generative mechanism	Type of transformation	Institutional structure
	Anakr anti	Bungatan jung	Cintol amo			
Reporting procedure for communicable disease (program-based)	✓	✓	✓	Adoption and incorporation	Coercive-driven transformation	<i>Resources reconfiguration</i> —SIHA, SITT (all districts), Sismal (except Bungatanjung) <i>Institutional rules</i> —new roles, reporting procedure/SOP <i>Practices</i> —Program planning, monitoring, and evaluation in P3M (communicable disease division)
Actors' awareness and mindset toward the role of data in health management	✓	✓	✓	Adoption and incorporation	Coercive-driven transformation	<i>Institutional logics</i> —mindset toward the role of data <i>Practices</i> —data-based program planning, monitoring, evaluation
Documentation of all process in Primary Health Care	✓	✓		Adoption and incorporation	Coercive-driven transformation	<i>Institutional rules</i> —PHC accreditation system <i>Practices</i> —documentation in the administrative process
ICD X-based diagnosis practices	✓	✓		Adoption and incorporation	Coercive-driven transformation	<i>Resource configuration</i> —PHC IS (ePuskesmas, Simpus) <i>Institutional rules</i> —enforcement of regulation on doctors <i>Practices</i> —clinical diagnosis according to ICD X
Actors' mindset toward technology	✓	✓	✓	Breaking and making	Agency-driven transformation	<i>Actors' institutional logics</i> —technology demand (from exposure to ICT)
Reporting and coordination of field and private midwives' practices		✓		Breaking and making	Agency-driven transformation	<i>Resources reconfiguration</i> —Sibima (for field midwives) <i>Practices</i> —reporting and communication
Tablet and remote work of field workers and cadres	✓			Breaking and making	Agency-driven transformation	<i>Resources configuration</i> —ePosyandu, ePuskesmas <i>Practices</i> —program monitoring, reporting and communication
Extended data processing tool for immunisation	✓			Breaking and making	Agency-driven transformation	<i>Resources configuration</i> —Ms Excel®-based data reporting
Patient handling, management, and Electronic Medical Record (online based)	✓	✓		Breaking and making	Agency-driven transformation	<i>Resources reconfiguration</i> —ePuskesmas, Simpus, kiosk queue system <i>Practices</i> —patients' registration and the flow inside PHC
Patient management in PHC (offline-based SIKDA)	✓	✓	✓	Adoption and incorporation	Coercive-driven transformation	<i>Resources reconfiguration</i> —SIKDA

Instances of HIS enabled transformation	District			Generative mechanism	Type of transformation	Institutional structure
	Anakr anti	Bungatan jung	Cintol amo			
						<i>Practices</i> —patients' registration and the flow inside PHC
Mother and Child documentation and reporting	✓	✓	✓	Adoption and incorporation	Coercive-driven transformation	<i>Resources reconfiguration</i> —ePuskesmas, Simpus, Ms Excel <i>Practices</i> —double documentation and reporting works (manual and electronic)
Data and information organisational unit restructuring	✓			Breaking and making	Agency-driven transformation	<i>Institutional rules</i> —district's organisational units and structure, local coordination and business process <i>Practices</i> —reporting and communication of all PHC
PHC certifications based on MoH	✓	✓	✓	Adoption and incorporation	Coercive-driven transformation	<i>Institutional rules</i> —accreditation-level determines capitation/budgetary <i>Practices</i> —PHC activities in adherence toward accreditation
PHC certifications based on industry-standard (ISO)	✓			Breaking and making	Agency-driven transformation	<i>Institutional rules</i> —service quality in health service provision <i>Practices</i> —PHC activities in adherence toward accreditation
Inter-organisational data exchange (PHC and health insurance provider)	✓	✓	✓	Adoption and incorporation	Coercive-driven transformation	<i>Resources reconfiguration</i> —ePuskesmas, Simpus, PCare <i>Institutional rules</i> —data exchange MoU <i>Practices</i> —Patients' admission in coordination BPJS (nation's social insurance)
Inter-organisational data exchange (PHC and Ministry of Internal Affairs)	✓	✓		Breaking and making	Agency-driven transformation	<i>Resources reconfiguration</i> —ePuskesmas, Simpus <i>Institutional rules</i> —data exchange MoU <i>Practices</i> —Patients' admission in coordination with citizenship database
Electronic-based data communication and exchange	✓	✓	✓	Breaking and making	Agency-driven transformation	<i>Resources reconfiguration</i> —email and Whatsapp <i>Practices</i> —Periodic reports submission and collection
DOTS standard for TB patients' treatment	✓	✓	✓	Adoption and incorporation	Coercive-driven transformation	<i>Resources reconfiguration</i> —SITT <i>Institutional rules</i> — <i>Practices</i> —evidence-based treatment control

Regulatory structure in Indonesia is organized into six hierarchies, each of which represents the depth of detail. For example, a broad policy of HIS is defined in Government Regulation, which is detailed into a long-term strategy by ‘Ministry of Health Regulation’ and ‘Decision of Ministry of Health’, which later direct the implementation at meso and micro-level. The district government describe these rules as top-down instruction from the central-level. Usually, the role of the district is to channel the instruction to be implemented at the micro-level (PHC). In practice, the top-down instructions are not limited to a significant strategic decision. Small instructions are frequently released without necessary change on formal rules. For example, in the Mother and Child program, MoH frequently introduces a new tool, new reporting templates, or new immunisation procedures.

District Anakranti and Bungatanjung were found to have a stronger approach to enforcing the regulation to their respective PHC. For examples, in District Anakranti, the authoritative actors require all PHCs within the district to report a regular rapport. PHC with a ‘red mark’ will be called directly by the officials. In District Bungatanjung, on the other hand, established a district’s regulation in 2015 that all licensed midwives in the district are mandated to make reports about the patients they served. Head of Family Health Division in Bungatanjung once told the story about how she sent an official commanding letter to all directors of health providers stating that since the government is the one who gives them license to operate, then it is fair for the government to ask them to send their data.

The top-down instruction usually triggers various responses from micro-level actors. From an institutional perspective, the actors will express their legitimation strategy as a response to coercive pressure. The defiance is found in all district, in a form of resistance to change the current work habit. A district-level officer in Bungatanjung confirmed.

“When there is something new, which they think that it will change the habit, people will resist ...” (BT07)

In this regard, a key element required during the enforcement is prerequisite mediation with actors at a lower level. Mediation is important since it differentiates the outcome of the transformation. For example, micro-level actors in District Cintolamo frequently expressed their frustration that the new instructions from the central government are enforced to them without adequate explanation about the background and clear procedures to follow. While in District Anakranti, meso-level actors emphasise the importance of educating the micro-level

actors about the background and motivation of a new change followed by listening to their complaint and feedback along the way.

“The thing is, when we give a task, we also need to give attention [care] [...] we can’t be ignorant” (AR06)

“... only via WA, ‘download this!’ There is no socialisation [explanation] about how to fill-in [the report], none! There was any explanation with details, never. It has been two months. (CL09)

“Why they don’t invite us and explain what data to report?! (CL04)

4.3.1.2 *Agency-driven institutional force*

The second institutional force that triggers the transformation is the local agency. Powell and DiMaggio (1991) acknowledged the local agency as a driver for institutional change, that in this study is regarded as the catalyst of the *emergence* of new local institutions, where the local actors break the existing institutions and make the new ones. In Indonesia’s public health ecosystem, the local agency acts a significant institutional force due to the decentralisation socio-political system that offers the autonomy of district-level actors.

Local agency becomes the trigger of the transformation when the actors show a significant eagerness to change and improve their local institutions without a strong reliance on the actors at macro-level. The authoritative actor, such as the head of health district government, district officers, or head of PHC, continuously seek opportunities for improvement and invite the operational-level actors to contribute actively and participate. This factor is a crucial point that differentiates the outcome across all three districts. In District Anakranti, the head of district encourages their people in district-level and PHC-level to create an innovation that can improve their work. For instance, several PHC were found to have excellent service management (e.g. ISO certified, paripurna accreditation), which are acknowledged as a positive change by the health workers at the bottom-level. Similarly, the district-level actors in District Bungatanjung continuously explore any insights from local health workers and their citizen so that any initiatives are well-grounded. For instance, Division of Family Health in District Bungatanjung is now working on a new initiative to assist field midwives (Indonesia: *bidan praktek*) who suffer from frequent exhaustion from their remote and field job.

“Yes, with God’s permission, the Head of PHC is supporting... he wants us to create more innovations ... you should see [our PHC] by yourself... there are plenty [of externals] come there [to do site visit].” (AR08)

In contrast, District Cintolamo, to some extent, offers a limited space to allow the local actors to take self-initiated action. The top authoritative actor in the district perceived that for public health, it is the primary responsibility of MoH to since that public health is a national concern. This indicates that the district still has strong dependability with MoH and to some extent, does not dare to take the self-initiative.

The importance of the local authoritative actors in agency-driven transformation is their power in utilising resources or establishing collaboration with other beneficiaries. Solely eagerness to change is insufficient if the necessary actions and collaboration are not present, because, surprisingly, the eagerness to change is found in all district. For example, in District Bungatanjung and Cintolamo, several actors told the researcher that they were motivated to make any positive changes so that it would make their colleagues' job procedure to become easier. A staff member from the immunisation division in Cintolamo once took the initiative to enable related workers in PHC to evaluate their village-based coverage. She also expressed her frustration with the use of paper-based system in today's world, which indicates that the pressure to change has emerged within some of the local actors but has not well-aligned across multiple actors.

4.3.2 Generative mechanisms

4.3.2.1 Adoption and incorporation mechanism

The adoption and incorporation mechanism encompasses all institutional change where the ecosystem at meso and micro-level is enslaved to change into a particular form of structure. This mechanism is typically triggered by the coercive-driven institutional force, such as the way MoH enforces district and PHC to adopt new IT resources by which they can incorporate a new procedure into their existing practices. That said, from ecosystem's perspective, the process of transformation is not the adoption and incorporation *of resources* per se, but rather a transformation of the structure, including rules and practices, where the resources are the tool to support or enable the transformation process.

An example of adoption and incorporation mechanism is a new practice of inter-organizational data exchange (from PHC to health insurance provider) through the integration of two core PHC systems in District Anakranti and Bungatanjung. In Anakranti, e-puskesmas, as the core PHC IS for patient management, has been linked with PCare, which is a standard nation-wide application for health insurance management. Similarly, District Bungatanjung recently has synchronized the core PHC IS (*Simpus*) with the same system (PCare). Meanwhile, in District

Cintolamo, this generative mechanism was found in reporting and communication practices enforced by program-specific division such as communicable disease division (e.g., tuberculosis monitoring and control). Overall, the new institutional structure from adoption and incorporation mechanism reproduces what is formed or defined by the coercive institutional force, which consequently causes the institutional isomorphism across the meso and micro-levels structure.

Enabling factors of adoption and incorporation

Since the adoption and incorporation are driven by coercive pressure, it triggers the existing institution to maintain its legitimation by showing various responses. It was found that in the three districts, the actors show a certain degree of compliant response, even though the pressure initially was against their interests. The analyses identify two factors that enable the adoption and incorporation mechanism which are local actors' coping mechanism and positive work attitude. The distribution of evidence for these factors is presented in Table 4-6, each of which is discussed next.

Table 4-6 Enabling factors of adoption and incorporation

Enabling factors	Anakranti	Bungatanjung	Cintolamo
Local actors' coping mechanism	✓		✓
Positive work attitude	✓	✓	✓

Local actors' coping mechanism

The first factor that enables adoption and incorporation is the actors' coping mechanism to incorporate the new change. It was found that the use of HIS affects their work habit, especially to the health workers who are already overwhelmed by their job in providing health service to the patients. Most of the local actors across all districts provided the same answer that they have no choice but to learn and incorporate the system into their work routines. The actors' coping mechanism is shown by their pledge to learn to use the application which overcomes the age and educational background. It was found that this attitude becomes one of the factors that enable the transformation since the reconfiguration of existing process and resources will be impossible without the conscious intention of the actors to enact them into their routines. For instance, bridging of Excel-based health service records (immunisation) with e-puskesmas in District Anakranti requires immunisation staff's willingness to reformat the whole data structure of their existing records. The willingness to comply and learn is shown in various responses as stated in the comments below.

“There are many applications, but that is okay, I will learn, with God’s willing I will be able to do it” (AR08, referring to a statement of her college who is a senior midwife)

“There is even a high school [staff’s educational background] [...] he was given a trust; then he is willing to learn. He keeps asking, how to do this [reporting]” (AR07)

To some extent, the character of the local people may correlate with the coping mechanism. People in this District Anakranti and Cintolamo have a compliant character, while people in District Bungatanjung have a mixed character between compliant and disobedient. One of the actors at the central government emphasised the uniqueness of local people character cannot be overlooked in HIS. Commenting on this, the interviewee, Head of a division in MoH, suggested that the people’s character from districts Anakranti, Bungatanjung, or Cintolamo, are still better than some other districts he has faced and struggled with. The people from the ‘North’, for example, are strong and perhaps obstinate, which requires MoH to take a different approach in giving top-down enforcement.

“Yes, another district has a different character. In the North, for example, they are rather strong and perhaps obstinate. They will ask you ‘What’s the advantage for us?!’” (ID02)

Positive work attitude

Another factor that enables the coercive-driven transformation is the positive work attitude of the micro-level actors. Top-down enforcement tends to be designed solely for the favour of macro-level actors, particularly in the completeness of data and information at district and micro-level. Thus, the enforcement to change and transform will not be realised if the local actors are not willing to spend additional time and energy to do this extra duty besides their core function. A standard view amongst interviewees at micro-level in all districts was that since the introduction of HIS, they needed to spend additional time to work at home dedicated specifically for data-related works, which is rare to happen for government employees working in the public sector.

“of course [working] overtime. We provide care to the patients until the afternoon. So, to finish it [reporting], that is the only way [working overtime].” (BT09)

Constraining factors of adoption and incorporation

The analyses reveal various instances of adoption and incorporation are failed or struggling due to various constraints. The analyses reveal that the coercive-driven transformation, specifically on adoption and incorporation, is constrained by three factors as discussed below.

Table 4-7 Constraining factors of adoption and incorporation

Constraining factors	Anakranti	Bungatanjung	Cintolamo
Bureaucracy at the macro-level		✓	✓
Inadequate support	✓	✓	✓
Language alignment	✓	✓	✓

Bureaucracy at the macro-level

The adoption and incorporation mechanism is triggered by coercive institutional force initiated by the actors at the macro-level. The relationship between macro-level actors and meso-micro is not established in a mutual constitutive way, indicated by the complex bureaucracy procedure that has not been resolved to ease the interlevel (top-down or bottom-up) co-creative activities. In particular, top-down enforcement is not accompanied by the improvement of the bureaucracy that simplifies the bottom-up process flow.

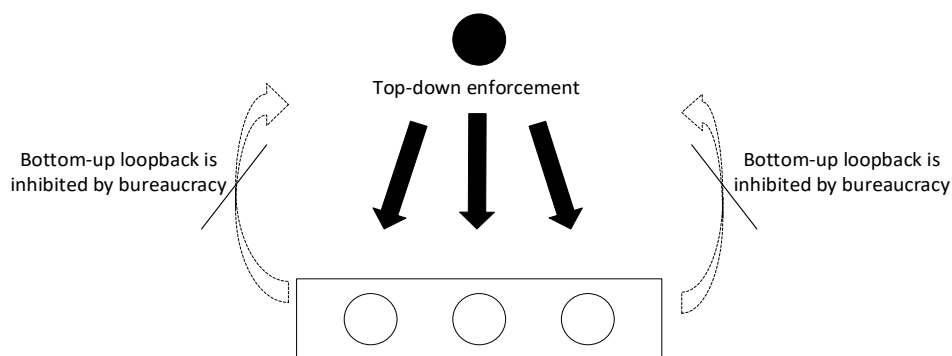


Figure 4-5 Co-creating activities are hindered by bureaucracy

This situation causes two scenarios of ecosystem imbalance. First, the meso and micro-level actors are hindered from providing bottom-up mediation, which is important in co-creating the value. This theme came up for example in discussions with a district staff in District Bungatanjung who emphasised that the systems enforced by macro-level tend to be an incomplete and ‘half-hearted’ work because they were deployed without adequate supports. A similar token was discussed with a national expert regarding this issue on the lack of

willingness at macro-level to collect and listen to the feedback from the operational level. It implies that mutual co-creating activities do not happen, which in the long run cause one party (the district) to loosen their attachment to the other party (central government). Talking about this issue, one of the interviewees exemplified how MoH even requested an official letter of inquiry from the district-level government to request a certain data of their district, which she called as ‘ridiculous’ procedure.

“And turns out, it does not show the Health Family Index (IKS) in the household and neighbourhood level. When we contacted the person in the central (MoH), turns out, it needs a letter!! What is the point of the application if it needs a letter first so the IKS can be provided?! All the things like that, which are produced half-hearted that makes them lose the benefits” (BT01)

Second, macro-level perceives what seems to be conformance of institutional change from above, while the institutional change in the lower level is a façade that does not precisely take a shape that they expect. For example, the MoH expects the district government to have real-time data of patients’ admission and diagnosis in PHC so the government can monitor and access the state of diseases nation-wide. Ideally, the data of diagnosis should be submitted by the doctors in their room after examining the patient. However, doctors in most PHC, especially in District Bungatanjung and Cintolamo, are unable to record their diagnosis electronically due to the absence of the computer in their room. Since the PHC chose to implement the system partially, that is, the patient admission and registration, then the data submitted to district officers and MoH is inaccurate since it does not represent the actual diagnosis from the doctors at that time. This practice is conducted just to show their conformance to the coercive force to cope with their struggle with resource constraint.

“It is undoubtedly that the possibility [of the mismatch in the data] will not be 0% [because] the diagnosis is not inputted [...] The point is the data needs to be able to be accessed directly by the government, if we propose to do it manually I think it will not be accepted.” (BT08)

Inadequate support

All three districts have experienced a failure of incorporating a new system intended for patient handling and management offered by macro-level actors to their day-to-day practice. The system (i.e., SIKDA) is intended to change patient management in the PHC. A standard view amongst interviewees was that the reason they discontinued using the system since it was difficult to contact the MoH to resolve technical problems. District Anakranti and

Bungatanjung tried the proposed system for six months which later they stopped and then looked for another solution. Meanwhile, District Cintolamo also stopped using application-based patient management but chose to revert to manual work and did not attempt to find another solution. It led to a negative consequence on the relationship between macro-level with meso and micro-level. One of such came up for example in discussions with the head of data and information division in District Anakranti, who told the researcher that even though the PHC are always imposed to use the system proposed by MoH, the local actors will be likely to reject it because of the past trauma they are currently experiencing.

“That gave us trauma. [when the updated system was just re-introduced] my colleague went down, “do not use that system anymore, we will struggle with [lack of support] again. They got trauma.” (AR03).

Similarly, a district officer, who previously became the head of program evaluation and monitoring in District Bungatanjung (where data and information function is embedded), told the researcher about the issue with inadequate support related to the SIKDA initiative.

“When there is a problem, the central is not [ready] on call [...] to guide us resolving the issue. When we needed for guidance, it was difficult to contact them. In the end, we let them [PHC] use it for only one year.” (BT07)

The inadequate support is also manifested in the inadequate and irrelevant knowledge transfer to the local actors, which indicate the lack of mutual understanding between the actors on what their actual need of their colleagues are. For example, the local actors suggest that their actual needs are practical coaching rather than conceptual teaching they usually received from the district or central-level government. Further, the local actors expect that the PHC staff can bring the sample of their forms or records at PHC to the training, which implies the importance of the practicality of the training materials.

“The problem is the format of the training. The format of the training should be practical, not theoretical [...] If the training is only conceptual, when they go back to PHC or district, then it still not-ready [to use in their work]. Ideally, they bring their work to the training and do it there.” (BT03)

Language alignment

Language alignment between macro-level perception and rule and the actual district-level operation procedure is the next factor that constrain adoption and incorporation mechanism. This misalignment is caused by a frequent change at the macro-level that normally takes time to be disseminated to meso and micro-level. The lag also occurred because the systems are not

easily modified in a short time to follow the dynamic of an operational procedure. This is prevalent in Nutrition and Mother & Child operational definition, which are frequently revised by MoH. The monthly reports (Indonesia: *Laporan Bulanan* – LB) are frequently modified in which new data elements are requested by MoH. In order to comply, the system needs to be modified which in practice is unrealistic since the meeting between the vendor of the application system and users in PHC are usually infrequent and sporadic. This leads to incongruous practices between micro-level operation and macro-level rules.

4.3.2.2 *Breaking and making mechanism*

The mechanism of breaking and making (of institutional structure) encompass the creation of new practices, rules, and the resource configuration led by the local agency. This generative mechanism is found in various forms: 1) The healthcare actors enact new practices mediated by HIS, 2) New rules emerged to establish a more effective inter-organizational process and workflow in the spirit of ICT use, or 3) Reconfiguration of resources constellation in the district and PHC that alter the pattern of resource integration practices. Most of the instances of this generative mechanism are the replacement of old practice with a new. For example, in the past, healthcare planning was conducted by copying the previous plan written in the same month in the past year. With HIS, the local actors are able to create a periodic plan based on the actual data.

“In the past, we used to copy and paste the activities from last year [for current program plans]. [Now] we do it based on the data. [...] Even sometimes, [we] use data from this year to plan activities [program] for the next two years to see our budgetary situation” (BT03)

Another form of this mechanism is embedding tentative practices to existing practices. The new practice is usually intermittent since they are trying to cope with the volatility of resources availability. For example, in District Bungatanjung, instead of doctors, nurses are assigned to submit diagnosis data to the system. To ensure validity, those nurses conduct a cross-check with the doctor's prior data submission. This practice has occurred for several months since the time PHC adopted the PHC IS for data management, but the doctor is overwhelmed by the services to the patients caused by an insufficient number of doctors in the PHC. As described in the background of all three districts, the ratio between the doctor and patient is still a major problem, in which occasionally one doctor can serve almost 150 patients a day.

The mechanism of breaking and making is highly related to the district's capability to perform self-initiated action and initiatives. In Indonesia, districts in the rural area tend to follow what

their regulators instruct them due to lack of experience and internal capability to exploit their own resource and undergo projects. This is caused by a lack of balance in development in the previous era when some argue it was Java-centric (the main and the most populated island where the capital city is located). A case in point, from researcher's informal discussion with Ministry of Health higher-level staff, districts in the main island (e.g. Java) tend to be more self-reliant and loosely coupled with central's control or direction. While this trait is found in District Bungatanjung (that is located in Java Island), surprisingly District Anakranti, to some extent, demonstrated a similar trait. Unlike other districts within the same province, this district has shown their independence in taking a decision and initiating action. For instance, while other districts chose to wait and see the provincial government's direction, the district chose to initiate the action on managing their HIS and public health system to overcome their poor state of public health since a decade ago.

Enabling factors of breaking and making

The breaking and making mechanism is highly associated with the attribute of the local actors as well as the synergy of the local institutions. Four factors enabling this generative mechanism emerged from the analyses, which are elaborated below.

Table 4-8 Factors enabling breaking and making

Enabling factors	Anakranti	Bungatanjung	Cintolamo
Exposure to ICT	✓	✓	
Mimetic force at district-level	✓	✓	✓
Local strategic direction	✓	✓	
Synergy and collaborative work	✓	✓	✓

Exposure to ICT

The exposure to ICT has an indirect effect on health workers, especially on how they perceive technology. Nowadays, they are interacting with ICT continuously, from a simple technology (e.g., mobile gadget) to a more advanced information system. For instance, to apply and extend their license, midwives are required to register and submit their application online, which compel them to learn to use technology. Consequently, regarding HIS, when the district-level government proposes a new system for the patient management system, it is no longer something new for them. Further, compared to the past when most health workers were technology illiterate, now the district government find them to be more critical and can provide a suggestion on their needs. For example, staff in District Bungatanjung explained how health

workers at the micro-level now have a good understanding of their actual needs and the potential use of ICT.

“Now they [PHC actors] have been more critical: ‘the [current] issue is this ...’ [...] When we [district-level] propose a training, they now say ‘I think we do not need that anymore’. So we listen to their suggestion.” (BT05).

“I think they are okay with it, maybe because they have been exposed [by ICT]. [...] The midwives now need to do it online, in applying for a license for their practice. So why don’t we make it online for the patient too, or why don’t we create an application, it’s not something new.” (BT02)

Exposure to ICT is also related to the actors’ previous experiences in ICT projects. These experiences inevitably build actors’ understanding of ICT or overall technology. This theme came up for example in discussions with a group of province-level staff in District Anakranti who told the researcher how they attempted to use the same PHC application system learned from a success story from a certain district in Java, from which they failed. The staff explained that it was caused by the issue with vendors' capability who failed to handle the differences of the data element and business process. Nevertheless, these experiences develop actors’ understanding that replicating the same ICT based on a success story from other districts does not guarantee the same result in another district.

Mimetic force at district-level

Another factor motivating the emergence of a new institution is the mimetic force experienced by the actors after interacting with more advanced health information systems, such as hospital IS. Both District Bungatanjung and Cintolamo expressed this perception. The districts’ actors discussed that public health institutions could also gain a maximum benefit from information systems as they found and experienced in hospitals. To some extent, district-level actors perceived the hospital IS as an ideal system for their PHC.

“In the hospital, they use IT every day, especially in private hospital. Patients only need to register in pharmacy at the back, and there is no paper anymore. Everything is automated, when we enter the doctor’s room, it is automatically recorded, it is really advanced. So I think why don’t we try to be like that.” (BT02)

The mimetic force is also manifested in incorporating technology in their day-to-day job. In general, the idea of the ‘coolness’ of incorporating technology into their workspace is found in District Anakranti and Bungatanjung. One actor in District Bungatanjung, for example, told

the researcher how cool it would be if the staff attend a meeting by bringing a laptop instead of a notebook where the data can be presented in an instance.

“We should think ahead regarding IT technology. We hope that we no longer need to bring our [paper] ‘book’. Like when we have a meeting, then we just open [the laptop and data] and we can discuss the data promptly”
(BT02)

Local strategic direction

The next factor of breaking and making mechanism is related to the vision and strategic direction of the district’s health actors. This factor is expressed through how the local actors possess a self-understanding of what their problems are and how they want to improve the health status of their people. This factor is prevalent in District Anakranti and District Bungatanjung. District Anakranti was one among districts in Indonesia denoted as a region with health problems (Indonesia: *Daerah Bermasalah Kesehatan*) over ten years ago. The district government then stressed the urgency of mapping their critical problem so that they can resolve the sources effectively. Thus, the role of HIS is crucial for mapping their health status. Meanwhile, District Bungatanjung set a goal that every local public service should be ‘technology in hand’. This goal, even though sound cliché and tends to be mimetic, becomes their baseline in setting the milestone and strategic plan regarding technology development for district health management.

“We have a strategic plan from 2016-2021. The milestone already exists, for example, two projects of system development this year [...]. We have the plot [milestone] until 2021”. (BT06)

Synergy and collaborative work

Synergy and collaborative work, either intra-organisation (e.g., divisions within public health system) or inter-organisation (e.g., between health and civil district government) have been acknowledged as the enabling factor across all districts. District Anakranti suggested the importance of inviting all stakeholders in a strategic forum to develop a sense of belonging to the health of their district. While in practice, the degree of collaboration has not been fully satisfied, the actors agree on the importance of this factor. For example, a district-staff emphasised that to initiate some improvement, a synergised work between all related divisions is needed. She exemplified the Mother and Child initiative for field midwives needs to be integrated with the office of demographic affairs (Indonesia: *Disdukcapil*). She criticised the current practice that each division has their ego that hinders collaborative work.

“We invited all stakeholders, so they feel involved in healthcare” (BT06)

“I always say to PEP that it needs everyone to make a move, not only Mother and Child [division] [...] we need a synergy, integrated with whoever it is, so it is not for one own but all of us.” (BT02)

“It is now the responsibility of Mr Pian [pseudonym], collaborating with Telkom.” (CL06)

Constraining factors

Since the agency-driven transformation is triggered by the local agency, the constraints of its generative mechanism are related to the district’s setting. The analyses identify two factors that constrain the breaking and making as detailed below.

Table 4-9 Constraining factors of breaking and making

Constraining factors	Anakranti	Bungatanjung	Cintolamo
Resource constraint	✓	✓	✓
Educational background	✓	✓	✓

Resource constraint

Resource scarcity is also found to be a challenge by all three districts for the creation of new institutions. Due to staff shortages, they are continuously overwhelmed by their existing job in providing health service that there is no sufficient time to learn or perform new systems or practices. It was found in all three districts that when the district government invites certain micro-level actors to the office to socialise new practices or rules, the activities of service provision in PHC is disturbed due to the absence of those staff.

“In some PHC, they need to give service first, because of their [resource] deficiency. So when we held an event that invites them [...], it will take one staff that causes their service provision to become disturbed.” (BT06)

“If I can suggest then at least, we need additional staff, but again, the budget [...] Here, to recruit additional staff, they even say that now the staff are abundant. So we do it by what we have even though the results as not as expected.” (BT08)

All three districts have the same problem with resources constraints, ranging from tangible (e.g., computer, network infrastructure, human resources) and intangible (e.g., IT skills and technical support). It is important then to be able to exploit their existing resources to keep ICT’s running without hindered by strict and long bureaucratic procedures. For example, since

it is unlikely to hire additional staff for IT, most PHCs have embodied the function of IT operation to their existing staff. Another instance is how the division of immunisation in District Anakranti customised and replicate Ms Excel[®]-based data reporting to automate other manual processes, so they do not have to purchase additional software.

"He [the staff] has an idea, 'It might be possible', he said. He checked the formula [in reporting template for Ms Excel[®]], rationalise it, the vaccine is replaced with the name of the disease [...] It is beneficial for other programs."
 "(AR04)

Educational background

Another factor that hinders the creation of new practices or rules is the educational background of micro-level actors. All three districts discussed how the educational background of various position in PHC, such as administrative staff or immunisation, affect the process of institutionalising HIS. For instance, cadres—the frontline health workers providing immunisation and neighbourhood health visits—are mostly only high school graduate. The cadres historically were recruited to aid midwives and nurses in providing immunisation, which later is recruited as permanent staff. Thus, to some extent, the educational and knowledge background has some effect on the receiving, understanding, and learning something new. It also applies to PHC registration staff.

4.3.2.3 Self-reinforcing mechanism

Exercising and establishing the new structure

The self-reinforcing mechanism is the overarching mechanism of all type of transformation to exercise, establish, and maintain the new institutional structure of the service ecosystem. This includes the district's action in reinforcing actors' institutional logic and institutional rules (explicit and tacit) to establish the enactment of the new practice. Various knowledge transfer, workshop, as well as the exercise of practices are undertaken to rebuild health workers' capacity, gain their feedback, and follow it up as self-reinforcement actions (see Image 2 for an example of this workshop). To ensure the new change is established and fully institutionalised, the district government needs to be ready to go into the field, followed by constant monitoring and evaluation. The unexpected outcome is evaluated and remediated.

"We are monitoring the enactment; why don't they use it, why the doctors do not input, why the registration is not optimal. From this monitoring, we know what problem the PHC has." (BT07)



Image 2 A workshop to all PHC on the process of area-based monitoring procedure held by district government

The prevalent process of the self-reinforcing mechanism is strengthening the governance of operational procedure of new practices to ensure that there are a set of instruments or control procedures to oversee the enactment of the new changes. For example, District Anakranti established a hierarchical chain of command and control so that they can monitor public health until the lowest level at the bottom (family-level). This organisation also ensures the escalation procedure to respond to an unexpected situation. The researcher learned the significance of this control procedure through an interview with a staff of PHC GSari. Regarded as one of the best PHC in the nation, this PHC established a hierarchical chain of command based on its area of control. This PHC is responsible for the health system of the population within seven villages. Cadres are appointed for each village, who collaborate with PHC. They conduct family visits, promotive and preventive health practices according to PHC's guidance. As the chain of command is established, a simple communication channel, Whatsapp[®], is used for the emergency report. As explained by the PHC's staff:

“In our PHC, we have a supervisor assigned to our staff [who is appointed to] each village. In each village, there are also cadres [...] That's our chain of coordination in order to have organised coordination. PHC does not always directly jump to the village [...] and it is much easier for a report or in case of the need for immediate [situation]. Say an event occurred, cadre takes a photo via Whatsapp [and send] then we can dispatch and provide service.” (AR08)

From the ecosystem's perspective, the outcome of the self-reinforcing mechanism can be observed through the way the actors understand the new role and interorganizational process and how they manifest those changes in their practice. An established structural shape of the local ecosystem is manifested through a good workflow among various institutions, which is an acceptable sign of successful transformation in a complex system as in in the public health context.

The researcher found that actors repeatedly explain that the indicator of transformation's outcome should not rely on the advancement of ICT, but rather the establishment of process. The regulation from the central government is dynamics that keeps changing over time, either radical or trivial, that require an effective reconfiguration process of cross-organizational procedure at meso and micro-level. Therefore, the interorganizational process needs to be established to adapt to those changes quickly.

Occasionally, those changes require temporary work on manual data analysis since the ICT applications need a longer time to adapt to those changes. Consequently, the structural flow of operating procedure in managing health data and information has become the primary concern of the stakeholders rather than adopting the technology. Moreover, in the context of public health management, they continue to face challenges on the frequent change on the leader of a government that leads to the frequent change of ICT applications. Thus, an established process is needed desperately, even though the application is frequently changing, as the local consultant and a district staff emphasised below:

“We don't know about the future... government changes, then their mindset changes, application changes. However, if the pattern has been well-established, HR is adequate, then [adapting] application is effortless”.
(AR02)

“I think the reason why we received that award is not that we made something [technology] new, but we strengthen our existing [process] [...] We do not expect the initiatives [pilot project] to the district [...] to be begun with the 'technology'. However, the objective is to strengthen governance and structure.” (AR02)

“...What I understand is, the system is everything related to creating information. So, information can be produced either by a system [application] or by manual [...] What we understand is information systems are not all about technology, but the process, HR, and their motivation.”
(AR05).

The analyses also reveal that the self-reinforcing mechanism also produces an intermittent outcome in the ecosystem. Frequently, while the local actors are willing to pursue the ICT enabled transformation, they face certain obstacles or constraints in their districts. Consequently, they enact the new practices while also maintaining the old ones, which is intermittent until the obstacles are resolved. For instance, tuberculosis (TB) staff enact a new practice to maintain their old way in recapitulating the patient's records and tracking the treatment progress while also using the electronic reporting tool for TB. The staff, who are mostly nurses, have already realised the benefits of using the tool that enables them to evaluate their data much easier. They also still want to keep the old hand-written book they usually used because they thought it would be useful in case the computer or the network are having a technical problem.

The intermittent outcome of transformation is also caused by the different settings of the local characteristics. The new rules set in the macro-level enforcing new HIS implementation occasionally are not locale-sensitive. Consequently, it was found that the local actors take a conscious decision to conform the enforced transformation by modifying their existing process since their existing local settings is different or has not prepared.

“The planning [on HIS] needs to be local-based problem. For example, in Pispeka (family health), the MoH program on Toward Healthy Indonesia based on family approach. In our district, we still face infrastructure problem, which is worse in the rural area. So maybe the solution cannot be generalised. [They need to] Look at the infrastructure, human resource.”
(BT06)

For example, PHC in District Anakranti and Bungatanjung have implemented a queue management system for patient registration to organise patient management and shorten the total service time, which is an indicator for PHC accreditation and service satisfaction. In District Anakranti, PHC have used end-to-end queue system that the system has managed the flow of the patient from registration, doctor's room, pharmacy, and cashier. Meanwhile, PHC in District Bungatanjung only uses the queue system in the initial point of contact in the registration counter, while the subsequent flow (doctor's room, pharmacy, and cashier) still use manual queue system where nurses shout to call the line. Image 3 shows the waiting room of a PHC in District Bungatanjung where the researcher conducted the field study.



Image 3 A PHC that uses the queue system partially (District Bungatanjung)

This situation is correlated with PHC IS. Ideally, the patient management in PHC IS is linked with the queue application system. When the queue system displaces a patient to one room, then the medical records should be presented in the room, so the doctor can access the data and later input the current diagnosis. In Bungatanjung, partial adaptation is applied by few PHC, particularly in the Dentistry and Mother&Child room, while most PHC in this district have not conducted the practice due to resource constraint. District Cintolamo, unfortunately, currently has not implemented the queue system.

Factors enabling and constraining the self-reinforcing mechanism

The self-reinforcing mechanism is involved in every instance of transformation. Each type of generative mechanism will carry out the self-reinforcing mechanism. The analyses identify four communal factors that enable and constrain the transformation regardless of the type of generative mechanism.

Table 4-10 Factors enabling and constraining of self-reinforcing mechanism

Factors	Anakranti	Bungatanjung	Cintolamo
Leadership's role	✓		
Stakeholders' commitment	✓	✓	✓
Resource management discretion	✓	✓	
Controls and accreditation	✓	✓	✓

Leadership's role

The analyses reveal the importance of leadership in the self-reinforcing mechanism that differentiates one district to another. The process of any type of transformations, including breaking-making, or adoption-incorporation, were influenced by the leaders' attribute. As explained by numerous interviewees, in the context of the public sector, which tends to be rigid and difficult to change, the role of the leader is important to promote a positive change. The researcher found that the role of a strong leader in HIS enabled transformation is prevalent in District Anakranti. Head of this district is acknowledged by his colleagues as an influential figure in district health development within past decades. As the participants stated:

"That kind of spirit from our leader is difficult to be found in other government. We hardly leave work at 4 pm. From Monday to Wednesday [this week] I left after sunset. There is always something to discuss. Then from 7 pm to 11 pm, we receive the surveyor team [...] He has a lot of breakthrough innovation [...] He wants to achieve, is not satisfied with only one achievement." (AR01)

"...the commitment of the leader [...] When the boss supports a new system, inevitably it will always cause the officers [to think] that this is important [for their work]." (BT07)

Strong leadership is indicated by how the related actors attempt to impose changes strictly. However, they assure that actors in PHC are provided with sufficient supports. District-level officer emphasised that they tend to impose the policy rather than offering the lower-level actors with negotiations, options, or alternatives. Accordingly, a simple form of reward and punishment is established by district-level management to PHC. The micro-level actors approve this approach and acknowledge the prominent figures of the head of the health district government. In a workshop the researcher observed, the staff of PHC explained that they face such direct control from the head of the district every day to ensure that all data from each program are always filled in and submitted on time and completely.

"Of course, otherwise, the Head [of health district government] will phone us: 'Hello, the report is incomplete!'" (*midwives, non-participants, the informal conversation during observation in District Anakranti*)

"In terms of the initiative, we impose it; there was no negotiation, options, or alternatives. We explain to them why we need the system [...]" (AR03)

“We want to give a deterrent effect, every month the head of health district of government calls their mobile [...] he would check-in details, which ones have not completed the data. He would ask, "Why is it all red? [blank reporting status] Why is it empty?!” (AR03)

At PHC-level, since nowadays PHC have flexibility in managing their programs, resources, and budgets, the attribute of authoritative actors of the PHC also play an important role in the self-reinforcing mechanism. Talking about this issue, the health workers expect the head of PHC to have a clear objective and capacity to execute the programs. That said, the Head of PHC needs to be open to innovation and has good technological apprehension.

“He (head of PHC) is good. Now, the head of PHC has to understand every program, what does he want for the agendas [...] He fully understands [about technology], not technology illiterate like in the past.” (AR07)

Stakeholder's commitment

The commitment of all stakeholders, including actors at meso and micro-level, is important in the public sector because, throughout the process of transformation, the actors in this context continuously face various obstacles in conducting a program and achieving key performances indicators. A common view amongst the participants in all districts was that the commitment needs to be well-aligned between all related stakeholders by advocating mutual understanding between the actors. This factor includes all related actors, ranging from authoritative actors, resource providers (e.g., ICT infrastructure company), vendors and consultants, and PHC. For example, a district officer in District Anakranti told the researcher that the health actors often turn down an initiative if the budget is not allocated by the government.

“Yes, because of a lack of commitment. Lots [government institution], when they see the budget, their motivation vanishes (laughing): 'If the budget is insufficient, why should we do it?'” (AR05)

The local consultant in District Cintolamo also describe a similar phenomenon related to the lack of stakeholder's commitment in his district.

“Also, the commitment is not well-aligned between all health stakeholders in this district. There was even a rally recently from the health workers [to indicate their problem with non-aligned commitment].” (CL03)

Resource management discretion

At district and PHC-level, local actors require a certain degree of discretion to manage and allocate their resources to perform the changes. Since the introduction of BLUD system for

PHC, certain districts consequently have different rules in resource management. It is prevalent in District Anakranti and District Bungatanjung. Through BLUD, PHC can allocate resources based on their actual needs, while in the old system, it needs to go through district / provincial approval. Furthermore, in a non-BLUD system, programs are proposed for a one-year financial plan with a strict quota and guidelines for each item, making it non-flexible to change it throughout the financial year, especially in case of immediate needs. The autonomy in managing resources enables PHC to allocate necessary resources based on their unique needs. Actors expressed that this system is helpful for them. For example, to ensure that the new system is used in health practice, PHC can hire technical support staff by themselves without consulting the district-level government in advance.

“Here, we are free to find [technician], to recruit. It does really help me [...] Now they [PHC] can find 'second man' who has IT background, they have a [new] system.” (AR03)

“Yes, that's right, but with BLUD they are easier to capitalise, flexible to manage their finances [...] they can shop themselves with BLUD funds. They are independent in managing their finances. With their income, what they need, what they do.” (BT06)

Controls and accreditations

The accreditation has a role in self-reinforcing and maintaining the new structure since this is introduced to measure the overall improvement of PHC process, capability, and governance. A standard view amongst interviewees was that the significant correlation between accreditation and HIS, since the PHC accreditation scheme is established to measure the overall capability of PHC. Furthermore, the healthcare providers, either institutions or health workers, are required to maintain their skills and competence. Doctor, for example, is required to accumulate specific points regularly to maintain and renew their license. This rule aims to ensure the doctors to keep up with recent progress and update in their area of competence as well as updating their skill and knowledge. This principle also applies to the providers as well. PHC are required to pass an accreditation assessment which is retested once in three years to ensure that all important indicators to provide healthcare are maintained. Any change in procedures, facilities, or processes, are assessed in the following accreditation.

“For instance, the patients’ queue. Normally the queue in PHC is always piled up, so the patients need a long time [for service]. The doctors also may be late. [But] with this [accreditation], it cannot happen. There are points in the assessment that examine the patients’ waiting time.” (BT06)

4.3.3 Summary

The constructs presented in Section 4.3 are summarized in a construct map below.

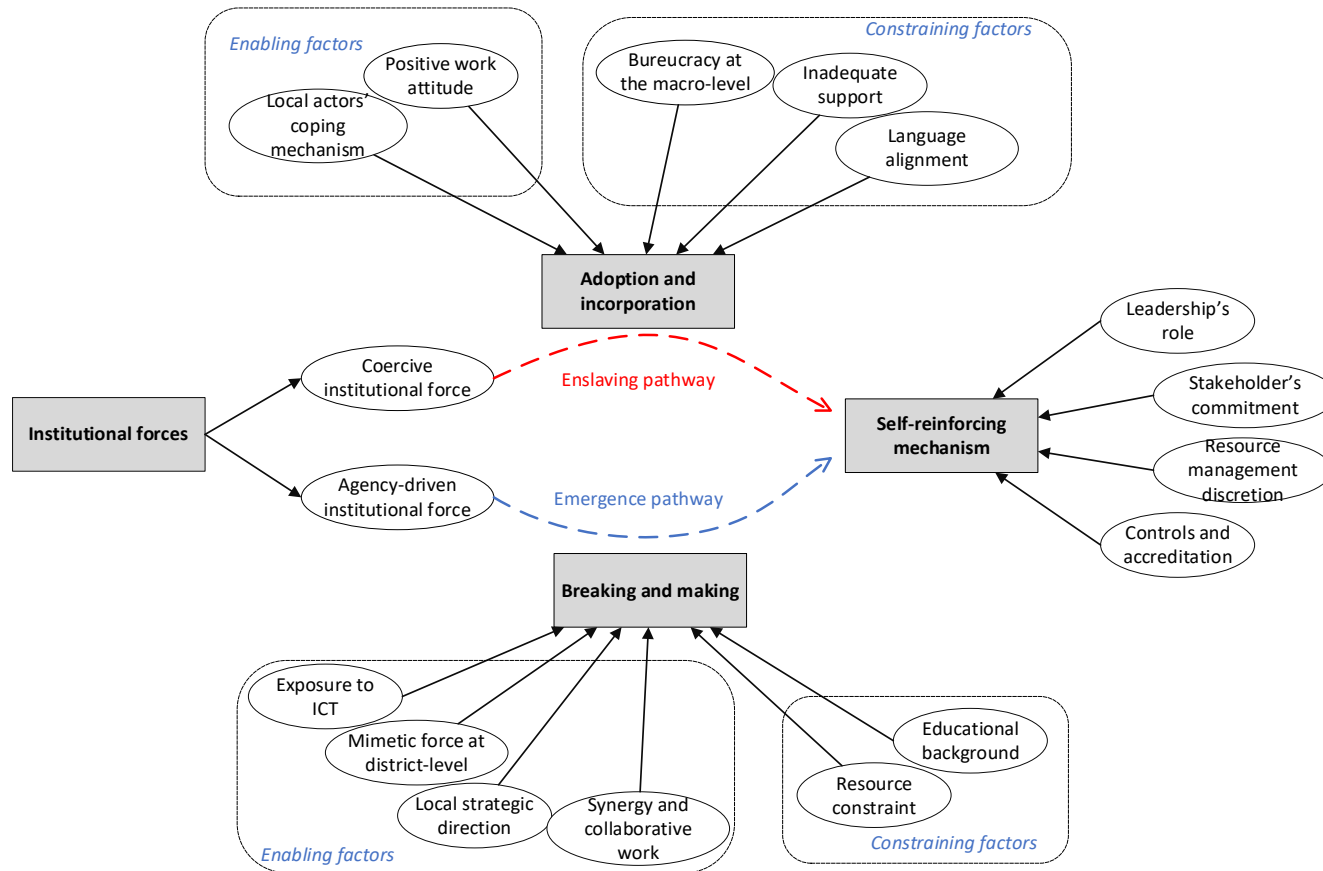


Figure 4-6 Construct map - mechanism

4.4 Impact of Health Information Systems Introduction on Indonesia Healthcare Service Ecosystems

4.4.1 On healthcare practices

The impact of the HIS introduction on healthcare practices is focused on practices at meso and micro level. The wide variety of HIS artefacts introduced to the ecosystem should affect the configuration of resources, the formal and tacit rules, the knowledge of actors, and later is manifested through the practices. The analysis identifies four areas of practices that experience a certain level of change following the introduction of HIS: 1) service patients' interface (micro-level), 2) program planning (meso-level), 3) program execution, monitoring and evaluation of clinical practice and health programs (meso and micro-level), and 4) reporting and communication between health actors. The distribution of evidence to support these themes is presented in Table 4-11. Details are discussed below.

Table 4-11 Impact of HIS on healthcare practices

Impacts	Anakranti	Bungatanjung	Cintolamo
Service patients' interface			
Patient handling, service time, and error avoidance	✓	✓	
Monitoring outpatients with chronic illness	✓	✓	✓
Dyadic patients-provider interaction	✓	✓	
Program planning			
Data-based annual/quarterly planning	✓	✓	✓
Program execution, monitoring and evaluation			
Program performance evaluation	✓	✓	✓
Reporting and communication			
Automating the reporting process	✓	✓	✓

4.4.1.1 On service patients' interface

The impact of HIS introduction on service patients' interface is prevalent as it reconfigures the interface between the health providers (staff) and the patients. The impact can be direct or indirect. The direct impact is found when actors use technology. For the patients, this includes the use of queue management system that changes the way they register at admission service and move to the related rooms to receive medical treatment, take the medicines, and optionally administer the payment at the cashier. The patients acknowledge that this technology as the 'visible' transformation in their PHC that has later improved their trust and comfort in getting

health service to the providers. On the other hand, health workers are improving their clinical treatment to the patients from using PHC IS. For example, they can provide a stronger and more grounded medical advice since currently they can identify and analyse the patients' medical records (e.g., method of contraception, previous visits, and previously given medicines) provided by the system.

The indirect impact is found in the way HIS alters and optimises the process of patient management, which leads to various positive consequences. For example, the electronic medical record implemented in e-Puskesmas or Simpus allows administration staff to register the patients much quicker and more accurate. Consequently, since the health workers have a better arrangement on the typically disorganised paper-based medical records, they can handle the patients more effectively, which leads to an improvement in the total service time. The implementation of this technology then improves patients' experiences since they get a better health service in a much shorter time.

Since these HIS artefacts (e-puskesmas, Simpus, queue systems) are implemented in District Anakranti and partially in District Bungatanjung, the impacts were only found in these two districts. District Bungatanjung, which implemented the system partially (e.g. front-end module of Simpus and queue systems), suggested that the impacts can be positive and negative. District Cintolamo, who once used PHC IS for a while, explained that it was really helpful if they could provide healthcare services with the aid of technology. Next subsections discuss the impacts of HIS to service patients' interface in more detail.

Patient handling, service time, and error avoidance

Patient-handling—Electronic queue management system is perceived by all actors as an excellent achievement since it improves the patients' handling in primary health care, which once was regarded as a chaotic and disorganised environment. It reorganises the flow of the patients from the initial point of contact (admission) to service room (e.g., doctor, midwife, mother-child), to the endpoint (pharmacy and cashier). The improvement of this process also leads to another positive consequence that the patients gain more convenience in getting care to PHC, unlike the paper or manual-based queue system they used in the past. One of the nutritionists praised their PHC, which now it feels like being at the airport since the patients are called by the system and not by the nurses like they used to. Image 4 shows the admission kiosk in a PHC in District Bungatanjung, which organises the patients' admission at the registration room.

"In the PHC, the registration process has used a queuing technology, so I do not have to worry about being preceded by other patients." (AR10)

"All of them are already electronics [...] the new system is like at the airport [...] *ting-tong*, [patient] straight this way... go there, and there." (AR08)



Image 4 Queue system kiosk in a PHC (District Bungatanjung)

Service time—The core application, PHC IS (e.g., e-Puskesmas, Simpus), organises the electronic medical records (EMR) of the patients. Consequently, the visible transformation enabled by PHC IS is the digitisation of paper-based EMR. The health workers are now able to locate the patient's data quickly. The outcome expected from this transformation is the improvement of total service time or waiting time required by the patient to get end-to-end medical service. Waiting time is one of indicator in Community Satisfaction Index Assessment (Indonesia: *Indeks Kepuasan Masyarakat – IKM*) that represents the performance of a PHC and overall public health system. The impact of HIS on total service time improvement is expressed by both service provider (doctors and district officers) and patients.

"And it is very helpful in searching the history of [my] previous visits."
(AR10)

“There are correlations [between PHC IS and service improvement]. Because it improves the waiting time. [One of] the assessments of the Community Satisfaction Index (IKM) is waiting time. If the waiting time is quicker, the patient is more satisfied, which leads to a higher IKM.” (BT01)

In District Bungotanjung, the actors who are still in the process of understanding and theorising the use of HIS, to some extent, experienced a contradictory outcome. While the health workers can improve their clinical service through EMR, the total service time of each patient is getting longer since the process of data entry has not been optimised and established. Therefore, as discussed with one of the interviewees, the correlation between HIS and dyadic service improvement in this district is uncertain and indeterminate. The patient also confirmed this phenomenon. Although they acknowledged that the queue systems have improved the PHC service, they argued that this system creates confusion during service provision in the doctor’s room.

“So far, I think the interaction [between doctors/midwives-patients] is still unchanged. The only change is only the queue system. [...] For [the clinical room], I do not think so. Because [the doctors need to do] two jobs, both hand-writing and typing [data entry on diagnosis and prescriptions]. I think for that [data entry], one is enough because it speeds up the process, it will be more efficient” (B11)

A contrasting situation inevitably occurs in District Cintolamo. Since the PHC in this district currently do not have a fully operational PHC IS, the medical records are still organised in paper-based form. During a group discussion, a team of the registration staff in a PHC expressed their difficulties in organising and handling the medical records papers, especially compared to the time they used the electronic system (SIKDA). Even though they used the system only for a couple of months, they have realised the benefit of SIKDA, especially in managing incoming patients registration. The PHC IS allowed the staff to process patients’ admission more effectively, which led to a better organisation of the paper-based medical records in the registration room. Currently, since they do not have a fully functioning PHC IS, they are facing the difficulties in organising the paper-based medical records without the aid of the electronic medical records. Image 5 shows the registration room in a PHC in District Cintolamo where the paper-based medical records are stored.

“Those are all [medical records] we have. In the past, when we used SIKDA, even though [the patient does not bring] their card, we still could find it on

the computer. Now when they do not bring the card, it will difficult to find [their records].” (CL08)



Image 5 PHC staff struggle to organise the medical records while concurrently administering the overwhelming number of patients due to the absence of PHC IS. The picture was taken in registration room in a PHC in District Cintolamo

Error avoidance—A trivial human-error can lead to a fatal consequence in health care service. In a PHC, the chaotic environment and workers’ tiredness can cause a ‘silly but fatal’ human error especially if it is made by a clinical worker. This finding came up in discussions about the role of the technology in anticipating and mitigating the clinical error. For example, a pharmacist once mistakenly gave different medicines to a young patient, which was supposed to be given to an old patient but with a similar surname. This error is caused by incomplete patient’s record typically written in the paper handed by the nurse or doctor. The pharmacist later realised the mistake, who then rechecked the electronic records in PHC IS and visited the patient’s house to replace the medicines.

Monitoring outpatients with chronic illness

The introduction of HIS to primary care enables the health workers to have complete and accurate data to monitor outpatient with particular chronic illness who need prolonged treatment. Tuberculosis patients, for example, are normally given a 6-9 month treatment. The patients need to visit PHC regularly to check their sputum and collect the medicines. The responsible nurses are required to check the conformance of each patient and take follow-up action to the dropped-out patients by directly contacting or visiting them. The offline-based application system, SITT, which is used in all three districts, enables the responsible nurses to track the records as well as to analyse the outcome of the treatment whether the patients are cured or become resistant to the drug.

“We need to see the dropped-out TB patients, who took medicines for three months then disappeared. With SITT, it is clear. We can see which ones are cured, which one fails, which ones become MDR (Multi-Drug Resistant), the ones that become XDR. It is now presented in the data [...] PHC is tracking. If in two successive weeks [the patients] do not come, they have to be monitored” (BT03)

Dyadic patients-provider interaction

Another positive impact from the introduction of HIS on the dyadic interaction during service provision is the improvement of the way clinical staff produce a diagnosis. The doctors are now required to clarify and specify their diagnosis according to disease classification in ICD (International Classification of Diseases) X codes. This practice causes positive consequences that the doctors become more disciplined and thorough in examining the patients and stating the diagnosis. Talking about this issue, a district official acknowledged that in the past some doctors wrote down the diagnosis carelessly, especially for common diseases like a cold or cough. Now, they need to be careful and be more specific in giving diagnosis since it will be inputted to the system. Commenting on this, one of the interviewees said:

“In the past, doctors were unwilling to write diagnosis with ICD X, an international diagnosis standard. With *PCare*, doctors have to be more disciplined in diagnosing [according to] ICD X. For instance, in the past, when I was [working] in PHC, a typical diagnosis, especially for senior [citizen], is cough and cold. [...] As for now, doctors are required to input [which one of cough?] according to ICD X, for example, J06 like ..., J10 like ...” (BT01)

Impact on clinical practice is also found in the adherence to the standard of the tuberculosis treatment. The data in SITT enables health officers to control the conformance of nurses or

doctors with the DOT (Directly Observed Treatment), the standard of tuberculosis treatment. The standard specifies the series of steps of TBC treatment that need to be adhered by the health providers including the compulsory supporting data (e.g., sputum analysis) related to each step. Furthermore, since it is not uncommon for the patient to visit another district or PHC to get health service, chronic patients may visit different primary care to continue the treatment. Consequently, all involved primary care need to synergise their control to those patients. Sadly, electronic data interchange between PHC within all the districts has not been introduced, which cause a problematic situation that the data synchronisation can only be manifested manually (e.g., household visit). In this regard, the practice of control is then shifted from individual PHC-based to collective-based.

“It was automatically [reported] for further evaluation. For instance, whether the treatment is or is not complying with DOT standard (for tuberculosis). SITT normally will record this data. The medicines, sputum test, and many more, normally if they do not comply with DOTs, there will be an alert on the important [clinical] step missing during the treatment. If we follow this up, of course they [doctor/nurse] will have to fix it with the patient. That means service improvement” (BT04)

Health workers at the micro-level are now also required to maintain close contact with the patient recorded in their systems. This contact will be one of the indicators that determine the PHC capitation, the scale based on which PHC’s budgetary is determined. District-level staff in Bungatanjung told the researcher that in the national coverage system era, PHC is imposed to maintain contact with the patients as promotive and preventive care even though they do not currently need curative treatment. For example, a mother taking her toddler to PHC is also needed to be recorded in the system and to be provided with health counselling. As such, this practice transforms the PHC role from a care centre that solely provides curative treatment to a provider of promotive and preventive care.

“So it can be concluded that the positive effect [of HIS] is to improve the quality of health services as a whole, not only curative or rehabilitative but also, philosophically, the preventive and promotive program.” (BT01)

4.4.1.2 Program planning

Health district and PHC are required to develop a program plan and subsequently allocate resources to conduct such a plan. The relationship between HIS and the practice of program planning was found in all districts even though in a different extent. All districts emphasise the importance of accurate program planning in public health, because it strengthens the

anticipation of diseases according to its prevalence and develops an effective program to address key health indicators (e.g., malnutrition). Thus, the plans are needed to be time and context-specific, based on health characteristics and indicators of each district or village such as demography, diseases prevalence, pregnancy rate, inhabitants with malnutrition, or its epidemic diseases (e.g., dengue fever). These indicators should become the baseline by the authoritative actors in designing a public health program. This issue came up, for example, in discussions with staff in District Cintolamo. She described an example of this theme based on the current issue in her district. The data once indicates a significant malnutrition problem of children in a particular village. Consequently, the district officer and the head of nearest PHC design an intervention program, for instance, a recurring distribution of supplementary food for children such as milk or vitamin (Indonesia: *Pemberian Makanan Tambahan - PMT*).

Program planning is also ideally designed based on the output of program monitoring and evaluation. Program evaluation that relies on the data from HIS contributes to more precise program planning. For example, data of the previous year indicates a low coverage of mental health patients, which contradicts their common assumptions that mental health is one of the district's emerging issues. The program managers then assume that a large number of targeted patients did not seek clinical treatment to public health providers. Thus, for the upcoming year, the program managers in district-level create program priority for mental health, such as a direct household visit to the targeted patients.

In this regard, the accuracy, completeness, and newness of actual data are crucial. The actors realise the benefit of HIS in their program planning activities, which further explain that HIS allows them to create a more responsive program. In particular, a fully-functional HIS strengthens the role of data in the development of Implementation Activities Plan (Indonesia: *Rencana Pelaksanaan Kegiatan – RPK*). At the operational level, reports generated from HIS enable the district-level and PHC staff to plan more accurate and timely programs according to their specific needs. Compared to the past, program planning was developed solely based on what they created in the previous year because they do not have a comprehensive depiction of the current progress of the district's health status.

“Yes, so we know what [our district's] problems are since we see them from our data. For example, maternal and infant mortality, or the number of visits K1 and K4 (expectant mother). In the past, sometimes [our] colleagues design their plans merely based on their hunch, not based on [health] program's requirements” (AR01)

There is a significant difference between data-based planning or planning 'with the aid of' data. Even though the data has been part of planning practice before HIS introduction, the use of data was limited to budgetary and material allocation. For example, the data of immunisation coverage was merely used for supply and stock allocation, while currently the actors can develop a comprehensive program from planning, monitoring, and evaluation based on a more complete and representative data. The actors thus acknowledge that healthcare program planning should be created based on the actual state of the health status of their districts or villages, which later allows them to justify the rationale behind program priorities.

“We didn't know [our data] and were groundless in creating the programs. That is why with the technology we can produce real-time data, which is accurate with the plans we created ...” (AR06)

“Once we have mapped the problems, it is easy to develop rational activities.” (BT03)

In District Cintolamo, while the data-based program planning has not been completely realised yet, they have shown an increasing awareness of the crucial role of data in this activity. The local consultant acknowledged this positive change. From interactions with HIS, they can be convinced and advised that the program planning can no longer be based on their ‘hunch’ or a copy of previous year’s plans.

“I cautioned them all, for monthly, quarterly and annual RPK, it is based on data, not based on what was needed last year in the same month. [For example] we need the medicine for this [clinical] case, so it has a clearer detail on what we need to do. That is the thing [that has changed], on their awareness of data.” (CL03)

4.4.1.3 Program execution, monitoring and evaluation

The relationship between HIS introduction and the process of program execution, monitoring and evaluation were found in all districts. On program execution, limited ICT systems support promotive and preventive health care practices. Promotive health process, to some extent, is currently supported by e-Posyandu application. Some PHCs in Anakranti have used e-Posyandu to conduct this activity. In some exceptional cases, field health workers have been provided with a mobile tab for reporting since PHC is responsible for promoting care through village health care services (for mother and child) and direct door-to-door health visits. The services include baby or infant weighing, vaccination, consultation, and all-related care, which normally do not require medication. This process also includes antenatal class. Health workers

or cadres who provide this service are required to record data, write reports, and then submit them to PHC.

"That's why our staff, the nutritionists, in PHC have been equipped with tab to input the data in e-Posyandu." (AR01)

"We also have a healthy greeting program (Salam Sehat). We greet them door-to-door to provide promotive and preventive care. We provide that service based on the previous data we obtained." (BT07)

On monitoring and evaluation, HIS provides data to regular evaluation meetings on the current health program performance either at district-level or at PHC-level. The information extracted from HIS, either a complex system (e.g., PHC IS) or a simpler system (e.g., Ms Excel®) presents the current status of the healthcare program, which becomes the topic of discussion in district and PHC's regular meeting. For example, at the district-level, the actors suggest that they now can see the progress of the immunisation coverage for each PHC to determine which ones need to be prioritised. For instance, PHC with low coverage of immunisation is instructed to conduct door-to-door sweeping (i.e., family or household visits). Another example is the use of the current information of expectant mother to determine the coverage of the HIV test. The introduction of HIS thus enables more accurate program evaluation. It allows the actors to monitor which programs that have achieved the target and which ones that have failed. Therefore, the actors, such as program coordinator, can focus on specific programs that need more intensive work to achieve the target. For example, district officers or PHC's staff have estimated that the prevalence of DBD (dengue fever) is high in January-February for the current year. From the data, the actors can look at current reported cases and compare them to the previously estimated rate of prevalence. If the trend of dengue fever shows a possibly severe threat, they can allocate more resources or intensify preventive works such as fogging activities in the villages. The sample of the data processed and published at PHC is presented in Image 6.

"As the coordinator of P2M, I ensure which programs need a little sprint to achieve. For example, the indicator of TB in the first quarter, say 100, [then] we can read or predict whether the target is achievable until the end of the year. We cannot stay still, there must be actions to achieve it." (AR09)



Image 6 Sample of data publications exhibited in a PHC

4.4.1.4 Reporting and communication process

HIS and its related ICT artefacts have changed the way the actors enact their reporting and communication practices. The reporting practices have been shifted from paper-based work to computer-based work. The communication activities, including documents exchange and data verification, also change through email and mobile messaging (e.g., Whatsapp®). Consequently, it minimises the opportunity cost of operation as well as the intangible cost caused by the time wasted for searching and finding files.

This impact was found in all districts. For example, even though the majority of the documentation process in District Cintolamo is still paper-based, the communication channels (e.g., for sending reports from PHC to district, see Image 7 for example) has been changed to electronic channels such as email or Whatsapp®. This new way of communication is perceived as a significant improvement by local actors because in the past the PHC staff need to travel to collect the hardcopy to the district-office, which is resources-consuming for rural PHC. On the other hand, the online-based HIS in District Anakranti and Bungatanjung, such as e-Puskesmas or Simpus, allows real-time data exchange that consequently improves the connectivity, which leads to more productive healthcare institutions.

NO	PUSKESMAS	LUCI	KID	MELINGKAPAN		TT BUMIL					KET	
				RODSTER	CAMPAK	1	2	3	4	5		
1	KERILAH	7.11	6	20.20	57.10	100	120					
2	ISUKARAJA	8.11	6	18.15		23	23	7	5	2		
3	BEROWARU	8.11	9	0.4		18	35	16	11	0		
4	SAZRA	8.11	11	28.36		12	13	32	19	9		
5	REKESING	6.11	18	10.47		113	87					
6	LEKONG	14.11	6	19.8	27	2	5	26	17	13		
7	TERARA	8.11	7	5.13		30	28	10	2	2		
8	MT. BETON	4.11	10	6.10		9	17	12	24	15		
9	SKULUR	WA		17.15	32	7	80	18	12	14		
10	KOTARAJA	7.11	7	4.19		0	4	10	14	14		
11	WAASABAR	8.11	2	12.11		0	6	10	14	14		
12	UD. INANGKA	7.11	5	6.17		0	0	12	54	38		
13	PRINGASELA	6.11	10	16.19		1	10	42	32	9		
14	LEKONG	15.11	8	12.12	10	8	6	10	9	5		
15	KERONGKONG	9.11	14	11.12		3	3	35	24	18		
16	DENGGEN	8.11	5	8.8		1	3	4	2	9		
17	SELONG	6.11	6	15.4		2	4	11	1	5		
18	LE. PHAI	13.11	7	12.12	18	0	0	82	11	25		
19	KORLEKO	3.11	5	21.13		0	2	24	15	2		
20	BATUYANG	7.11	10	18.11		27	33	42	15	12		
21	LEKONG	15.11	8	23.26	29	98	80					
22	SUELA	6.11	8	18.27		33	14	11	8	8		
23	LENEK	8.11	6	6.14		0	13	16	12	9		
24	AUKMEL	8.11	10	19.21	40	0	2	7	25	33		
25	KALIAGA	1.11	3	17.11		29	21	8	2	0		
26	WANASABA	9.11	6	4.5		21	30	20	10	11		
27	SEMBALLUN	9.11	5	6.6								
28	SAMADUA	15.11		14.13	27	4	8	7	6	11		
29	BELANTING	9.11	3	5.5		10	7	4	3	5		

Image 7 Sample of reports sent from PHC to district (District Cintolamo)

“Not 100% [of reports are electronic-based]. Some reports, such as immunisation, diarrhoea, malnutrition, are still manual (paper-based). But hardcopy doesn’t exist anymore, all [are reported] by online or via email. [We are] no longer using paper.” (AR09)

However, the current design of reporting processes may have a negative impact on the overall state of the service ecosystem. In particular, the reporting process is designed only in favour of macro-level actors which causes an unsettled situation at micro-level since the local actors undertake additional duty that they perceive has a zero benefit for them. As suggested by service ecosystem literature, certain actors’ practices may cause an unsettled situation in another part of the ecosystem. As one of the midwives stated.

“Because we have to. As I said, I only do the job, but there is no benefit for me. There is no reward or punishment because this is a task and duty, so I just do it without thinking” (BT09)

Another related example is the legacy of ‘cohort’ used by the midwives as their primary workbook. The cohort records patients’ record, such as the tri-semester visits by expecting mother. The objective of this cohort is to help the midwives tracking the progress of the patients to control their pregnancy. The current reporting process in HIS is criticised by the

midwives, both from District Anakranti and Bungatanjung, that it does not address their objective compared to the one in the cohort. A midwife in Anakranti exclaimed that the sequence of visitation records in the system is an error. Meanwhile, a midwife in District Bungatanjung does not see any benefit of using the system for tracking the patients (expectant mothers) visitation. As such, the midwives only use the system for inputting the data without any further use regarding their practice as midwives, which indicates that the reporting features of the system are currently beneficial only for the macro-level actors.

4.4.2 On actors' institutional logics

The analysis reveals that the connection between HIS introduction and the change on actors' institutional logics is complex and lengthwise. The transformation of the logics is prevalent, but it is a result of complicated process in a longitudinal pattern. Further, the outcome of the transformation in institutional logics is contextually specific, which is not solely determined by the acquisition and deployment of HIS artefacts. Nevertheless, three broad themes emerged from the analysis: acknowledgement of the role of data in health, actors' attitude toward technology, and self-contentment (Table 4-12). Each of them is discussed below.

Table 4-12 Impact of HIS on actors' institutional logics

Impacts	Anakranti	Bungatanjung	Cintolamo
Acknowledgement of the role of data in health	✓	✓	✓
Actors' attitude toward technology			
Establishing process rather than implementing technology	✓		
Fascination	✓	✓	
That technology has limitations	✓	✓	
Self-contentment			
Self-contentment and job satisfaction	✓	✓	
Job frustration			✓

4.4.2.1 Acknowledgement of the role of data in health

The prevalent impact of HIS introduction on the actors' institutional logics is their increasing understanding of the importance of data in every aspect of the public health system. From complete (District Anakranti), partial (District Bungatanjung), to limited implementation (District Cintolamo) of PHC IS and program-based applications, improvements of actors' acknowledgement toward data were found across the three districts. The actors' institutional

logics was reconfigured that there is an increasing awareness of the importance of data, which influences their commitment to take data seriously in public health processes. The transformation of this institutional logic is a critical pillar in data-based healthcare practices, which is an ideal trajectory in healthcare practices.

“The way I see it, some districts are aware of data, some are not [...]. Yet, they see us as one of the best [on data and information]” (AR06)

In District Cintolamo, for example, HIS introduction (e.g., Ms Excel[®] tool or SP2TP) affects the actors’ institutional logics that they are currently more critical about their data since it is now more organised and easier to interpret. A local consultant in this district once convinced the local actors on the importance of HIS by showing the non-realistic and erroneous figure from paper-based reports they usually receive from PHC. Consequently, it increases the actors’ awareness of the accuracy of the district’s health status reports they write annually. This case also correlates with the implementation of inter-organization data verification and validation practices.

“The most significant [of change] is now they know about the condition of their data. For example, KIA (Mother and Child) data in December has passed over 100%. It was 110%, 120%, or 130%, caused by either erroneous denominator or incorrect amount of expecting mother or infant. Well, at least now they are aware of the condition of their data, starting from the bottom (PHC) to the district level.” (CL03)

The consequences of the increasing acknowledgement of the role of data are manifested in the priority of ICT in the ecosystem. Currently, PHC has improved its priority to extend the proliferation and use of ICT infrastructure and application in the public health system. This shift is a significant improvement because in the past ICT was perceived as a liability or tertiary resource by PHC. Talking about this theme, a district-level officer in District Anakranti explained that PHC had established certain expectations on the technology, which indicates that there is a positive shift in actors’ perception toward ICT, as she stated:

“They had many priorities ..., HIS is maybe placed third or fourth. But now PHC’s mindset has been shifted a lot compared to the time when I started. In the past, ‘it was a headache’ to ask one computer [to be purchased by] PHC. Now they are the ones who think, ‘That’s correct! We have to!’” (AR03)

As a result, the use of HIS improves the actors’ confidence with their health data. The improvement is prevalent compared to the past when the actors were not only uncertain with

their data but also with the overall Operational Definition (procedure) of conducting healthcare process. However, a standard view amongst interviewees, especially in District Anakranti and Bungatanjung, was that the healthcare actors took several years to realise the benefits of HIS. For example, the head of data and information in District Anakranti told the researcher how difficult it was to change health workers' willingness to change their way of work from handwriting to computer-based work. She also pointed out an exceptional case happened in two of the district's PHC that nothing has changed on actors and practices since the district introduced the HIS.

“It [perception of data] has been shifted. In the past, we were not sure about our data... Perhaps even with the Operational Definition, everything was slipshod, that's how I see it [...] At that time, to change from handwritten to the computer was extremely difficult. It took about five years for them, for moving on and realising the benefits. Two PHCs couldn't even [managed to] change like others.” (AR03)

4.4.2.2 *Actors' attitude toward technology*

Establishing process rather than implementing technology

The analysis suggests that the actors who have developed a good understanding of HIS demonstrate a great apprehension on the co-dependency between the process workflow and technology implementation. Since a complex application system is difficult to develop from scratch, district officer or PHC chose to subscribe a packaged software from a system vendor, which then inevitably re-engineer the existing business process and interrelationship activities according to its predefined software design. The prevalent impact realised from this apprehension is that the district actors are able to analyse and filter any proposed software offered to them by external actors since they now can identify what their needs are and how the software will fit into their district.

“The application is easy, it's all about operating it. The technology is only a support and tool. For us, [what really matter is] how to generate information.” (AR05)

“Once the [workflow] pattern is established, the human capital improved, then the application [software] will be easy [...] That's why the initiatives cannot begin with the technology.” (AR02)

In District Anakranti, the researcher found that the current achievement of HIS enabled transformation is a result of a long and continuing process. The district has gone through various failed projects and exhausting process of cognitive refinement that continuously

develop and self-reinforce a proper perception toward ICT. This means that it is significant to have proper perception toward the use of technology rather than on the technology advancement itself. Not only the actors need to acknowledge the capability of ICT, but they also need to understand how their needs fit the ICT and what changes on resources, logics, and rules are required before the proposed capability is realised and established. The C-level respondent from a national vendor acknowledged the outstanding apprehension of the actors in this district:

“Because that district has acquired marvellous vision, mission, including information technology, about their healthcare.” (ID04)

Fascination

The introduction of HIS and its supporting infrastructure invited unique responses by the actors. The deployment of new technology inevitably invites interests and curiosity. Fascination is expressed by the actors, either by the physical existence of the devices or equipment or by the features of the technology. This is prevalent in District Anakranti and Bungatanjung. For example, a patient in District Anakranti expressed his amazement that PHC in his district now has queue technology calling the patients with a voice, similar with the system he encountered in the bank where the (queue) number is displayed on a monitor.

“Yes, there is [an impact]. At the counter at the front, we are provided with a screen with an instruction to push the queue button. Then the number of queues comes out automatically and is recorded [displayed] on the monitor. The system uses the sound.” (AR10)

Similarly, a patient in District Bungatanjung said that the use of computerised queue system exhibits a significant improvement in his PHC.

“The obvious one is the queue system. In the past, it was manually with the card [ticket]. Now it is computerised, which is quite helpful. Using that manual number is outdated. For public service, it should have been more systemised, simpler, neater, so [that service is] more organised.” (BT11)

The technology has limitations

Through interaction with technology, actors found various concerns regarding the use of technology. It indicates that despite the initial hype from the acquisition of ICT resources, the actors, especially in District Anakranti and Bungatanjung, now have a better understanding of their limitations. Commenting on this issue, one of the midwives in District Anakranti told a

story about how she perceived that the technology is not handy since it cannot provide data instantly when there is an inspection by the management.

“Further, there is no guarantee that the data will be available, in case some inspectors come and say, ‘where is it [the data]?’” (AR07)

They also learned that a more advanced application could not adapt to frequent change. In mother and child division, reporting templates are frequently changing by MoH on which new additional data elements were added in the reports. The frequent change is also influenced by the various type of new vaccinations, such as the recent PCP (Pneumocystis Carinii Pneumonia) and MR (Measles and Rubella) vaccines. Since the application system requires a longer time to modify, incorporating new various reporting forms was postponed for several months. As a result, the actors realised that a simpler system like Ms Excel[®] is more handy rather than a complex and advanced application system.

“Another question arises since this form was changed again yesterday. There was the PCP vaccine, the pneumococcus. Tomorrow there will be vaccine MR. The PCP is given every two, three months, [which implies] that this form will be modified again. Consequently, this [application update] is postponed. That’s why we operate Ms Excel[®] now.” (AR04).

4.4.2.3 *Self-contentment and job satisfaction*

The actors perceived that the implementation of HIS and the continuous use of its artefacts should be acknowledged as an achievement in public health service. It is not surprising since the number of districts and PHC who have used HIS in their healthcare processes is still limited among which are still struggling with resources and infrastructure. Actors in these districts gain self-contentment and job satisfaction, which are expressed by most participants in Anakranti and some participants in Bungatanjung by depicting their current state as ‘very good’ and worthy of awards. This finding demonstrates the outcome of transformation on actors’ institutional logics in service ecosystem because it shows the way actors perceive the value from using ICT resources.

“I don’t want to brag, but our PHC did [good job] for the last three months series.” (AR08)

“That’s why the central government regards us as diligent.” (AR06)

“The response is good. I got full support from the president of IDI (Indonesian Medical Association), who is delighted with this. [This system] only exists in our district, none other, so it is our pride.” (BT02)

A contrast situation was found in District Cintolamo. The overwhelmed and redundant job caused by diverse non-integrated HIS applications across various divisions and programs instills the uncertainty of job distribution among the staff, which make them become frustrated by this circumstance. The situation is worsened by inadequate training and system control from the authoritative actors. As a consequence, one of the respondents even stated that he has been thinking to move from his PHC to a more established institution such as a hospital who has a more advanced HIS.

“I feel like want to return to the hospital again; I got tired to ‘learn this, input this’. The next year [I] become a technician for health promotion program, what a headache [...] That’s a flaw here, the regeneration. After training, when we need a peer-learning, that person moved out.” (CL05)

4.4.3 On rules of the healthcare service ecosystem

The process of HIS enabled transformation involves a continuous change of institutional rules in the service ecosystem. The relationship between HIS and the institutional rules is bidirectional, which means that the impact is rarely found in a cause-effect pattern. The formal rules, for example, can act as either a coordinative mechanism of HIS or an instrument to enforce HIS use. Nevertheless, the analysis found that the impact of HIS introduction on the institutional rules in service ecosystems is prevalent in four areas: 1) language incongruency, 2) redefinition of the role of accreditation and compliance, 3) the emerging role of accountability, and 4) the emergence of organisational and or individual’s role discrepancy. The distribution of evidence for these themes is presented in Table 4-13, each of which is discussed belows.

Table 4-13 Impact of HIS on institutional rules

Impacts	Anakranti	Bungatanjung	Cintolamo
Incongruent language		✓	✓
Redefining accreditation and compliance	✓	✓	
Strengthening accountability	✓	✓	
Actors’ role discrepancy	✓		✓

4.4.3.1 Incongruent language

Operational Definition (OD) (Indonesia: *Definisi Operasional*) is a *language* that contains guidance, definition, data element, and to some extent, the standard operating procedure. It defines the terminology and workflow of all programs across all healthcare divisions or

organisations. As described in Chapter 2, OD is an institution in public health in Indonesia that standardise the operational procedure across the country. Ideally, OD must be aligned between explicit rules at the macro level, operations at district and micro level, and data definitions and workflow in HIS. The district officers thus need to disseminate these rules to all actors at the lower level (see Image 8 for example).



Image 8 District-level officers are explaining new control procedure to midwives (District Anakranti)

A common view amongst interviewees, particularly in District Bungatanjung and Cintolamo, is that a lot of terms and workflow in HIS applications currently operating at the micro-level are different from the OD. This situation indicates that the vendor of the system does not adopt the terms or workflow currently used by the local actors. For example, the current version of HIS that is currently used for reporting tool in District Cintolamo requires midwives to fill in K2 and K3 (expecting mother's visitation #2 and #3), which are different from their current OD. The system also specifies a perinatal as 28 days after birth, which is not consistent with their terms. This finding indicates the importance of the involvement of the micro-level actors in the development of HIS. This situation also confirms the findings on the importance of establishing the process and interorganizational flow so that any changes in the rules can be disseminated quickly in the service ecosystem.

“[...] the operational definition is different from SP2TP. At the front, there is K1, but at the back, there are K1, K2, K3, K4, while we only have K1 and K4. Where can we get that K2 then? That's why we, as midwives

coordinator, want to be included in HIS team gathering. We can't just fill it in. [...] Perinatal is defined as 28 days, that is no longer perinatal, it is already a baby. The [form] requested in SP2TP is not consistent with our OD in Mother and Child.” (CL04)

4.4.3.2 *Redefining accreditation and compliance*

The introduction of the national health coverage system offers a better opportunity for PHC in management and budgeting flexibility. Therefore, a significant improvement in the process, capability, and governance is required. The PHC accreditation scheme is established to measure the overall capability of PHC, including the management of health data. In this regard, actors acknowledge the significant role of HIS on PHC agenda in gaining a satisfactory level of accreditation¹⁵. The introduction of HIS brings a significant change in operating procedures and technical guidelines in healthcare process while also provides the records of all PHC activities. This finding is discovered in District Anakranti and Bungatanjung in which the use of HIS artefacts and its relationship with accreditation is prevalent.

"There is the accreditation now [...] all programs we do need to be [recorded] in application." (AR07)

“The change is significant, from SOPs, technical guidelines and many more. Significant! Moreover, now all puskesmas are expected to be accredited [...] So from the registration, then the examination, later the diagnosis and the drug, all are integrated [in Simpus]. So, the Simpus supports the accreditation, because it will improve the health service.” (BT06)

Similarly, the management of information system is one of the aspects examined in PHC performance assessment held by the district-level government. A satisfying performance (10 marks) is indicated by the effective use of HIS and the depth of HIS proliferation (e.g., the number of divisions that use HIS). Thus, ideally, the partial implementation of HIS in District Bungatanjung will be marked as inadequate since it is only being used in patient's registration, unlike comprehensive end-to-end use in Anakranti. From the district-level perspective, this assessment aims to stimulate the health workers to comply and incorporate the clinical or provisional service procedure guided by HIS, so the overall health care is improved. In District Bungatanjung, the district even holds regular PHC achievement award to attract the

¹⁵ The levels of PHC accreditations (from the lowest to the highest): non-accredited, basic, medium, primary, and plenary (Indonesia: *tidak terakreditasi, basic, madya, utama, paripurna*). The level of accreditation is correlated with capitation, that is, the budget allocated by the responsible institution. Related regulation: *Peraturan Menteri Kesehatan Republik Indonesia Nomor 46 Tahun 2015* (Appendix C)

stakeholders to improve their public service, where the winner will be invited to the provincial level and central-level government for higher competition.

4.4.3.3 *Strengthening accountability*

The use of HIS improves the accountability of health care provision and reporting at the micro-level. It prevents actors' negative attitude found in the past, such as altering and faking data input or lying about data reporting. It implies that there is a new tacit rule in the ecosystem following the use of HIS. The district staff explained that any ICT application was avoided by some people in the past because they could no longer input fake data or be careless in conducting data entries since they fill in the records merely based on their hunch. They also cannot lie to the authoritative actors at the district-level whether they have submitted their report or not because it can be checked in the system. Through the system, the head of the district-level government now is able to find out which PHC that have not completed and submitted their report to the head's office. Similarly, as explained in Subsection 4.4.1.1, HIS also enables the transparency and accountability of the treatment provided by clinical workers. For example, program managers in district-level can use SITT to find TB treatments that do not comply with DOT standard and then follow them up to the respective doctors or nurses to carry out the missing step during the treatment.

“They cannot lie anymore. In the past, this is the thing that is avoided by the people. With online-based data [system] they cannot deceive, cannot fill in the data as one wishes. In the past, it was possible. Today the data like this, but tomorrow when we confirmed then it changed, it was refilled in with correction pens. So there might be a lot of fakes.” (AR03)

4.4.3.4 *Actors' role discrepancy*

The introduction of HIS, however, creates additional job function at the operational level, which frequently is assigned to certain workers that later collide and complicate with their natural function. Some of the HIS-related tasks, especially on data input and reporting, do not replace or simplify their primary job function. These additional tasks assigned to the health workers, particularly on data clerk or system operator, are accompanied by an official duty appointment through a letter written by authoritative actors (e.g. head of PHC). The letter defines and describes the role and job description of the data clerk or operator. This role is regarded as a function which in practice is assigned to an existing person as an embedded job to his/her original function. Since this function is far from their natural function, various conflicts and concerns arise. For example, the tasks create a burden for these workers that lead

to their frustration. They face various conditions where they cannot focus on their primary function, such as providing service to the patients.

“But because we also need to create records, it is like an additional job. It is twice our work.” (AR07)

“But that role is plotted to someone without considering his/her natural function. That’s the thing I criticised. For someone with IT background or a person dedicated only to that role, then he/she will be able to do it optimally. But, I cannot do more than one [role]!” (AR09)

This situation creates emerging risks to data validity due to inconsiderate job distribution. In district Cintolamo, for example, an exhausting process occasionally causes the absence of data verification. Since they are not allowed to postpone data reporting, they still need to do data entry even though they had a busy day from an unexpected patients outbreak, which increases the probability of human error. A local consultant in this district exemplified some irrational data in the system, error from a thousand patients to hundred, which makes the aggregated indicator over 120%. There are also possible risks related to job interests, where data entry job is assigned to someone who may have a conflicting interest in the data.

“I am a nurse, [but is] instructed to become JKN technician. Next, when creating SKP, [I write] how many time my shift is. [...] When it comes to the assessment, I can cheat then, can’t I? I can write something I did not do.” (CL05)

4.4.4 On resources configuration

From the ecosystem perspective, the constellation of resources and its exchange patterns are transformed following the introduction of HIS. However, since the country and most of its districts are at different stage of digitisation of their healthcare process, the overall structure of resources configuration is disorganised. The analysis reveals two emerging themes with regard to resources structure: 1) dispersed information silos, 2) augmentation of existing resources. Table 4-14 outlines the distribution of the evidence found across the three cases.

Table 4-14 Impact of HIS on resources configuration

Impacts	Anakranti	Bungatanjung	Cintolamo
Dispersed information silos	✓	✓	✓
Augmenting existing resources	✓		

4.4.4.1 *Dispersed information silos*

The disorganised development of HIS in all three districts creates dispersed information silos because the non-core applications (PHC IS) are scattered across multiple divisions across meso and micro-level of the ecosystem. Each health division operates various applications intended specifically for the programs of their division. The applications are either developed by the MoH or by district-level division (as found in District Bungatanjung). As a result, by zooming out the perspective to see the broader service ecosystem, the constellation of resources is dispersed and disorganised. Such applications are now difficult to integrate, especially with the core PHC IS, which ideally acts as the main application and primary source of data. The scattered applications have not been integrated due to the different formats and the degree of complexity in each division (e.g., the complex sequence of immunisation data). The course of integration is also constrained by the continuous changing of report formatting set by the MoH. The MoH is also frequently criticised due to launching too many applications scattered to various division.

“They [HIS] existed but dispersed.” (ID01)

“I think the immunisation (excel tool) is good. Unfortunately, it cannot be combined with the e-Puskesmas. The reason is [...] e-Puskesmas also has immunisation [module], but the sequence [process flow] is not similar.” (AR04)

“The MoH launched too many systems. In the end, they (health workers) become overwhelmed, doing data input as they wish.” (BT01)

The partial use of HIS in District Bungatanjung also creates a challenge on the validity of the aggregated data at district-level. This data is retrieved from the patients’ admission room while ideally the data should be retrieved from the treatment room (doctors) and pharmacy. This source of data sometimes is inputted incorrectly, depends on whether the staff follow up the entry or not. It causes the discrepancy between the data from admission (registration) and the data from actual care (e.g., doctor’s room). Occasionally, the workers manually edit the excel form, which later is merged with the data in the system. This finding indicates that there is a defect in resources exchange activities currently occurred in the ecosystem.

“That depends on the staff whether they are willing to enter the data in each room. If room [staff] does not enter the data, then the output will not be 100% [...]. The diagnosis will not be 100% [...]. Fortunately, the report from this application can be integrated with Excel. So it can be modified to

match it with manual data [...] so the gap between the total patient and the number of diagnosis is not too far.” (BT08)

4.4.4.2 *New configuration (augmenting) of resources*

HIS needs to be integrated with other supporting resources to enable the enactment of new practices. The direct house visit program, for example, requires ICT resources not only on PHC officers’ side but also on the field health workers’ side so that the co-created activities are realised. In this regard, it was found that District Anakranti has extended their ICT configuration to assist their frontline health workers by augmenting their PHC IS (i.e., e-Puskesmas) with additional infrastructure such as WiFi in PHC’s building. PHC in Anakranti also allocates a budget to provide additional phone credit to their health workers so they can continue the data input from their home. Certain PHC even provide their nutritionists who are working in the field with a tablet to allow them to record and submit the data immediately after providing services. The deployment of the tablet for mobile data recording and submitting, WiFi for PHC’s operation, and supporting resources for working from home, maybe the ideal configuration of resources for the public health system.

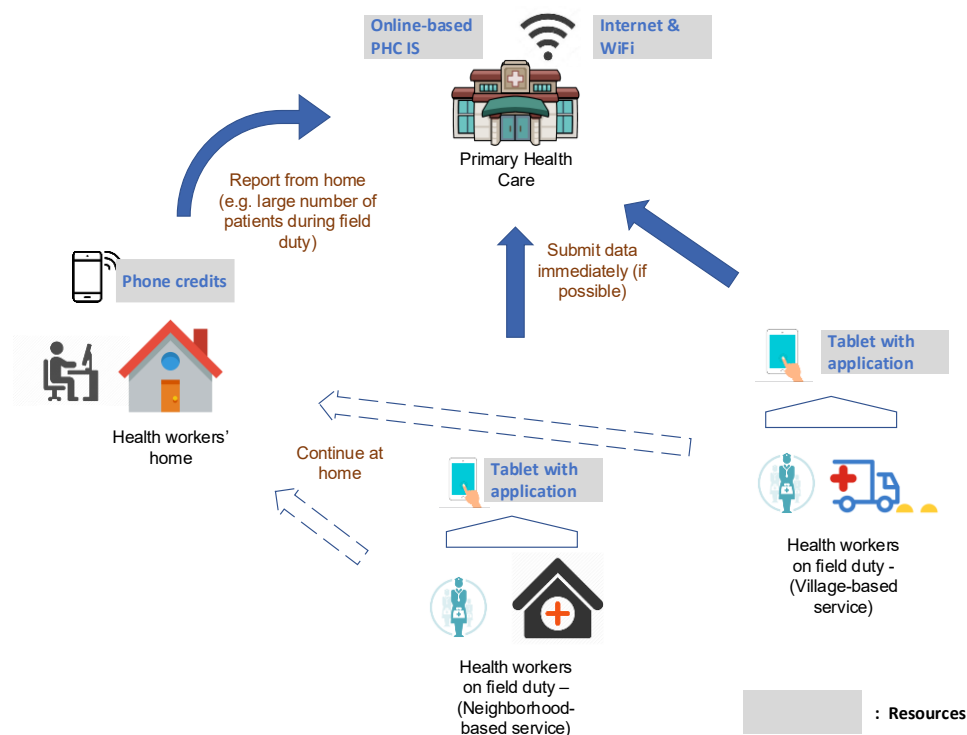


Figure 4-7 Constellation of resources supporting field health workers in Anakranti

This configuration of resources allows the workers to access the online-based application from home. A data operator in a PHC told the researcher that sometimes the village’s midwives contacted him about the troubles in using the application even when he is already at home or

during his off duty. He emphasised the difference of the current system with the previous system (SIKDA) that now he can handle the trouble remotely as long as the internet access is available. However, the new configuration has a negative impact, since it is interlinked to several entities, which makes it inflexible and creates domino-effect if one side experiences an error. A group of midwives explain their frustration with an error found in the system that causes a series of subsequent error in their records.

“The formula is wrong, if we change it, then everything else will be changed [too]. Overall, the formula in that application needs to be fixed. We can do it [in manual or Excel]. But we can’t check it in the application. If they give us, it’s easy for us.” (*midwives (group), District Anakranti – recorded observation*)

4.4.5 Summary

The constructs presented in Section 4.4 are summarized in a construct map below.

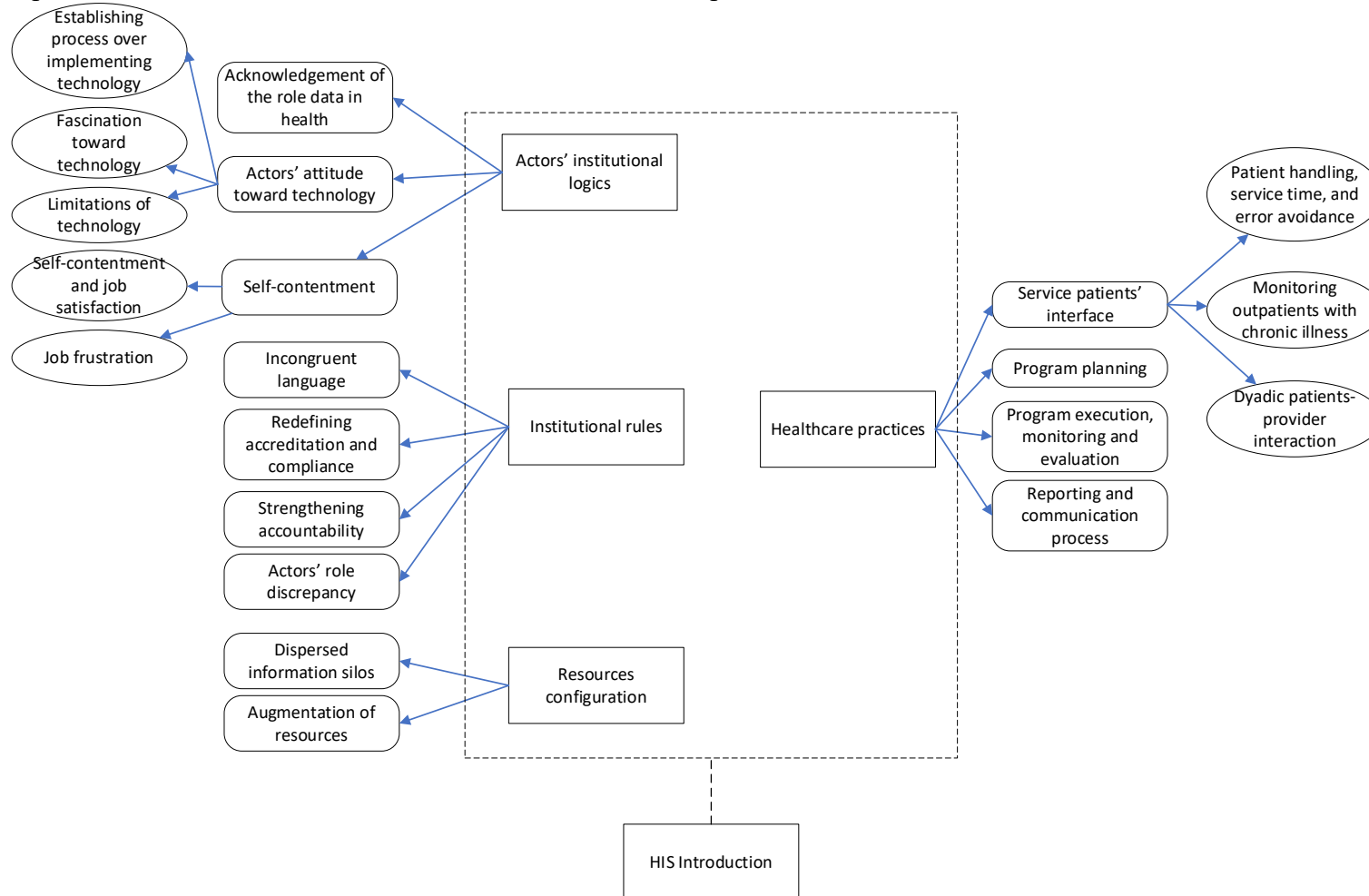


Figure 4-8 Construct map - impact

4.5 Chapter summary

This chapter has outlined the results of the analyses from the empirical study. It presents the exploration of the research context, and the empirical findings on HIS enabled transformation in Indonesia's service ecosystem. Themes emerged from the analyses provide rich insights into the mechanism of transformation and the impact of HIS introduction on service ecosystem's structure. The next chapter proceeds with the discussion and the interpretation of these findings on the mechanism and impact of HIS introduction on the service ecosystem transformation.

5 Discussion

5.1 Chapter overview

This chapter discusses the interpretations of the findings to generate knowledge and address the research questions. The discussion is framed by the theoretical lenses: SD logic and generative mechanism of transformation.

SD logic stands on the premises that value is instantiated at the moment of resource integration as the enactment of value co-creation practices (Vargo and Lusch 2016). Since the acknowledgement of the institutions as the social structure coordinating the value co-creation practices, SD logic calls for studies on how we can explain the dynamics of the structure of service ecosystems (Beirão et al. 2017; Frow et al. 2016; Peters 2016). Referring to Giddens (1984) and Orlikowski (2000), as presented in Chapter 2 Section 2.3.2, the parsimonious and overarching conceptual constructs of social structure are rules and resources, by which the actors through their institutional logics instantiate them in practices.

These conceptual foundations suggest the multifaceted nature of value co-creation practices: 1) the instantiation and reinforcement of structural components (logics, rules, resources), and 2) the enactment of value co-creation through resource exchange and integration. Therefore, the creation of new healthcare practices can be an anchor to evaluate the dynamics and relationship among the structural components and further to understand the mechanism and impact of HIS on service ecosystems. These premises become the foundation to interpret the study findings.

This chapter is structured as follows. Section 5.2 discusses the interpretation of the empirical findings presented in the previous chapter and how they address the research questions. This section consists of interpreting the mechanism of HIS enabled transformation (Section 5.2.1) and the impact of HIS introduction on the structure of service ecosystems (Section 5.2.2). Section 5.3 discusses how the findings address research questions. This chapter then outlines the study contributions to the ICT4D and service literature (Section 5.4) and implications to practice (Section 5.5). Finally, Section 5.6 summarises the chapter.

5.2 Interpretation of the findings

5.2.1 The mechanism of service ecosystem's transformation

The findings on generative mechanisms explain how the service ecosystem is transformed following HIS introduction. The analyses identify two institutional forces that trigger the transformation, namely, coercive and agency-driven institutional forces. Three generative mechanisms are identified, namely, adoption and incorporation mechanism, breaking and making mechanism, and self-reinforcing mechanism.

The findings suggest that the generative mechanisms of transformation are intertwined with the institutional forces that trigger the transformation. Coercive institutional force triggers *adoption and incorporation* mechanism, while agency-driven institutional force triggers *breaking and making* mechanism. Both pathways of transformation require the ecosystem to exercise and establish the new structure through *self-reinforcing* mechanism. The relationships between institutional forces and generative mechanisms underline two pathways of ecosystem's transformation, *enslaving* and *emergence* pathways, as illustrated in Figure 5-1 below. The enabling and constraining factors emerged in the empirical findings constitute the *contingencies* in generative mechanisms (see Section 3.2 and Figure 3-1). The two pathways of service ecosystem's transformation are explained below.

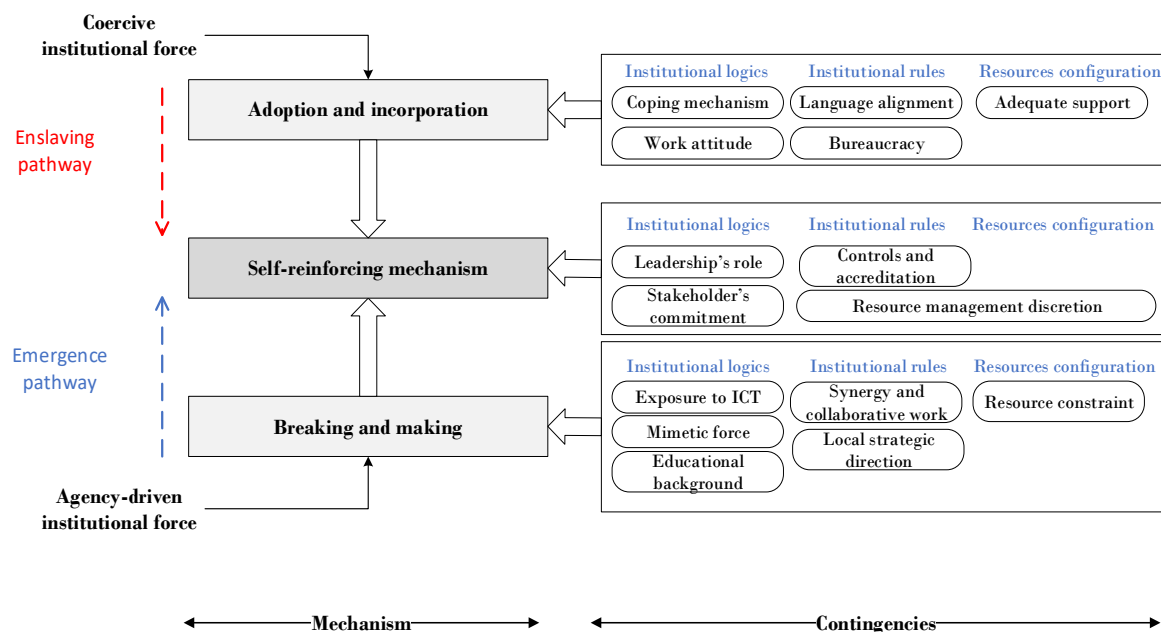


Figure 5-1 Two pathways of ecosystem's transformation

5.2.1.1 *Enslaving pathway*

Enslaving pathway delineates the transformation triggered by coercive institutional force from which adoption and incorporation mechanism is dispatched. Based on the findings (see Table 4-5, Section 4.3.1.1, and Section 4.3.2.1), the enslaving pathway is triggered by changes on formal rules as the catalysts which then trigger and control the movement at the lower level of ecosystems. Formal rules are not limited to a significant strategic decision, since throughout the time, small top-down instructions are frequently released without any necessary change on regulation. The local actors ‘incorporate’ new procedure into their practices as set by new rules while, if necessary, adopt new resources to enact such changes in practices. The findings demonstrate that this pathway is not the adoption and incorporation of resources *per se*, but rather a transformation of the structure, including rules and practices, where the resources are the tool to support or enable the transformation process. The new institutional structure from adoption and incorporation mechanism produces a structure predefined by the coercive institutional force (e.g., diagnosis reporting procedure), which consequently causes the institutional isomorphism across the meso and micro-levels.

The analysis identifies five themes on the contingencies of enslaving pathway. Two of the themes, *local actors’ coping mechanism* and their positive *work attitude*, represent the actors’ responses toward institutional force. The next two themes, *language alignment* and *bureaucracy*, indicate the institutional rules that constrain the mutual constitutive relationship between actors enforcing the change (i.e. macro-level) and actors enacting the change (meso and micro-level). Combined with the fifth theme, *adequate support* (resources), it can be implied that the enslaving pathway of transformation heavily relies on how macro-micro relationship establishes the adequate rules and resources so the local actors can enact the new practices. It is corroborated by the empirical findings on the incongruent practices between micro-level operation and macro-level rules, that the local practices are conducted only to show their conformance to the coercive force to cope with their struggle with resource constraint.

The findings further demonstrate a specific role of self-reinforcing mechanism. The self-reinforcing mechanism determines the outcome of transformation for both enslaving and emergence pathways. The self-reinforcing mechanism represents the way service ecosystem exercises, establishes, and maintains the new institutional structure. The mechanism includes strengthening the governance of operational procedure of new practices by developing the instruments or control procedures to oversee the enactment of the new practices. The

contingencies that enable/constrain the self-reinforcing mechanism are related to three structural components: actors (leadership and overall actors' commitment), resources provision (resource management discretion), and institutional rules (controls and accreditation). The outcome of the self-reinforcing mechanism can be observed through the way the actors understand the new role and interorganizational process and how they manifest those changes in their practice.

5.2.1.2 *Emergence pathway*

Emergence pathway delineates the transformation triggered by the local agency where the local actors break the existing institutions and make the new ones. Powell and DiMaggio (1991) acknowledged the local agency as a driver for institutional change that in this study is regarded as the catalyst of the *emergence* of new local institutions. The findings show that the local agency acts a significant institutional force due to the socio-political decentralisation system that offers the autonomy of district-level actors. This causes the local actors to detach themselves from dependency on resourceful actors at the macro-level, which leads to an emergence of local change. The cross-case analyses demonstrate that the successful transformation is influenced by the local agency promoting change in the ecosystem. District Anakranti, and to some extent Bungotanjung, have shown a significant autonomy, while on the contrary, the third district offers a limited space to allow the local actors to take self-initiated action while also still have strong dependence on the MoH. The significance of the local authoritative actors in agency-driven transformation is demonstrated through their power in utilising resources or establishing collaboration with other beneficiaries. Eagerness to change is insufficient if the interorganizational collaboration and necessary actions are not present and established.

However, since the agency-driven institutional force only acts as a catalyst, the success/failure of transformation relies on the generative mechanisms of transformation. The breaking and making mechanism is represented by the district's capability to perform self-initiated action, which heavily relies on the way each structural component of the ecosystem is conditioned. The six factors presented in the Findings chapter (see Section 4.3.2.2) represent the contingencies of each component. Actors' institutional logics is represented by the *exposure to ICT*, the peer-pressure for a *mimetic act*, and *educational background*. The institutional rules are represented by the *local strategic direction* (formal) and *synergy-collaborative work* (formal-tacit), while resources are represented by *resource constraint*. These contingencies

emphasise the importance of capacity and capability to perform the transformation in emergence pathway.

5.2.2 The impact on the structure of service ecosystems

The findings on the impact of HIS introduction (Section 4.3) show how the structural components of service ecosystems change following HIS introduction. Each structural component—resources configuration, institutional rules, institutional logics, and practices—has a distinct and unique pattern of impacts following HIS introduction. In this section, each component is discussed separately by proposing key insights on the relationship between HIS introduction and the structural components of service ecosystem, followed by the supporting arguments based on the research findings. Subsequently, a model of HIS enabled service ecosystem's transformation is proposed.

5.2.2.1 Resources configuration

The findings show how HIS introduction impacts the resources configuration of service ecosystems. The relationship between HIS introduction and resources configuration is summarised into theoretical insights below.

Insight 1a: *HIS introduction has a direct impact on the constellation and flow of resources configuration by facilitating access to previously unavailable resources and recombining existing resources that enable the establishment of new practices.*

Insight 1b: *Co-creating value from the new resources configuration entails mutual constituting relationship between the actors.*

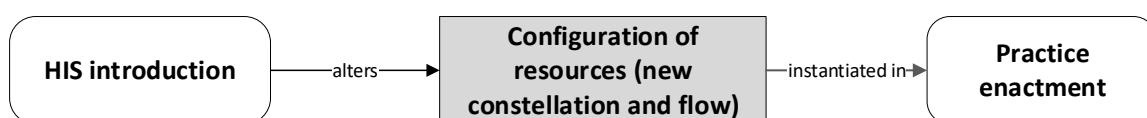


Figure 5-2 HIS introduction and resources configuration

The primary resource identified in the service ecosystem studied in this research is information resource. Information resources are produced during provider-patient interactions at the micro-level located in Primary Health Care. Two emerging themes presented in the Findings chapter, *dispersed information silos* and *augmentation of resources configuration*, imply that HIS introduction transforms the *constellation* and *flow* of information resources. The constellation represents information resource configuration currently takes place in each district. Various ICT artefacts operate separately in each public health division/program in both PHC and health

district government, causing the information to be *dispersed*. On the other hand, the flow of information resources is indicated by how HIS in the ecosystem allows the actors to access and use certain resources that previously was unavailable, ranging from health workers (e.g. tracking chronic outpatients, medical history), program officers (e.g., patients admission and their diseases, either by real-time (District Anakranti and Bungatanjung) or periodically (District Cintolamo)). Zooming-out these sample of events, these findings indicate that in the complex resources constellation in the ecosystems, HIS provides the *network offerings* (Moeller et al. 2013) that enable *resource access* previously unavailable (Beirão et al. 2017).

On the other hand, the finding on *augmentation of resources* is related to the operant role of ICT in the health service ecosystem that transforms the *flow* of information resources. Resources augmentation occurs when ICT artefacts are embedded in the existing resources configuration that alters the way health information is processed, shared, and exchanged in service ecosystems. However, the finding suggests that the augmentation of resources, especially tangible resources (e.g. infrastructure, devices), only creates value when they are provided not only to PHC or district's officers but also to all involved actors (e.g., frontline health workers) to enable co-creating activities. The case of the village's cadres demonstrates the co-creating practices between frontline health workers and officers at PHC in District Anakranti. Drawing from the foundational premise (FP) 6 (value is co-created by multiple actors, always including the beneficiary) and FP8 (a service-centered view is inherently beneficiary oriented and relational) of SD logic (Table 2-8), this finding suggests that *mutual constituting relationship* is the key for transformation that underlines the deployment of ICT resources in the public health ecosystem.

From the interlevel perspective, the introduction of HIS, particularly at the micro-level, enables a significant change on practices at district-level. The findings suggest that resources integration practices at meso-level, such as program planning, are indirectly transformed following the reconfiguration of resources at micro-level. Through HIS, the health information resources are compiled, shared and exchanged from micro to meso-level, enabling program managers at district-level to provide more responsive planning or dispatch emergency action. The emergence of technology facilitating the practices also causes a repercussion, that any technical error will potentially obstruct the resource aggregation and subsequently resource integration practices at the higher-level context of the ecosystem. This implies that meso-level practices that rely on operand resources from micro-level may develop a certain degree of dependency on the operant resources managing the practices at micro-level.

The correlation between resources at the micro-level and practices at the meso-level is also observed through on inaccurate data exchange from PHC to districts-level officers at Bungatanjung and Cintolamo (Section 4.4.1 and 4.2.1) caused by inadequate patient management system (PHC IS). While the rules dictate the PHC to enact data submission (i.e., resources sharing), the operant resources (i.e., infrastructure) producing such information is inadequate. Consequently, from the interlevel perspective, the inadequate technology-supported healthcare at micro-level may lead to a defect on practices, such as potential inaccurate planning-evaluation practices and program design at meso and micro levels.

To sum up, the relationship between HIS introduction with ecosystem's resources configuration is straightforward; it has a direct effect on the transformation of resource configuration since the HIS augments, recombines, and creates a link between the existing resources in the ecosystems which further transforms the constellation and flow of information resource. HIS, therefore, acts on the existing resources (i.e., information resources) as operant resource, being the material embedded to the existing structure (Giddens 1984). The impact on overall service ecosystem, however, requires an examination on resource exchange and integration practices.

5.2.2.2 Institutional rules

HIS introduction impacts the institutional rules of service ecosystems. The relationship between HIS introduction and institutional rules is more complex than resources configuration, which is summarised below.

Insight 2: HIS introduction has indirect impacts on the transformation of institutional rules. The transformation of institutional rules (incl. tacit and roles) is mediated by the enactment of new practices that reinforces local institutional rules.



Figure 5-3 HIS introduction and transformation of institutional rules

The findings suggest that the impact of HIS introduction on institutional rules can be observed from two domains, which are formal rules and tacit rules. The formal rules are created and amended to accompany HIS implementation. From the findings, these rules are manifested in various forms (Section 4.3.4), including new language, new organisational system, new set of actors' roles, accreditation, and compliance (Subsection 4.4.3). Accreditation and compliance represent the formal rules emerged in the ecosystem that accompany the process of HIS enabled transformation. They guide, enforce, and maintain ICT resource provision and regulate the new operating procedure for new practices. PHC accreditation scheme conducted recently also represents the formal rules as it considers HIS introduction as one of the assessment criteria.

The transformation of tacit rules emerges in the ecosystem when the actors attempt to comply with the new formal rules, that they inevitably interpret and internalise the rules as new seamless norms (i.e., the tacit rules). This is demonstrated by the finding of *strengthening accountability*, which redefines collective understanding among the actors about the new rules or norms in enacting their practices in the digital age. This finding demonstrates the enforcement on compliance as formal rules as well as the tacit rules, which is consistent with what Giddens (1984) calls as a social sanction, rights, and obligations. Thereby, the actors experience a growing understanding of the new norms or tacit rules, which accumulatively develop a collective stock of knowledge.

The tacit rules also imply contextual specific norms established uniquely and exclusively in each district. In this case, even though the formal rules are set at the macro-level for all regions, each district performs differently according to their contextual setting (e.g., resources and people's attribute). While enacting a practice, actors always interpret the formal rules based on their values or belief that collectively reshape the tacit rules (Besharov and Smith 2014). This indicates that there is always a process of translation of rules to local practices, such as redefinitions of the job functions and actors' roles. The findings show that the job functions emerged from HIS introduction are tackled differently across the three districts according to the availability of dedicated IT staff or embedding the functions to the existing staff (i.e., the frontline health workers in PHC).

The findings on the impact on institutional rules also suggest the dynamics between formal rules and tacit rules in service ecosystems. Two emerging constructs; *incongruent language* and *actors' role discrepancy* indicate the misalignment between formal-explicit rules (e.g., regulation) and the way they are actualised at the micro-level. The incongruent language

indicates that in a complex service ecosystem, each level may have different terms/definitions even though it has been standardised through formal rules. The incongruencies may occur between any of the following three aspects: formal language (e.g. operational definitions), HIS terms and workflow, and local practices. The incongruent language is not only caused by the delay on the dissemination of the formal rules to all districts or PHC. Some rules dictating manual-based operations are maintained as the legacy system since in health practices they are considered as the best practices rather than being substituted by digital-based operations. The cohort book, for example, is still considered as the best practices for midwives by the MoH, while the application system currently operating in PHC is not aligned with the book.

Meanwhile, actors' role discrepancy indicates the collision of the new role created through HIS introduction with their ideal role. Actors who enact new role or additional tasks experience conflicts, burdens, and distraction from their primary function, which imply that actors prefer to enact their natural function in service ecosystems. This condition potentially causes risks in the practices since the actors tend to put aside the additional tasks or role (e.g., data input, IT system operator) from their natural role (e.g., nurses). The findings provide various examples of these risks such as inaccurate information resources from careless data input or violation of the segregation of role.

To sum up, HIS does not directly change the institutional rules. Institutional rules and HIS work jointly throughout the transformation process. The formal rules are developed or altered to guide and accompany the HIS introduction. Through the practices, these formal rules enable HIS enabled resource configuration, which simultaneously support and reinforce the transformation of tacit rules. Therefore, the complete institutional rules (formal and tacit rules) are established and internalised within the ecosystem after the actors enact their everyday practices. The case studies indicate that each district translated the formal rules into their localised rules based on existing norms or resources availability. By enacting the new practices, the actors continuously establish a collective understanding of the new rules or norms in the ecosystem including procedure, process workflow, and distribution of roles and responsibilities.

5.2.2.3 *Actors' institutional logics*

HIS introduction impacts the actors' institutional logics of service ecosystems. The relationship between HIS introduction and the actors' institutional logics is summarised into insights below.

Insight 3a: *HIS introduction does not directly alter the actors' institutional logics. It is the continuous practices emanated from such introduction that challenge (and change) the institutional logics.*

Insight 3b: *Knowledge transfer (e.g. workshop and training) only reconfigures the 'surface structure' of the institutional logics. The new knowledge needs to be institutionalised, that is, when its role and objective are clearly articulated by collective actors within the ecosystem.*

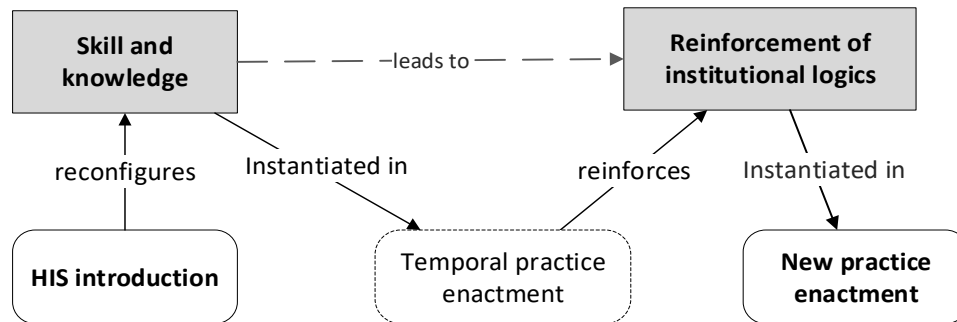


Figure 5-4 HIS introduction and transformation of institutional logics

The transformation of institutional logics is represented by how knowledge is continuously rebuilt and used in enacting the practices. Knowledge is considered a key aspect to advocate change in the society that plays two roles; 1) the baseline of understanding the interactions in value co-creation (Srivastava and Shainesh 2015), and 2) the fundamental source of competitive advantage (Vargo and Lusch 2004). From the findings, the themes emerged on the impact on institutional logics (see Section 4.4.2) indicate the different depths of actors' institutional logics. The logics range from the initial impression (fascination of physical existence and features of technology), to the realisation of the limitation of technology, to the realisation of the importance of establishing process rather than implementing technology, until the actors have a good understanding of the role of technology in public health ecosystem and their jobs.

The actors' institutional logics are developed after considerable interactions and experiences with the implementation and use of HIS. While the actors display diverse responses to the introduction of HIS, ranging from negative and neutral ones (e.g. sceptical, frustration, indifferent), to positive displays (e.g. fascination), it has not challenged the deep structure of the institutional logics. Rather, the transformation of institutional logics, as found in this study, is represented by the depth of actors' understanding of the role of technology. Not only the actors need to acknowledge the capability of ICT, but they also need to understand how such

capability fits their needs and what changes on resources, logics, and rules are required so that the proposed capability can be realised and established.

Other emerging themes presented in the findings (*establishing process over technology acquisition and acknowledgement of the role of data in health*) also suggest the complex and iterative process of institutional logics that the actors continuously build new understanding through their practices. These themes demonstrate that through practices the actors develop a new understanding that the technology has limitations and do not provide an instant improvement. As a result, the actors understand that establishing the workflow process and governance is much more important in the whole transformation process. The *acknowledgement of the role of data in health* represents the self-developed understanding and increasing awareness of the importance of data, which influences their commitment to take data seriously in public health processes. These emerging themes indicate the nature of the transformation of institutional logics from HIS introduction. Specifically, the actors' institutional logics (Frow et al. 2016; Mccoll-Kennedy et al. 2015) are evident *after* the enactment of new practices that involve new resources integration patterns, new rules, and new knowledge. The impacts on logics are visible after realising the technology to their work/practices, which implies that the transformation (of institutional logics) is not directly caused by HIS introduction. The transformation of institutional logics is not anchored by a discrete ICT artefact but from the continuous practices during which the actors gain positive or negative experiences (e.g. failed project experiences) as well as the exposure to ICT.

The complex and iterative process of institutional logics also implies the existence of the 'surface' and 'deep' structure of *stock of knowledge* in the society (Giddens 1984; Pentland 1999). This stock of knowledge is represented by the collective actors' institutional logics, beyond the 'surface' knowledge and skills as we normally refer in organisations (Pentland 1999). Therefore, equipping district-level staff or frontline workers' knowledge with workshop and training has not reached the deep structure of institutional logics. While such surface knowledge can be upgraded instantly and become obsolete any time, the use of knowledge the practices requires more than just 'that' knowledge (or skills). "Knowledge is part of the institutional structure we call society" (Vargo and Lusch 2016, p. 11), which means that knowledge is always challenged by the structure, and further involved in instantiating and reproducing the structure. Therefore, it can be argued that during the timely process of the transformation of collective institutional logics, there are *temporal practices* enacted by the actors during which they reinforce their logics.

Therefore, the study posits that a transformation of the institutional logics requires *institutionalised knowledge*, which is manifested through collective perception and use of HIS. The institutionalised knowledge is manifested at the personal level (e.g., attitude, mindset) and complemented by collective/organisational perception and experience. The practices then instantiate such new logics while also self-reproduce the structure throughout these enactments. The transformation of actors' logics by means of HIS is an in-depth activity of the ecosystem's structure. As New (1994) pointed out, the structural transformation is indicated by a satisfactory change on actors' logic that "practical consciousness of how they (new structure) work is discursively articulated" (p. 203). This includes the way actors think about the HIS and the strategic perspective of HIS for current and future work of their organisation. They are reinforced not only from training, but also through the use of it in their healthcare practices that various social reproduction factors emerge throughout the process such as conflict and language misalignment. That said, enactment of practices "influence actors' mental model [...], and their performance of activities" (Frow et al. 2016, p. 33).

5.2.2.4 Practices

The discussion above shows that the transformation of three structural components—resources configuration, institutional rules, and institutional logics—cannot be isolated from the practices. The transformation of these components, especially on institutional rules and institutional logics, is completed once the actors exercise the new change through practices. Enactment of the new practices exercises and reinforces institutional rules and actors' institutional logics. As discussed in Chapter 2 (see Table 2-9), the enactment of practices instantiates and exercises the social structure as a way to 'maintain' the existence of the society.

On the other hand, the transformation of practices requires prerequisite changes on the other structural components. The evidence-based diagnosis, for example, requires some changes on doctors/clinicians' mental model in generating diagnosis (institutional logics), easy-to-retrieve ICD code from the application (resources configuration), and daily diagnosis reporting procedure (institutional rules). Various instances of failed HIS coercion with the healthcare practices indicate the lack of any one of the following components: the resources configuration is inadequate (e.g. network access problem), the local institutions are not established (e.g., unclear tasks assignments and coordination procedure), or the knowledge or logics have not been built (e.g. inadequate knowledge transfer). Drawing from the FP3 (goods are distribution mechanisms for service provision), FP7 (actors cannot deliver value but can participate in the

creation and offering of value propositions), FP10 (value is always uniquely and phenomenologically determined by the beneficiary), and FP11 (value co-creation is coordinated through actor-generated institutions and institutional arrangements) of SD logic (Table 2-8), this finding suggests that the enactment of practices is the actual manifestation of value co-creation that instantiate the new resource configuration, institutional logics, and institutional rules.

Therefore, the discussions above infer the multifaceted role of practices in service ecosystems. The enactment of practices 1) reinforces new institutional rules and institutional logics, 2) instantiates the (new) value co-creation practices associated with HIS introduction. The relationship between HIS introduction and value co-creation practices can be summarised into an insight below.

Insight 4: The new practices by means of HIS require the transformation of resources configuration, institutional rules, and institutional logics. The enactment of these practices instantiates and reinforces the structure of service ecosystems.

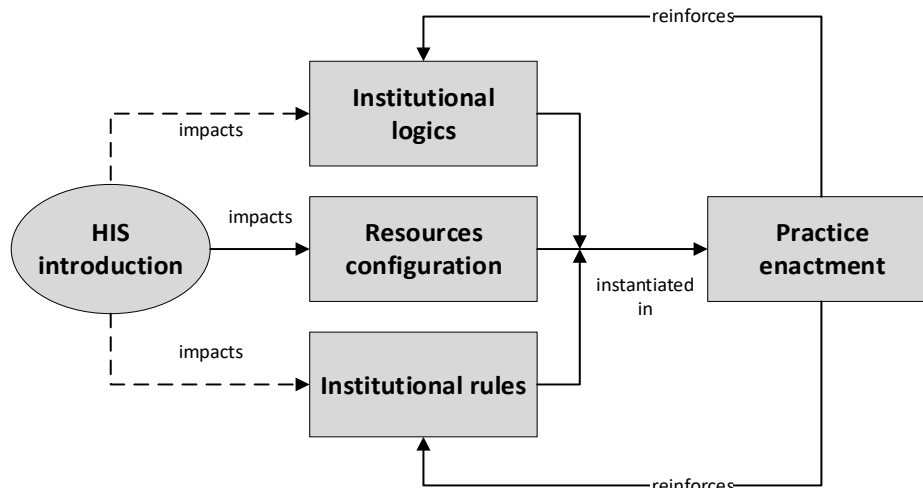


Figure 5-5 HIS introduction and transformation of practices

5.2.3 A model of ICT-enabled service ecosystems transformation

The interpretation of mechanisms and impact of HIS introduction presented above suggests that the change process of ecosystem's components is complex and lengthy. In this regard, the researcher frames the process of transformation by drawing on critical realist's three stages of social change (Archer 1995; Volkoff et al. 2007). The first stage, *structural conditioning*, explains the initial structural activity in the ecosystem, particularly how the ostensive-material components, such as resources or rules of the structure, respond to the institutional forces. The

second stage, *structural instantiation/interaction*, delineates the way these structural components *interact* through the enactment of practices. At this stage, the practices are represented as the ‘performative aspect’ of a social system that instantiates the logics, rules, and resources as well as reinforcing such structure. The last stage describes the outcome of structural instantiation, *structural elaboration* (i.e. transformation) as the successful outcome or structural reversal¹⁶ as the unintended (i.e., failed) outcome, which explains the diverse outcomes of the transformation process. Figure 5-6 depicts the stages of transformation of service ecosystem’s structure.

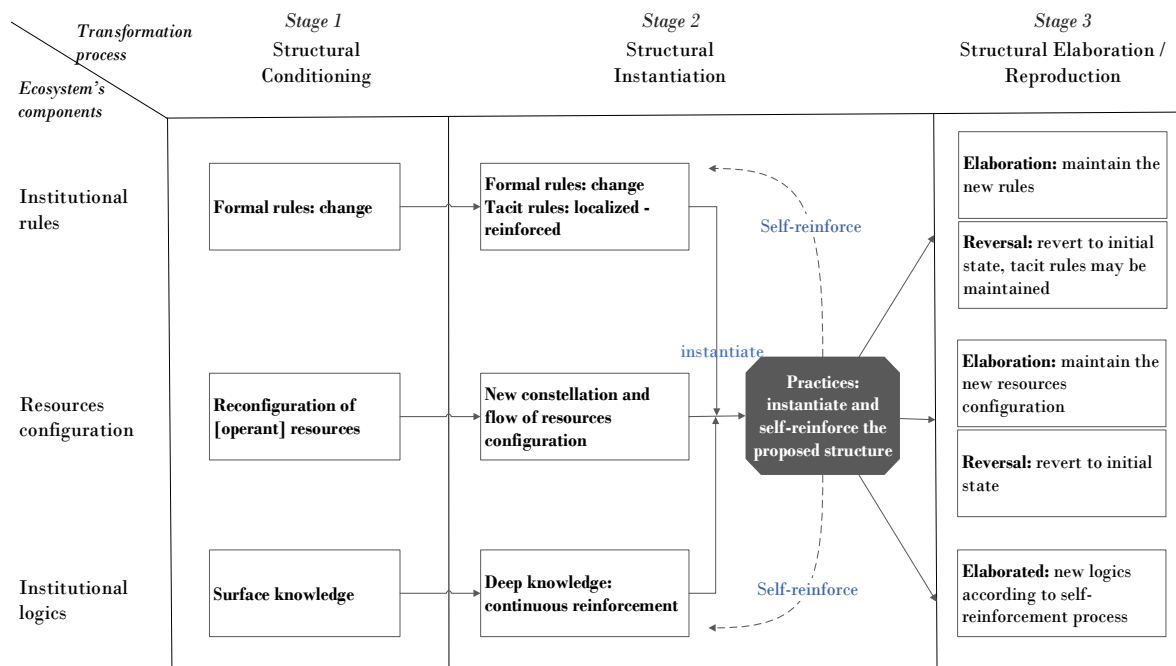


Figure 5-6 Stages of the transformation of service ecosystems’ structure

Stage 1: structural conditioning

Structural conditioning delineates the current structural properties emerged from the past (e.g. previous cycle of transformation) and the initial condition of the structural components as triggered by institutional forces (Archer 1995; Njihia and Merali 2013). It depicts the causal powers that are responsible for the subsequent process of transformation and the way each structural component responds to such forces.

In this study, the structural conditioning is marked by any change on formal rules either on macro-level regulation (as coercive-driven transformation) or local (district) rules (as agency-

¹⁶ Archer uses ‘reproduction’ for a failed structural change. This thesis uses ‘reversal’ term to avoid a confusion with other scholars’ term of social ‘reproduction’ (e.g., Bourdieu, Giddens)

driven transformation). For example, the MoH releases the ministry's regulation on nationwide HIS as an instrument deriving the national goal to have a nation-level health data (i.e. institutional force). The formal rules have also dictated and explicated the new role of actors or work procedure as new institutional rules. While the deployment of HIS has started reconfiguring the resources configuration, it is limited to the ICT resources (i.e., operant resources) while the information resources (i.e., operand resources) have not been instantiated and used in (new) healthcare practices.

Overall, although some of the structural components may have experienced some changes, none of the structural legitimacy in the ecosystem has been challenged (New 1994). Thus, the performative aspect of the (eco)system has not been challenged (Volkoff et al. 2007). Furthermore, following FP7 in SD logic, it is best argued that at this stage, the value of HIS enabled transformation has been proposed but it has not been co-created yet. That said, the deployment of the tablets by the field nurses manifests the value proposition, while its co-creation occurs at stage 2 where they have been integrated with the local rules and logics through enactment of practices. End of stage 1 is marked by an intermittent change on each structural component that is normally observed through resource augmentation or substitution, new operational procedure and task assignment in district-level where the performative aspect occurs.

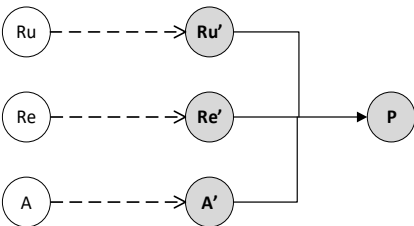
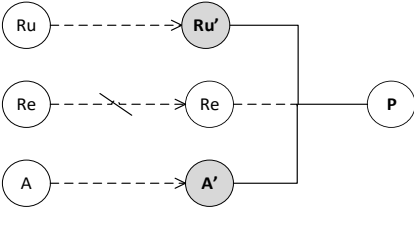
Stage 2: structural instantiation

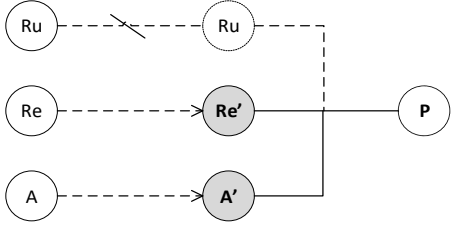
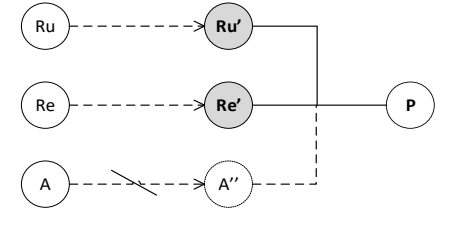
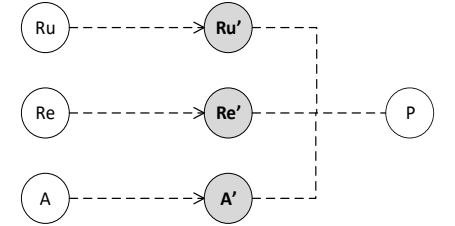
Structural instantiation is marked by the emergence of 'performative aspect' in social change that represents how the actors 'perform' the new structure (Volkoff et al. 2007). The previous discussion on each structural component suggests that actors can enact new practices if the structural components are adequately conditioned, while throughout the time, the enactment of the new practices reinforces the structure especially the tacit rules and institutional logics.

Consequently, in stage 2, the outcomes from the structural conditioning (stage 1), resources configuration (new constellation of resources), institutional rules (translated/localised rules), and actors' logic (new skill and knowledge) shape the new practices. These emphasise that the value co-creation does not depend on the deployment of the resources, but on how their configuration aligns with agents' logic and institutional rules enable optimal performative (i.e. the practices) aspect of structure so that the value proposition can be realised through the new practices (Volkoff et al. 2007). The new practices are then enacted by which throughout the time they self-reinforce the overall structure of the service ecosystem. Thus, in these

continuous cycles/loops of self-reinforcing mechanism (Bygstad 2010; Bygstad et al. 2016; Henfridsson and Bygstad 2013), the contingencies play their role in the process of value co-creation and determining the outcome of the overall process of transformation. The contingencies are related to the pathway or generative mechanism that underlie the transformation and the self-reinforcing mechanism as the way the new structure is exercised and established. Various scenarios occurred during the process: failure to deploy necessary resources, failure to translate and localise the formal rules, or failure to re-establish actors' logics. Thus, the success or failure of transformation is caused by an insufficient upgrade on at least one of structural components, though in reality most of the failure is caused by a composite scenario (Van de Ven and Poole 1995). Table 5-1 presents the scenarios of inadequate change on any structural component caused by its related contingencies that lead to the failure of the enactment of the new practices.

Table 5-1 Scenarios of structural instantiation

Scenario of structural instantiation	Emergence of contingencies (section 4.4)	Example of scenario
<p>Success to establish new practices</p> 	<p>[all emergent contingencies according to the mechanism of transformation]</p>	<p>District Anakranti and Bungatanjung (some PHCs) – ICD X-based diagnosis practices</p> <ul style="list-style-type: none"> - <i>Localised institutional rules</i>: daily diagnosis need to be inputted and reported into PHC IS - <i>Resources configuration</i>: computer and PHC IS - <i>Actors' institutional logics</i>: knowledge to operate PHC IS, adherence and willingness to new stricter diagnosis - <i>Practices</i>: all diagnosis are specified according to ICD X
<p>Fail to deploy necessary resources</p> 	<ol style="list-style-type: none"> 1. Resource constraint (BM) 2. Inadequate support – Unresolved technical problems (AI) 	<p>District Cintolamo –patient management in PHC through offline-based SIKDA</p> <ul style="list-style-type: none"> - <i>Localised institutional rules</i>: roles placement by Head of PHC - <i>Resources configuration</i>: inadequate technical support and network reliability - <i>Actors' institutional logics</i>: positive attitude toward the system - <i>Practices</i>: technical problems and lack of support caused complaints from patients
<p>Fail to translate and localise rules</p>	<ol style="list-style-type: none"> 1. Local strategic direction (BM) 	<p>District Bungotanjung – misalignment and disorganisation in inter-division works</p>

Scenario of structural instantiation	Emergence of contingencies (section 4.4)	Example of scenario
	<ol style="list-style-type: none"> 2. Synergy and collaborative work (BM) 3. Bureaucracy at the macro-level (AI) 4. Interlevel perception mismatch (AI) 	<ul style="list-style-type: none"> - <i>Localised institutional rules</i>: fail to constitute inter-division agreement and workflow - <i>Practices</i>: Each division develops its own system that causes dispersed HIS artefacts
<p>Fail to reinforce actors' logics</p> 	<ol style="list-style-type: none"> 1. Exposure to ICT (BM) 2. Mimetic force at district-level (BM) 3. Educational background (BM) 4. Coping mechanism (AI) 5. Positive work attitude (AI) 	<p>District Cintolamo – midwives' reporting practices</p> <ul style="list-style-type: none"> - <i>Localised institutional rules</i>: new rule for reporting is disseminated - <i>Resources configuration</i>: SP2TP as Ms Excel based reporting tool - <i>Actors' institutional logics</i>: lack of midwives' engagement and coordination in new reporting procedure - <i>Practices</i>: confusions and different terms/definitions in Mother&Child documentation and reports
<p>Fail to establish (self-reinforce) the new structure</p> 	<p>Contingencies of self-reinforcing mechanism:</p> <ol style="list-style-type: none"> 1. Leadership's role 2. Stakeholders' commitment 3. Resource management discretion 4. Controls and accreditation 	<p>District Cintolamo – patient handling in PHC with SIKDA</p> <ul style="list-style-type: none"> - <i>Localised institutional rules</i>: intensive mediation by local consultant - <i>Actors' institutional logics</i>: Show a willingness to change but “difficult to move from their ‘comfort zone’” - <i>Resources configuration</i>: acquired and deployed successfully - <i>Practices</i>: Lack of leadership role in enforcing the new change due to “difficult to move from their ‘comfort zone’”

(BM: Breaking and Making; AI: Adoption and Incorporation)

Stage 3: structural elaboration / reversal

The third stage delineates the outcome of the transformation based on the process of self-reinforcing mechanism occurred at the previous stage. This stage depicts two alternatives of the final state of the ecosystem's structure: structural elaboration or structural reversal (Archer 1995; Njihia and Merali 2013; Volkoff et al. 2007). Structural elaboration occurs when the overall structure of an ecosystem is fully transformed, indicated by “practical consciousness of how they (the new practices) work is discursively articulated, their role in social reversal begins to be known and their legitimacy challenged” (New 1994, p. 203). The structural elaboration is evident after cross-case analysis, especially on several instances of successful

HIS enabled transformation in District Anakranti that the new structure is demonstrated collectively, well-aligned across meso and micro-level, and uniformly articulated by the participants.

On the other hand, structural reversal occurs when the structural components revert to the initial stage, which indicates the failed transformation. However, while the practices seemingly revert to the old one, looking into each structural component allows us to discover that the overall state of the structure is no longer the same as the initial one, especially on actors' institutional logics. Actors redefine their interpretation of failure, specifically on the previously proposed structure (rules and resources) (Volkoff et al. 2007), which later influences the next cycle of the transformation efforts. In some cases, with the new logics, actors seek to continue enacting the new practices by coping the absence of the enabling rules and resources. For example, as in District Cintolamo, while PHC IS failed and was no longer used, the actors maintained their practices of collective data verification even though by utilising the old configuration of resources (manual paper-based work). Thus, in an extreme case, when almost all structural components revert to its original state, the entire structure does not maintain its status quo since the actors' logics are no longer in the same state. In this regard, as suggested by Giddens (1984) and Bhaskar (1975), the new structures may take a form of unintended outcomes. Nevertheless, the findings suggest that the unintended outcomes tend to be temporal and only act as the intermittent structure due to the likeliness of the continuous social change occurring in the forthcoming cycle of transformation.

Insight 5: Three pillars of HIS enabled transformation are the institutionalisation of new knowledge, contextually fit resources (re)configuration, and established local institutional rules. The inadequacy of at least one of these pillars will constrain the enactment of the new practices that lead to the failure of HIS enabled transformation.

5.3 Revisiting research objectives

The objective of this study is to explore the structural transformation by focusing on the dynamics of the ecosystem's structure rather than the (advancement of) ICT technologies. The study's results including the theoretical arguments presented above offer explanations to address the research questions outlined in Chapter 1. The first sub research question states:

What are the underlying mechanisms of institutional transformation in the service ecosystems following HIS introduction?

The analyses of empirical data collected from three districts produce three generative mechanisms of transformation. Two of the mechanisms are related to the institutional forces that constitute the pathways of transformation (adoption-incorporation mechanism and breaking-making mechanism), while the third mechanism (self-reinforcing mechanism) represents the exercising and establishing process of the new structure.

This study offers an explanation to address this question that the institutional structure of the service ecosystem is transformed in two pathways. First, the enslaving pathway occurs when the existing structure adopts and incorporates new structure (rules, resources, logics, and practices), which is triggered by coercive institutional force. Second, the emergence pathway takes place when the existing structure breaks and makes a new structure (rules, resources, logics, and practices), which is triggered by agency institutional force. Each pathway requires the ecosystem to self-reinforce the proposed structure to exercise and establish the structural components that determine the outcome of transformation.

The second research question addresses the impact of HIS introduction on the service ecosystem's structure.

What are the impacts of HIS introduction on the institutional structure of service ecosystems including actors institutional logics, rules, resources, and practices?

This study suggests that the impact of HIS introduction is unique on each structural component of the ecosystem. The impact on resource configuration is rather direct, as it alters the configuration by creating a link for access and recombining the existing resources. The impact on institutional rules is realised on the formal rules—the collateral effect of HIS introduction which guides the HIS, and the tacit rules—the institutional rules actualised and enacted by the local actors. The impact on institutional logics, on the other hand, is realised in a complex way, that ranges from the 'surface structure' to the 'deep structure' of logics. From the analyses on the three districts, the impact on each structure varies to a certain level, which suggests that these three components are transformed in certain stages. How these components are transformed, however, are determined by the practices. That said, this study uncovers the unique role of practices in ecosystem's transformation that instantiate the proposed structure as well as reinforce new structural (components). The outcome of the transformation process delineates the overall impact of HIS introduction on the ecosystem's structure, either it is elaborated or reverted.

Finally, the overall research findings address the broad research question:

How is the institutional structure of service ecosystems transformed following the introduction of ICT?

Built upon the findings on two sub-research questions, a critical-realist model of transformation of the service ecosystem's structure is proposed to address the overall research question. The model suggests that the transformation of institutional structure of service ecosystems consists of three stages. The first stage, *structural conditioning*, explains the initial structural activity in the ecosystem, particularly how the structure responds to the institutional forces. The structural conditioning is marked by any change on formal rules either on macro-level regulation (as coercive-driven transformation) or local (district) rules (as agency-driven transformation). The end of stage 1 is marked by an intermittent change on each structural component that is normally observed through resource augmentation or substitution, new operational procedure and task assignment in the district-level where the performative aspect occurs. The second stage, *structural instantiation*, delineates the way new practices are constituted. At this stage, the practices instantiate the logic, rules, and resources as well as reinforce such structure. During these continuous cycles/loops of self-reinforcing mechanism, the contingencies on each structural component, according to the transformation' pathways, determine the outcome of the overall process of transformation. The inadequacy of at least one of these components will constrain the enactment of the new practices that lead to the failure of HIS enabled transformation. Finally, the last stage describes the outcome of structural instantiation; *structural elaboration* (i.e., transformation) as the successful outcome or *structural reversal* as the unintended (i.e., failed) outcome, which explains the diverse outcomes of the transformation process.

5.4 Contributions to research

5.4.1 Mechanisms and pathways of transformation

5.4.1.1 To ICT4D literature

Each pathway of ecosystem's transformation extends the current discussion in the ICT4D literature.

- The enslaving pathway contributes to our understanding of the reason of numerous failures of the top-down technological transfer in a complex context (Aanestad and Jensen 2011; Gera et al. 2015; Hayes and Westrup 2012; Madon et al. 2007; Sahay 2016). Not only the technology transfer needs adequate support (*resources*) and local actors' acceptance

(*logics*), it also needs to be accompanied with a mutual constitutive relationship between macro-level actors and meso-micro level actors (e.g., bureaucracy, language alignment – *rules*). Therefore, top-down technology transfer should extend beyond delivering ICT resources by establishing adequate procedures that allow bottom-up feedback. While regulation, including punishment, is a necessary instrument of enforcement, this study suggests that it must be accompanied by close monitoring and inclusive support to enable co-production activities among all related stakeholders.

- The emergence pathway complements those earlier ICT4D studies highlighting the importance of inclusion, engagement, and empowerment of the societal groups rather than pursuing the technology advancement (Srivastava and Shainesh 2015; Walsham 2012). In particular, *technological readiness* should not be literally interpreted as the country's readiness for technology transfer, and technology advancement may not contribute directly to the transformation. Various successful transformations found in this study are basically utilising the same technology already tried several years ago. The technology itself may not be new, but the rules and actors work in better synergy and involvement in term of resources choice and provision. Therefore, the ICT-enabled transformation works well when the locals possess a collective capacity to initiate change, collaborate effectively, and sustainably enact the practices as the new structure.

The pathways of transformation may also offer a consolidation of the debates on top-down approach and bottom-up approach in the ICT4D literature (Aanestad and Jensen 2011; Boateng et al. 2008; Braa et al. 2007; Diniz et al. 2014; Leong et al. 2016; Madon 2005; Mahdi and Dawson 2007; Ramadani et al. 2018; Sahay 2016). The findings offer two insights.

- First, while the source of initiative may come from central government (as technology transfer) or local actors (as social-embedded), the subsequent process involves the same structural components. Therefore, this study suggests that the sources (i.e., the institutional forces) are not the determinant of transformation (Diniz et al. 2014) but merely the catalyst, while the process of ICT-enabled transformation relies on the generative mechanism of all structural components. The outcomes of transformation pertain to the contingencies of each process, such as *ICT exposure, local strategic direction, and cross-organizations synergy* for the bottom-up approach, and *local actors' coping mechanism, work attitude, bureaucracy, and language alignment* for the top-down approach. It perhaps suggests that focusing on the top-down or bottom-up approach restricts our perspective that overemphasises the technology. The central argument is not the technology appropriation,

but the way the ecosystem's structure is self-reinforced regardless of where the initiative is originated from.

- Second, while previous studies suggest that bottom-up approach produces a more successful outcome than the top-down approach (Aanestad and Jensen 2011; Stillman and Denison 2014), it may cause misunderstanding that the structural change should emerge from the bottom. Past studies only compare the approaches to ICT introductions and their respective outcomes, from which they gain a conclusion that bottom-up approach has a more successful outcome than the top-down. It overlooks the fact that the structural condition at the time the ICT introduction is different. This study's finding demonstrates the importance of investigating the structural conditioning prior to HIS initiative that even though the practices may look similar, the constituting structural components may be different. While the practices and resources in a failed transformation revert back to the origins, the change on actors' institutional logics is lasting and irreversible, which has a significant implication on the next cycle of the temporal transformation. Accordingly, a reassessment of the ecosystem's structure is still required and comparing two ICT initiatives in different time frames might be fallacious due to different state of, specifically, actors' institutional logics.

The pathways of transformation also extend the social mechanism in IS literature (Avgerou 2013; Gebre-Mariam and Bygstad 2019). The enslaving pathway resembles what Hedström and Swedberg (1998) call as the situational mechanism or macro-micro mechanism, which represents how the "contextual conditions influence the action of people". However, unlike the situational mechanism, this study posits the structural components as the locus of transformational process rather than the institutional force. This study suggests that the institutional force only acts as a catalyst, while the success/failure of transformation relies on the structure of service ecosystems. Further, the empirical insight from public health context shows that the contextual conditions are not limited to macro-level beliefs or desires (i.e., logics) but far more complex and broader, including formal rules, exposure to ICT, or mimetic force. The findings also suggest the role of the core social structure, that is, the formal-tacit rules (e.g., role) and resources, as the pillars of the creation of new practices.

On the other hand, emergence pathway resembles what Hedström and Swedberg (1998) call as the transformational mechanism (micro-macro), which explains how the actions of local actors transform the whole social system. Hedström and Swedberg's (1998) transformational mechanism signifies the role of the agency as institutional entrepreneurs (Powell and

DiMaggio 1991), who are responsible for the institutional change by mobilising the resources or controlling institutional policy. The findings from this study extend Hedström and Swedberg's (1998) arguments. First, this study shows that institutional change and transformation are influenced by numerous other factors that are not related to the agency. The actors only initiate the transformation by exercising their causal powers through rules and resources, while the transformation itself relies on the interaction between practices and other structural components. Second, while the findings also confirm the significance of control and leadership from powerful actors, they are contextually bound to the public sector context that cannot be generalized to all service ecosystems. Therefore, this study concurs with the existing discussion in the literature that repeatedly puts a caution on overemphasizing the significance of certain actors in institutional change, omitting the complex and emergent nature of the new structure (Lounsbury and Crumley 2007).

5.4.1.2 To service literature

The mechanisms extend the discussion in the service literature in two ways.

- This study offers insights into how practices emerge in the ecosystem. Many studies have discussed how actors' practices enabled and constrained by institutions (Mele et al. 2018; Pop et al. 2018; Sajtos et al. 2018), but very little investigate their origins and lifecycle (Chandler et al. 2019; Lounsbury and Crumley 2007). Similarly, Pohlmann and Kaartemo (2017) highlight the dynamic and evolving nature of ecosystem's structure that we have not adequately understood. This study shed new light on this discussion as it identifies how the service ecosystems evolve their structure (incl. norms, views, beliefs) and the institutional forces that trigger this activity. The mechanisms outline the contingencies that influence the transformation process. Thus, this study follows Feldman and Orlikowski (2011) who call for studies that explore the underlying process of transformation to counterbalance the dominant view of the human agency as the primary driver of institutional change.
- The empirical insights from public health context complement those of earlier studies of the mechanism of institutional change which mostly investigated the organisational level (Koskela-Huotari et al. 2016; Kurtmollaiev et al. 2018). This study investigates the interplay between the structural components of service ecosystem which previously is examined separately. Further, what might be a unique and valuable insight from the this study's context (both public health and developing countries) is the 'unintended

consequences' in the dynamics of service ecosystems that theoretically has been suspected by previous scholars (Koskela-Huotari et al. 2016). The temporal state of practices (Figure 5-4), as well as the diverse outcomes of transformations, provide the empirical evidence of such unintended consequences which are unlikely to occur in organisational setting. Unlike organisations that tend to evolve in teleological (i.e., objectives/goals achievement) type of change setting (Van de Ven and Poole 1995), public health, especially in decentralised socio-political country, evolves in a composite type of change. As shown in this study, the conflicts (e.g., misalignment, frustration) between the actors and the role of formal rules to enforce change indicate that the transformation of public health service ecosystems not only evolve in teleological mode but also in dialectical mode (Van de Ven and Poole 1995). This shows the complexity of institutional change in public health service ecosystems that inevitably may involve unintended consequences along the way.

5.4.2 Impact of transformation

5.4.2.1 To ICT4D literature

The findings on the impact of HIS introduction to service ecosystem extend the current discussion in the ICT4D literature.

- First, emphasising structure rather than the approach or technology remedy our tendency to overemphasise the significance role of agency in ICT4D, such as resourceful actors (e.g. donors) (Thompson and Walsham 2010), policymakers (e.g. governments) (Silva and Figueroa 2002), or social entrepreneurs (Srivastava and Shainesh 2015) in developing countries. This prevents us to objectively examine and elaborate the way local actors and institutions react to and process ICT initiative to the end of the creation of a new socio-technical structure. Although the agency and its causal powers pose as the catalyst of change (stage 1), this study suggests that without properly coordinated work between the structural components (stage 2), the resulting new structure potentially fails to survive. As shown in stage 2, the new practices ultimately require two conditions of other structural components: 1) the sustainability of the new configuration of resources proposing the value, 2) the enforcement of the coordinating rules, both formal and tacit, on which all actors and beneficiaries play their role in co-creating the value. Indeed, as an example, the actors in District Anakranti are not acknowledged based on their innovativeness of the technology, but rather on their leadership, tight and close control on the new emergent practices, while the micro-level actors develop their sense to the openness to learn, change, and collaborate.

- The findings on the impact on institutional rules contribute to existing knowledge on the role of social settings in developing countries. While the unique settings of the context of developing countries have been identified by numerous studies (Barjis et al. 2013; Hayes and Westrup 2012; Sey and Ortoleva 2014), positing them as merely the constraining factors may limit our understanding. This study suggests that such unique settings are not the key driver of transformation but rather act as the tacit rules that are transformable. They work together with resources constellation, formal rules, and actors' knowledge during the moment of practices which in turn reconfigure such unique settings.
- The findings on actors' institutional logics seem to be consistent with the vast ICT4D studies on capacity-building (e.g. Stillman and Denison 2014; Urquhart et al. 2008) that developing the local capacity is a long painstaking process, beyond intensive training or coaching, that the local actors need to experience it through which they build their capacity by themselves. This finding also emphasises that while the absorptive capacity of the locals determines the outcome of ICT4D initiatives (Chaudhuri 2012; Sharma et al. 2012), it always can be expanded and developed.

This study also addresses answer recent calls on a systemic perspective of ICT4D (Avgerou 2008; Hayes and Westrup 2012; Njihia and Merali 2013; Ramadani et al. 2018; Thompson and Walsham 2010). Specifically, ICT4D research should shift from merely a study on ICT adoption (Walsham 2012). The relationships between HIS introduction, resources configuration, institutional rules, institutional logics, and practices demonstrate the complex interaction between ICT and social structure that shows the systemic perspective of ICT4D. By looking through the perspective of the ecosystem's transformation, the ICT acts as a tool (i.e. operant) working conjointly with other resources and structural components in the evolutionary process of social transformation.

5.4.2.2 To service literature

The present study enhances the current understanding of service ecosystem in the service literature in three ways:

- First, this study contributes to our understanding of the interplay between value co-creation practices with the viability of service ecosystems' structure (Beirão et al. 2017; Frow et al. 2016; Peters 2016). This study offers insights into how new practices emerge and subsequently influence ecosystems structure, including actors' mental mode and resources configuration (Beirão et al. 2017; Frow et al. 2016). By looking at the constitutive

components of the structure, this study suggests that the relationship between practices and the ecosystem's structure is not unidirectional. While Frow et al. (2016) suggest that the new practices can cause the imbalance of structural viability, this study shows that this imbalance is *coexistent* with the enactment of practices in a recursive and self-reinforcing way (i.e., the stage 2 of transformation—structural instantiation). This finding is more convincing since it considers the origins of such new practices and, more importantly, positions the practices as part of the structure. As discussed earlier, there is a prerequisite change in the structure that subsequently alters the existing practices (or create new ones). HIS introduction leads to a reconfiguration of resources constellation, while the realisation of value depends on the way actors enact the practices. For instance, the evidence-based diagnosis in District Anakranti and Bungatanjung is first preceded by reconfiguration of resources (from paper-based to digital) and rules (application-based report). The continuous enactment of this practice then shapes the doctors' logics in the way they treat the patients and generate a diagnosis.

- Second, the transformation of public health service ecosystem offers a novel empirical perspective on value co-creation in the SD logic literature. Given that value is specific and contextually determined by beneficiaries (FP10), a dynamic and evolving context should have influences on the co-creation of value. In particular, this study shows that during the transformation process, the components enabling the value co-creation practices (rules, resources, and actors' logics) are continuously changed and reinforced, which imply that the enactments of resource exchange and integration are transforming as well, some of which may encounter destructive practice. It can offer a new understanding of value, especially on what has been suggested by a number of scholars as value co-destruction (Echeverri and Skalen 2011; Plé and Cáceres 2010; Skálén et al. 2015). Since this study does not focus on this concept, future research lies ahead on investigating this phenomenon.
- Finally, this study demonstrates that the practices are not a mere construct in an ecosystem that is perceived simply as human daily activity or routines (Frow et al. 2016; Mccoll-Kennedy et al. 2015). Rather, they are the core element responsible for constituting the structural conditions (Feldman and Orlikowski 2011). The practices are not only the enactment of value co-creation through resources exchange and integration but also the instantiation and reinforcement of structural components (logics, rules, resources).

5.5 Contributions to practice

Various practical implications can be obtained from this study. First, the micro-level actors or institutions may get benefits from the autonomy on management and budgeting rather than strict bureaucratic controls. This study observes that PHC deserve a higher level of autonomy through BLUD scheme. The case study on three districts suggests that the BLUD scheme for PHC offers an excellent opportunity to the actors at PHC to improve the digital transformation as well as the overall health service provisions. It is suggested from the findings on District Anakranti and Bungatanjung that the time of PHC' restructuring might be correlated with the digital transformation outcomes. Districts Anakranti has restructured its PHC as BLUD over five years, while District Bungatanjung has initiated the restructuring for two years. While granting autonomy to PHC (through BLUD) puts a huge responsibility to them, the control and accreditation system, as well as the continuous upgrade on PHC' governance system, ensure the transformation process.

Second, the implication of inclusion and engagement of local actors in transformation's pathways is taking the frontline health workers as the key actors in digital initiatives in public health. Doctors, midwives, and nurses deserve priority in planning and designing digital provision since they are the 'key resource integrators' who provide promotive, preventive, and basic curative care to the population as well as produce the information silos for program officers and managers at meso and macro-level.

Third, the provision of HIS to PHC in a district seems to be more successful using an incremental stepwise approach. This approach allows district officers to focus on a small number of PHC on transferring and developing knowledge as well as establishing operating procedures. This approach is suggested by actors in District Anakranti and Bungatanjung. The radical approach (whole PHC at once), which was attempted in District Anakranti and Cintolamo, only worked in Anakranti since they have experienced numerous digitalisation initiatives previously that indirectly reconfigure the local actors' logic.

5.6 Summary

This chapter has presented the discussions and interpretations of the study's findings to address the research questions. HIS introduction has different impacts on each component of ecosystem's structure, which are summarised into theoretical insights. Meanwhile, the impacts

on resource configuration, institutional rules, and institutional logics, cannot be isolated from practices which instantiate and reinforce the new structure.

This chapter has also discussed the mechanisms of transformation. The generative mechanisms underline two pathways of ICT-enabled transformation of service ecosystem. The relationship of these structural components, as well as the process of transformation, are synthesised into a model of structural transformation of service ecosystem.

This chapter has outlined the contributions of this study. It discusses how mechanisms of transformation and impact of HIS on the ecosystem's structure offer theoretical contributions to both ICT4D and service literature. This chapter also discusses the practical implications to key stakeholders in the respective context based on the overall research findings.

The next chapter concludes this thesis by summarising the overall study and outlining the study limitations and future research agenda.

6 Conclusion

6.1 Chapter overview

This chapter concludes this thesis. Section 6.2 provides a summary of the study. It is followed by the study's limitations (Section 6.3), and future research avenues (Section 6.4).

6.2 Summary of the study

Multiple concerns have arisen regarding the overemphasis of the adoption of ICT resources in ICT4D research. A review on ICT4D literature has been conducted which suggests that there is a need to study the holistic and systemic perspective of ICT4D, particularly on the interplay between ICT and social actors and structure. Accordingly, this study has explored how the institutional structure of public health service ecosystem in Indonesia has transformed following the introduction of HIS. Specifically, this study has investigated the mechanisms of transformation and impact of HIS introduction on the institutional structure of this ecosystem. This study draws on SD logic to conceptualise the structure of public health service ecosystem and critical realist's generative mechanisms to investigate the process of transformation.

Critical realism has been selected as a suitable philosophical stance for this study's objectives. This study employs a qualitative multiple case study design which allows the researcher to explore the phenomenon in its natural setting and collect rich explanations. Three districts have been studied regarding the introduction of HIS and the associated structural components of their health ecosystem. The researcher has conducted a field study to collect primary data sources (interviews and observations) and secondary data sources (documents and internet publications). The data has been analysed based on established qualitative data analysis techniques and a critical realist approach on social mechanisms.

This study has outlined the key events related to HIS introduction in three districts in the last decade. The analysis has revealed *three generative mechanisms* and institutional forces of HIS enabled transformation. The first is *adoption-incorporation* mechanism which encompasses all institutional change triggered by the coercive driven institutional force where the ecosystem at district level is enslaved to change into a particular form of structure. The second is *breaking-making* mechanism which encompasses all institutional change triggered by the

agency driven institutional force where a new structure emerges at district level. This study has also revealed that the ecosystem performs *self-reinforcing* mechanism to exercise and establish the new structure that determines the outcome of transformation. The contingencies that enable and constrain the transformation have been identified. Based on these findings, this study proposes two pathways of the ecosystem's transformation, namely, *enslaving* and *emergence pathways*.

This study has identified the *impact of HIS introduction* on the structural components of service ecosystems. On *resource configuration*, the analysis reveals that HIS introduction has a direct impact on the constellation and flow of resources configuration by creating a link for access and recombining existing resources that enable new practices. On *institutional rules*, the analysis suggests that HIS introduction has indirect impacts on the transformation of institutional rules. The transformation of institutional rules (incl. tacit and roles) is mediated by the enactment of new practices that reinforces local institutional rules. On *institutional logics*, the analysis suggests that HIS introduction does not directly alter the actors' institutional logics. This study suggests that the transformation of institutional logics is emanated from the enactment of new practices by means of HIS introduction. Finally, the analysis reveals that the transformation of practices entails the transformation of *other structural components*—resource configuration, institutional rules, institutional logics—the enactment of which instantiates and reinforces the structure of service ecosystems. This study has proposed a model of ICT enabled transformation of service ecosystems by drawing on critical realist's perspective of social transformation.

This study offers theoretical contributions to ICT4D and service literature and practical contributions to HIS implementation in Indonesia. The distinct impacts of HIS introduction on components of ecosystem's structure offers a systemic perspective of ICT4D. The pathways of transformation complement those earlier studies exploring the reasons for numerous failures of the top-down technological transfer and the importance of inclusion, engagement, and empowerment of the societal groups in ICT4D. To service literature, this study offers insights into the origins and lifecycle of practices and how they emerge in the ecosystem, which shed light on the dynamic and evolving nature of ecosystem's structure that currently has not been adequately understood. Finally, the results of this study advocate the autonomy of the district's health providers, the inclusion and engagement of local actors, and the incremental approach of HIS implementation in public health ecosystem.

6.3 Limitations

The study's limitations are primarily bound to the context, methodology, and theoretical lenses, which offer opportunities for future research avenues. The context of the study, the public health service ecosystem, has enabled the researcher to explore multiple actors, formal and tacit (local) rules, and resources contingencies as well as non-profit value co-creation practices. However, selecting this context also has consequences. Public health is a highly-regulated context relying on government's control to the whole ecosystem (Mills et al. 2002). In particular, district government in rural areas in the developing country plays a significant role in planning, monitoring, and evaluation, as well as throughout the complete lifecycle of public health processes (Trần et al. 2006). Therefore, several constructs on contingencies of generative mechanisms emerged from the analyses might be contextually specific to this context, such as the leaders' role, accreditation, and bureaucracy. In this regard, this study suggests that the contingencies represent the circumstances leading to social change, which portray the 'terrains' of how the society embark to certain conditions (Pettigrew 1997). Thus, while some of the contingencies are specific to public health ecosystem (e.g., the significance of control and leadership from powerful actors), studying different contexts such as an open society might discover different types of contingencies.

The choice of Indonesian health ecosystem as the research context might also have limitations. Being an Indonesian himself, the researcher emphasised the role of 'complete observer' in this case study. This role might deviate somehow during the field study. The potential bias might take place during data collection and analysis that emerged from social interaction or activities with several participants, though unconsciously, that might influence the interpretation. However, similar to other ethnographic studies, the researcher takes a stance that it is important for scholars to have the sensitivity on the contextual metadata, especially when studying society (Trauth 1997). The potential concern of this bias has already mitigated through several strategies: 1) establishing case study protocol, 2) purposive sampling for case selection rather than convenience sampling, and 3) data triangulation (Yin 2018). Further, all the three districts have different ethnics to the researcher, each of which has a distinct characteristics, nature, and environment.

The analytical lenses might also pose some limitations. Some scholars might argue that common theories such as structuration theory, institutional theory, or Actor Network Theory may offer more systematic guidance for the researcher to conduct the study. However, the

researcher argues that using SD logic and critical realism as the ‘sensitising device’ offer rich explanations of the empirical findings. Rather than ‘guided’, ‘restricted’, or worse, ‘matched’ by terms or definitions from theories (Gregor 2006), the researcher takes a stance on the importance of rich insights from context-specific studies (Davison and Martinsons 2016). The dialogical reasoning (Klein and Myers 1999), which is aligned with retroduction (Wynn and Williams 2012), requires iterative cycles of empirical data analyses and literature. The analytical lenses in this study, SD logic and generative mechanism (critical realism), are sought to be the appropriate lens to address ICT4D literature.

The use of critical realism in this study as a research paradigm might be found fragmentary. In particular, this study only adopts Archer’s (1995) three moments of social change to frame the findings. The researcher acknowledges that one of the limitations in employing Archer’s approach is delineating the time period of social transformation (Gebre-Mariam and Bygstad 2019). ‘Bracketing’ certain time event, as in sequence events in each district presented in Chapter 4, and to find the stages of transformation process is ‘challenging’, or may even be inaccurate, since during that time, “there were a number of overlapping events” (Gebre-Mariam and Bygstad 2019, p. 20), and more importantly, may derail the researcher to investigate the dynamics of the ecosystem. Rather than attempting to establish periodisation of the ecosystem, this study selects the ‘instances’ of transformation, which is more suitable to identify mechanism as shown by some notable studies (Henfridsson and Bygstad 2013; Srivastava and Shainesh 2015). Moreover, employing maximum variance cases, in this study, was proven to be more powerful in informing different stages of transformation rather than employing time bracket in a single case study mostly used in prior critical realist studies (Gebre-Mariam and Bygstad 2019; Njihia and Merali 2013).

6.4 Future research avenues

The results of this study invoke a further research agenda on the relationship between the value co-creation practices and the outcome of the ecosystem’s transformation. The findings from three different districts show that self-reinforcing mechanism correlates with the practices, during which the actors attempt to enact a new pattern of resource exchange and integration. However, there is a need for a further investigation of the correlation between how new practices are enacted during the process of exercising and the establishment of the new structure with the outcome of structural transformation. This phenomenon has not been explored in the SD logic literature. Value co-creation in SD logic lies on the premise that value

is always co-created during the execution of service. However, it is inevitable that in several occasions, the service failed fully or partially indicated by a poor user experience that leads to disappointment, complain, or switching (Echeverri and Skalen 2011; Plé and Cáceres 2010; Skálén et al. 2015). By looking at the origins of the (new) practices, this study suggests that the co-destructive practices are caused by the enactment of practices that are not supported by adequate change on rules, resources, or knowledge.

Studying a non-profit context shows the significance of the dynamics of institutions and how they affect value co-creation. Notable scholars, such as Skálén et al. (2015), suggest that in an extreme social phenomenon, value co-destruction *does* exist. In this case, the eleventh premise of SD logic may overlook the fact that the institutions are not constant and rigid, but rather continuously transforming and evolving. Several research questions can be formulated. For examples: How is the structural reversal (i.e., failed transformation) correlated with value co-destruction? To what extent will the successful (new) value co-creation practices lead to a new ecosystem's structure?

Second research agenda is related to a further investigation on the *value*, that is, the individual and organisational perception and experience during ICT transformation. This study offers an interesting discussion on how people's attributes are unique to each district, that to some extent become contingencies of generative mechanisms (e.g., coping mechanism and work attitude). Since the human attributes have been strongly linked with how value is perceived (Helkkula et al. 2012), a clear research agenda lies ahead on how we can explain value (as perceived by individual or organisational) during the transformation process.

The next research agenda expected from this exploratory study is theory-testing research. In particular, this study invites a quantitative inquiry on the relationship between ICT introduction with the ecosystems' components. For instance, how can we verify and validate the ecosystem' components that are directly/indirectly impacted by ICT introduction? The theoretical insights presented in Section 5.2 can be a starting point for future research to formulate hypotheses on the relationship between ICT and the structure of service ecosystems.

Finally, in the context of healthcare in Indonesia, a research exploring the issue of systems integration and data interoperability will offer a practical contribution to the nation's HIS. Since the districts across the country are operating different application systems, especially PHC IS, understanding the challenges and formulating the best strategy toward integrated health system are critical to advance the nation HIS.

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Appendix A – Procedure to conduct a field research in Indonesia

The procedure required to undertake a research in Indonesia is briefly described below. Generally, it takes at least three steps involving several authoritative institutions within related province/district. However, since Indonesia adopts decentralisation of its public administration system, each district can develop its own unique procedure.

- a. To gain an approval from subject institutions by submitting letter from university and the summary of research proposal. The outcome is an introduction letter from intended observed institutions (i.e. health district and Primary Health Care).
- b. Such introduction letter then needs to be submitted to Regional Planning Institution (Bappeda). This institution is responsible on strategic planning of the regional (province or district) government. Normally, a particular research division handles the application. The outcome of this step is approval letter from Bappeda.
- c. The final approval is a clearance letter written by the intended institution as a follow-up of the letter from Bappeda.

Figure below is an example of approval letter to undertake research in Indonesia. This letter is written by macro-level institution, which is slightly different from letter of approval from district-level.



KEMENTERIAN KESEHATAN REPUBLIK INDONESIA
SEKRETARIAT JENDERAL

Jalan H.R. Rasuna Said Blok X-5 Kavling 4-9 Jakarta 12950
Telepon (021) 5201590 (*Hunting*)



Jakarta, 16 November 2017

Principal Supervisor of Computing and Information Systems
Melbourne School of Engineering
Doug McDonnell Building, room 10.16

Dear Dr. Sherah Kurnia,

Thank you very much for your letter of request for assistance in a supervised research project conducted by:

Name : Luthfi Ramadani

Student ID : 844451

Research title : Exploring the Digital Transformation of Healthcare Ecosystem in
Indonesia

Ethics ID : 1750359

Department : School of Computing and Information Systems, The University of
Melbourne

I am pleased to accept your request for assistance in a supervised research project in Pusat Data dan Informasi, Kementerian Kesehatan.

I appreciate all of your efforts on my behalf and look forward to give assistance for him in a supervised research project.

Kepala Pusat Data dan Informasi,



Dr. drh. Didik Budiarto, MKes

Pusat Data dan Informasi
Jl. H.R. Rasuna Said Blok X-5 Kav. 4-9. Blok C, Lt.6
Jakarta 12950

Appendix B – List of interview questions

Background of the participant and organisation

1. Please briefly tell us about your position, job description, and length of employment.
2. What is the role of your division within the overall Indonesian healthcare system?

ICT Introduction

3. What are major changes related to processes and information systems/technology use within your division in the past three years?
4. What are the motivations for adopting these (new) systems?
5. To what extent do the stakeholders show willingness to adopt and use the systems?

Use and Impact

6. Before the implementation, how did you initially perceive these new systems in the aspect of a) technical, b) non-technical (e.g. approach, policy)?
7. After the implementation, which aspects of the plan do you think are working and which ones do you think are (potentially) not?
8. Can you tell me about the program to develop users' skill and knowledge to use the system?
9. So far, what are the positive impacts on your work? What factors do you think contribute to those impacts?
10. How do these systems affect the collaboration between your institution and other institutions/districts/provinces?
11. So far, do you perceive any (potential) major issues affecting your institution and the overall Indonesian healthcare system?

Institutionalisation

12. How are the new systems internalised within day-to-day work?
13. Are existing policy and/or procedures significantly changed? How are these new procedures internalised?
14. Which parts (e.g. technical, interaction) do you think take a longer time for the stakeholders (you) to get used to?

Concluding questions

15. To what extent the central government gives flexibility in implementing the system?
16. Would a bottom-level implementation (e.g. initiative, unique story) promote feedback for other districts or central government?

Appendix C – Government regulations related to this study

Legislation in Indonesia is manifested in several forms. It is organised into six hierarchies, ranging from 1945 Constitution (*Undang-Undang Dasar 1945*) as top and Regional Regulation (*Peraturan Daerah* or *Perda*) at sixth place.

- 1) 1945 Constitution (*Undang-Undang Dasar 1945*)
- 2) Resolutions of the People’s Representative Council (MPR) (*Ketetapan Majelis Permusyawaratan Rakyat*, Tap MPR).
- 3) Acts (*Undang-Undang* or *UU*) and Government Regulation in Lieu of Acts (*Peraturan Pemerintah Pengganti Undang-Undang* or *Perpu*)
- 4) Government Regulation (*Peraturan Pemerintah* or *PP*)
- 5) Presidential Regulation (*Peraturan Presiden* or *Perpres*)
- 6) Regional Regulation (*Peraturan Daerah* or *Perda*)

During field study and document analysis, this study found key regulations underlying the digital transformation of healthcare ecosystem in Indonesia. For example, Health Information Systems are enforced based on the recent Government Regulation (*Peraturan Pemerintah*) No 46 Tahun 2014. Ministry of Health then developed a detailed plan of action through e-health strategy in the MoH Regulation No 46 Tahun 2017. Relevant regulation related to this study is presented in the Table below.

Type	Name / Identity	About
Acts	Undang Undang No. 39 Tahun 2009	Health (including national budgetary for health, 5% of national budget)
Government Regulation	Peraturan Pemerintah Nomor 46 Tahun 2014	Health Information Systems
Government Regulation	Peraturan Pemerintah No. 41 Tahun 2007	Regional / Local Government (Pemerintahan Daerah)
Ministry of Health Regulation	Peraturan Menteri Kesehatan Republik Indonesia Nomor 46 Tahun 2017	National e-Health Strategy
Ministry of Health Regulation	Peraturan Menteri Kesehatan Nomor 75 Tahun 2014	Community Health Centers (<i>Pusat Kesehatan Masyarakat</i>)
Ministry of Health Regulation	Peraturan Menteri Kesehatan Republik Indonesia Nomor 46 Tahun 2015	Accreditation of PHC, Klinik Pratama, Klinik Pratama (Primary Clinics), Independent

Type	Name / Identity	About
		General Practices, Independent Dentists Practices
Decision of Ministry of Health	Kepmenkes no 192 2012	Roadmap – action plan – strengthening Health Information Systems Indonesia
Decision of Ministry of Health	Kepmenkes no 511 2002	Policy and strategy of national HIS development
Regional Regulation	Peraturan Daerah No X – Province Y	Protection and improvement of maternal, infant and toddler health
Regional Regulation	Peraturan Daerah No X – Province Y	Organization of Local Government (<i>Pembentukan Susunan Organisasi Perangkat Daerah</i>)
Regional Regulation	Peraturan Daerah No X – District Anakranti	Regional Government Affairs
Draft – President Regulation	Drafting (per 2018)	One Data – Indonesia

Appendix D – Documents and other secondary data

Documents and other secondary are collected from two sources: 1) publicly available documents and data from the internet and 2) non-published data or documents copied from research participants. Data on demography and socio-economy indicators, for instances, are organised and managed by Center for Bureau of Statistics (Indonesia: Badan Pusat Statistik - BPS). Each district and province have a dedicated website for BPS. Most of Ministries and Regional Offices (province and district) also have established their own website from which annual reports are publicly available to download.

Secondary data is listed as below:

Macro-level documents

1. Profil Kesehatan Indonesia 2015, Kementerian Kesehatan Republik Indonesia 2016
2. Profil Kesehatan Indonesia 2016, Kementerian Kesehatan Republik Indonesia 2017
3. Roadmap Sistem Informasi Kesehatan 2011-2014, Kementerian Kesehatan Republik Indonesia 2012
4. WHO country cooperation strategy 2007-2011, Country Office for Indonesia
5. Indonesia Health Information System Review and Assessment, Center for Data and Information, Ministry of Health of Indonesia, 2007
6. Kebijakan Sistem Informasi Kesehatan (materi sosialisasi), Pusat Data dan Informasi, Kementerian Kesehatan Republik Indonesia 2018
7. Pemetaan aplikasi puskesmas (materi sosialisasi), 2017
8. SIKDA Generik, Buletin Data dan Informasi Kesehatan, triwulan III 2011
9. Tantangan e-Kesehatan di Indonesia, Buletin Data dan Informasi Kesehatan, Semester I 2016
10. Infografis Indikator TIK 2016, Kementerian Komunikasi dan Informatika Republik Indonesia
11. Laporan Tahunan 2016, Kementerian Komunikasi dan Informatika Republik Indonesia

District Anakranti documents

1. Profil Kesehatan [province] 2015, Dinas Kesehatan [province] 2016
2. Profil Kesehatan [province] 2016, Dinas Kesehatan [province] 2017
3. Profil Kesehatan District Anakranti 2012, Dinas Kesehatan Anakranti 2013
4. Profil Kesehatan District Anakranti 2013, Dinas Kesehatan Anakranti 2014
5. Profil Kesehatan District Anakranti 2014, Dinas Kesehatan Anakranti 2015
6. Data statistic daerah, (sub-domain of Center Bureau of Statistic (<http://www.bps.go.id/>), accessed 2016 to 2018
7. Standard Operating Procedure di Dinas Kesehatan District Anakranti

District Bungatanjung documents

1. Profil Kesehatan District Bungatanjung 2014, Dinas Kesehatan Bungatanjung 2015
2. Profil Kesehatan District Bungatanjung 2015, Dinas Kesehatan Bungatanjung 2016
3. Profil Kesehatan District Bungatanjung 2016, Dinas Kesehatan Bungatanjung 2017
4. Data statistic daerah, (sub-domain of Center Bureau of Statistic (<http://www.bps.go.id/>), accessed 2016 to 2018
5. Data aplikasi dinkes 2017 (internal document)

District Cintolamo documents

1. Profil Kesehatan District Cintolamo 2014, Dinas Kesehatan Cintolamo 2015
2. Profil Kesehatan District Cintolamo 2015, Dinas Kesehatan Cintolamo 2016
3. Kebijakan SIK District Cintolamo (materi sosialisasi), 2017
4. Workplan SIK District Cintolamo (materi sosialisasi), 2017
5. Evaluasi pelaksanaan SIK di Cintolamo (materi sosialisasi), 2017
6. Profil umum District Cintolamo, Cintolamo dalam data 2016

Data statistic daerah, (sub-domain of Center Bureau of Statistic (<http://www.bps.go.id/>), accessed 2016 to 2018

Appendix E – Sample of field notes

Title of the note	17 Nov 2017 – one staff Cintolamo (non-participant): the ‘Captain America’ (Evernote® android apps)	
Points taken	<p>Original:</p> <ul style="list-style-type: none"> • Kita sangat berkemauan sistem, tp tidak pernah appropriate • Pernah mulai sistem baru 2009, tp 2010 mati suri, sampai 2017 naik turun • Buang2 duit ini gf • Data sulit? Ga ada yg sulit di data kesehatan (US), kami aja manual bisa. Tp mereka yg ga ngerti ttg kesehatan • Satu lagi, ini nonprofit. Beda dgn rumah sakit yg profit • Sistem kesehatan di Indonesia beda, kuratif juga JKN, ga seperti di luar yg dikasih ke swasta • Jd dana sebenarnya cukup, internet bisa gsm, [our island] jg ga besar 	<p>Translations:</p> <ul style="list-style-type: none"> • We are willing to have a system but it has never been appropriate • There was once in 2009, but in 2010 it was suspended, until 2017 it is still unstable • This (donor) is just a waste of money • [they say] health data is difficult? There is nothing difficult with health data, even in manual form. The thing is just they do not understand about health • One more, we (public health) are non-profit, it is different from hospitals who are profit-oriented • Health system in Indonesia is also different. The curative care is also under JKN, unlike in the overseas there it is given to the private sector (insurance) • The budget is actually sufficient, we can use GSM for internet, we are not really a big [island]
Memo – reflection from the field study in Cintolamo related to this field note (written later in Ms Word®)	<p>I found an interesting thing when I went to Bappeda Cintolamo to administer government permission to conduct field study there. The officers (two grown men) who manage the official letter. One of them is a typewriter who was struggling with using Ms Word. He is guided by another officer who seemed to understand about Ms Word hotkey but was struggling with understanding English (my proposal summary). However, they showed enthusiastic in their work, willing to serve a high number of application for research by students from the local college. This shows, though might not be generalisable, the attitude of Cintolamo people.</p> <p>This phenomenon also shows a unique custom of Cintolamo people. Cintolamo is more conventional. Lower staff first impression and statement is a stern one who questioned my approval for conducting research here. Later, after acknowledging that I’ve managed several connections with his higher superior, as well as where I work and what’s position in Telkom, he softened his tone and later become my ‘participant’. The kadis and sekdis, though acknowledged that it is bureaucratic complex, still saw this as beneficial for them since the institution will have a record of my activity.</p> <p>The problem is they don’t know whom to contact because dedicated IT personnel are limited. Consider Mr. Bob from Cintolamo’s office who is responsible for all puskesmas. From the Head, they need IT personnel but were restricted by regulation (they were non-BLUD). There was an intern who usually did the IT work but moved due to finding a fixed job and promising salary. Nonetheless, BLUD scheme, which sounds promising, were currently rejected by a higher policymaker, as he was concerned with complex power play and the puskesmas will have to create double reports.</p>	