

Formation and Resolution of Misfits in a Multi-tiered Telemedicine Consultation Service Platform

Student Name: Rui Ma

Registration:190123758

**Acknowledgement**

When one door closes, another window opens.

-------Dame Julie Andrews (American Actress)

I would like to begin by expressing my heartfelt gratitude to my supervisor, Dr.Yichuan Wang and Prof. Fraser McLeay , for their exceptional guidance and support throughout my PhD journey. Their invaluable insights, expertise, and encouragement have been instrumental in the completion of this thesis.

I am also grateful to the members of my thesis committee, Dr.Sabrina Thornton and Prof. Francesco Schiavone for their valuable feedback and constructive criticism, which have greatly enhanced the quality of my research.

I am thankful to my family for their unwavering love and support throughout my academic endeavours. I would like to thank my parents, Mrs. Xu Hua and Mr. Ma Chi Cheng, for their constant encouragement and sacrifices, which have enabled me to pursue my passion for research.

I would also like to thank myself, Miss. Rui Ma. During the challenging times of my PhD, she always inspired me, understood me, supported me, and kept me focused. It has been a constant source of motivation for me to see how much she loves me, cherishes me, makes me happy, and encourages me.

Finally, I would like to acknowledge the support of Henan telemedicine centre and team member for providing the data support that enabled me to complete this research. In particular, I would like to thank Prof. Yunkai Zhai for their valuable suggestions and Mr. Jinming Shi for their constant support and encouragement.

I am truly grateful to all the individuals and organizations mentioned above for their contributions to this thesis. Without their support and guidance, this work would not have been possible. Thank you all.

**Abstract**

Based on the Organization-Enterprise System (Org-ES) fit theory, this thesis conducts a comprehensive investigation into the formation and resolution of various misfits within the telemedicine system context. The telemedicine system is conceptualized as a socio-technical system comprising two interconnected subsystems: the technological system and the social system. This viewpoint recognizes that each telemedicine service involves a multitude of interactions and coordination among individuals and organizations, facilitated by technical platforms. The thesis integrates an organizational perspective with the Chinese telemedicine system using the Org-ES fit theory. The Org-ES fit hypothesis examines fit across four structural levels: physical, surface, deep, and latent structure. In this research, the focus extends beyond individual organizations to inter-organizational dynamics at the fourth-level structure. Geographical proximity emerges as a trigger for challenges in telemedicine due to specific characteristics related to IT avoidance. Moreover, the influence of punishment expectations on inter-organizational relations diminishes over time, while high expectations of rewards prove significant. The National Telemedicine Centre transitions from formal control to social control by fostering interorganizational bonds, social embeddedness, and a two-way feedback mechanism among users. This thesis contributes to the healthcare information technology literature by offering a nuanced perspective on the telemedicine system as a socio-technical system, exploring misfits and their resolution through the Org-ES fit theory, and emphasizing the role of collaboration and social factors in healthcare information technology implementation. The findings and insights from this research can inform future studies and practical efforts aimed at enhancing the effectiveness and efficiency of telemedicine systems in healthcare settings.

**Table of abbreviation**

|  |  |  |
| --- | --- | --- |
| **Key role** | **Abbreviation** | **Definition** |
| **National level hospitals** | | |
| The platform director | P-PD | The platform director is a person who supervises and manages the telemedicine services provided through the platform by the telemedicine service and resource supervision centres. |
| **Province level hospitals** | | |
| Administrative staff | P-AS | There are two specific roles for administrative staff: triage staff and consultant assistants in national level. |
| Triage staff | P-TS | The Triage staff needs to strictly review the application form of remote consultation and supervise the application form filled in a standardized way. In addition, the medical record information of the consultation patients is checked by the triage consultant. Furthermore, the purpose of preliminary diagnosis and consultation should be consistent with the applied departments. The triage consultant verifies those two-information match. |
| Consultant assistants | P-CA | P-CA is mainly responsible for daily management of telemedicine services and the coordination of work among various partners through the system, developing service resources and time agreements, providing timely feedback to telemedicine service implementers, and ensuring that telemedicine services are delivered on time. |
| IT Support | P-IT | P-IT should perform unified operation and maintenance on the telemedicine server, data centre, infrastructure, and IT equipment.  to ensure that the telemedicine information system is operating reliably and efficiently. Meanwhile, P-IT assists in solving the problems of telemedicine consultation service platforms at regional and local level. |
| Healthcare Consultants | P-HC | Healthcare Consultants who receive telemedicine invitations, review telemedicine applications, provide consultants and consultation times, and provide telemedicine services such as diagnostic and treatment advice. |
| **Regional and local level hospitals** | | |
| Regional and local manager | RL-M | Regional and local manager is a person who supervises and manages the regional and local telemedicine services provided through the platform by the telemedicine service and resource supervision sub-centres. |
| Regional and local doctor | RL-D | Regional and local doctor who are responsible for submitting telemedicine applications, preparing telemedicine related information, participating in the telemedicine process and receiving reports on the telemedicine results. |
| Regional and local administrative staff | RL-AS | There are two specific roles for administrative staff: triage staff and consultant assistants in regional and local level. |
| Regional and local Triage staff | RL-TS | RL-TS is mainly response for daily telemedicine service applications. |
| Regional and local Consultant assistants | RL-CA | RL-CA is mainly responsible for daily management of telemedicine services and the coordination of work among various partners through the system. They ensure that telemedicine services are delivered on time. |
| Regional and local IT Support | RL-IT | RL-IT should perform unified operation and maintenance on IT equipment and telemedicine consultant service platform to ensure that the telemedicine service is operating reliably and efficiently. |
| **Telemedicine platform** | | |
| Telemedicine consultant service platform | TCSP | Telemedicine consultation system operated in Henan Province, China |

**Contents**

[Chapter 1 Introduction 10](#_Toc140050526)

[1.1 Research Background 10](#_Toc140050527)

[1.2 Conceptual background 12](#_Toc140050528)

[1.3 Research context 13](#_Toc140050529)

[1.4 Research gap 19](#_Toc140050530)

[1.5 The research questions, aim and objectives 21](#_Toc140050531)

[1.5.1 Research questions 21](#_Toc140050532)

[1.5.2 Research aim 21](#_Toc140050533)

[1.5.3 Research objectives 22](#_Toc140050534)

[1.6 Contribution 23](#_Toc140050535)

[1.7 Structure of the thesis 24](#_Toc140050536)

[Chapter 2 Literature Review 27](#_Toc140050537)

[2.1 The Definition of Telemedicine 27](#_Toc140050538)

[2.2 The Taxonomy of D2D Telemedicine 28](#_Toc140050539)

[2.3 The telemedicine literature reviews 30](#_Toc140050540)

[2.4 Theoretical Background 32](#_Toc140050541)

[2.4.1 Definition of fit from contingency theory 32](#_Toc140050542)

[2.4.2 Managing Fit from a socio-technical perspective 34](#_Toc140050543)

[2.4.3 Fit taxonomy 36](#_Toc140050544)

[2.4.3.1 People-technology fit 36](#_Toc140050545)

[2.4.3.2 Task-technology fit 38](#_Toc140050546)

[2.5 Misfit and misalignment foundations 40](#_Toc140050547)

[2.5.1 Ontological structure of ORG-ES misfit 40](#_Toc140050548)

[2.5.2 Identification of misfit 42](#_Toc140050549)

[Chapter 3 Methodology 46](#_Toc140050550)

[3.1 Research context 46](#_Toc140050551)

[3.1.1 The background of Chinese healthcare system 46](#_Toc140050552)

[3.1.2 TCSP structure 47](#_Toc140050553)

[3.1.3 Defining the telemedicine key roles and workflow 52](#_Toc140050554)

[3.1.3.1 Defining the telemedicine key roles 53](#_Toc140050555)

[3.1.3.2 Telemedicine consultation service platform workflow 55](#_Toc140050556)

[3.2 Research Philosophy 57](#_Toc140050557)

[3.3 Research approach 58](#_Toc140050558)

[3.4 Research design 60](#_Toc140050559)

[3.4.1 Research strategy 61](#_Toc140050560)

[3.4.2 Research methodological choice 63](#_Toc140050561)

[3.5 Data collection 66](#_Toc140050562)

[3.5.1 Participant observation 69](#_Toc140050563)

[3.5.2 Triangulation Interview 72](#_Toc140050564)

[3.5.3 Focus group 78](#_Toc140050565)

[3.5.4 Archival data 80](#_Toc140050566)

[3.5.5 System log data 81](#_Toc140050567)

[3.6 Data analysis 82](#_Toc140050568)

[3.6.1 Content analysis 82](#_Toc140050569)

[3.6.2 Digital trace analysis 85](#_Toc140050570)

[3.6.3 Trustworthiness of findings and analysis 86](#_Toc140050571)

[3.7 Ethical issues 88](#_Toc140050572)

[3.7.1 Data collection ethical issues 88](#_Toc140050573)

[3.7.2 Data analysis ethical issues 90](#_Toc140050574)

[3.7.3 Data management 91](#_Toc140050575)

[3.8 Summary 91](#_Toc140050576)

[Chapter 4 Research Findings: Formation of misfits and Resolution of misfit 93](#_Toc140050577)

[4.1 Data misfit 93](#_Toc140050578)

[4.2 Functionality misfit 99](#_Toc140050579)

[4.3 Usability misfit 105](#_Toc140050580)

[4.4 Role misfit 111](#_Toc140050581)

[4.5 Control misfit 118](#_Toc140050582)

[4.6 Resolution of deep structure misfit in the data and functionality domains 123](#_Toc140050583)

[4.7 Resolution of surface structure misfit in the usability domains 128](#_Toc140050584)

[4.8 Resolution of latent structure misfit in the role domain 134](#_Toc140050585)

[4.9 Resolution of latent structure misfit in the control domains 142](#_Toc140050586)

[Chapter 5 Discussion 148](#_Toc140050587)

[5.1 Introduction 148](#_Toc140050588)

[5.2 Summary of Research Findings 148](#_Toc140050589)

[5.3 Theoretical and practical contributions 152](#_Toc140050590)

[5.3.1Theoretical contributions 152](#_Toc140050591)

[5.3.2 Practical contributions 154](#_Toc140050592)

[5.4 Research limitations 156](#_Toc140050593)

[5.5 Future research 158](#_Toc140050594)

[Chapter 6 Conclusion 164](#_Toc140050595)

[References 168](#_Toc140050596)

[Appendix 189](#_Toc140050597)

[Appendix 1: Archival Data 189](#_Toc140050598)

[Appendix 2: Participant Consent Form 190](#_Toc140050599)

[Appendix 3 : Participant Information Sheet 192](#_Toc140050600)

[Appendix 4: Transcription of Interview 197](#_Toc140050601)

[Appendix 5: The Relevant Telemedicine Management Specification 212](#_Toc140050602)

[Appendix 6: TCSP Development History 225](#_Toc140050603)

[Appendix 7: Telemedicine Literature Review Table 229](#_Toc140050604)

**List of Figures**

[Figure 1. Socio-technical system (Adapted from Bostrom and Heinen 1977) 36](#_Toc139978572)

[Figure 2. Telemedicine system Architecture(Resource: Author) 48](#_Toc139978573)

[Figure 3. Telemedicine key roles and inter-organizational structure(Source: Author) 53](#_Toc139978574)

[Figure 4. Telemedicine workflow (Flow chart of telemedicine service requirements in Henan Province) 55](#_Toc139978575)

[Figure 5: Longitudinal data collection timeline (Source: Author) 66](#_Toc139978576)

[Figure 6. Data structure of data misfit 98](#_Toc139978577)

[Figure 7. Data structure of functionality misfit 104](#_Toc139978578)

[Figure 8. Data structure of Usability misfit 110](#_Toc139978579)

[Figure 9. Data structure of role misfit 117](#_Toc139978589)

[Figure 10. Data structure of control misfit 122](#_Toc139978590)

[Figure 11. A model of deep structure misfit (data and functionality) resolution 127](#_Toc139978591)

[Figure 12. A model of surface structure misfit (usability) resolution 133](#_Toc139978592)

[Figure 13. A model of latent structure misfit (role) resolution 140](#_Toc139978593)

[Figure 14. A model of latent structure misfit (control) resolution 146](#_Toc139978594)

**List of Table**

[Table 1. Summary of data source 68](#_Toc139978735)

[Table 2. Interview summary 75](#_Toc139978736)

[Table 3. First-round interview questions (Identify misfits) 76](#_Toc139978737)

[Table 4. Second-round interview questions (Identify resolution) 77](#_Toc139978738)

[Table 5. Focus group summary 80](#_Toc139978739)

[Table 6. Trustworthiness of study and findings (Flint et al., 2002, p106) 86](#_Toc139978740)

[Table 7. Data structure of data misfit 98](#_Toc139978741)

[Table 8. Data structure of functionality misfit 104](#_Toc139978742)

[Table 10. Data structure of role misfit 117](#_Toc139978743)

[Table 11. Data structure of control misfit 122](#_Toc139978744)

[Table 12. A model of deep structure misfit (data and functionality) resolution 127](#_Toc139978745)

[Table 13. A model of surface structure misfit (usability) resolution 133](#_Toc139978746)

[Table 14. A model of latent structure misfit (role) resolution 140](#_Toc139978747)

[Table15. A model of latent structure misfit (control) resolution 146](#_Toc139978748)

[Table 16. A summary of study findings and contributions for misfit formation 159](#_Toc139978749)

[Table 17. A summary of study findings and contributions for misfit resolution 161](#_Toc139978750)

[Table 18. Timeline for TCSP (Resource: Author) 227](#_Toc139978751)

[Table 19. Type of misfit and Definition (Soh et al., 2000, p.49 and Strong and Volkoff, 2010) 229](#_Toc139978752)

[Table 20. Telemedicine literature review 230](#_Toc139978753)

# Chapter 1 Introduction

1.1 Research Background

Expanding high-quality care to all populations, particularly those living in rural and underserved regions, has long been a priority for healthcare practitioners, researchers, and policymakers. Globally, the universal health coverage service index has increased from 45 in 2000 to 67 out of 100 in 2019, indicating steady but slow progress in improving access to essential health services over the last two decades (World Health Organization, 2021). To untangle this dilemma, many contemporary public health policy initiatives have been placing a great deal of emphasis on mitigating health disparities as a central component of their technology initiatives, often referred to as ‘telemedicine’.  Utilizing a mixture of information and communication technologies (ICTs), telemedicine creates a new form of the interoperable healthcare system that holistically manages individual and community health (Bardhan et al., 2020) and delivers value with the patient-centric process (Agarwal et al., 2020). It has been 40 years since telemedicine systems and services were developed. However, there are significant disparities in the uptake of telemedicine or teletherapy across countries, although over 70 % of countries have adopted telemedicine or teletherapy to overcome disruptions to care services. Telemedicine and teletherapy are more widely used in high-income countries than in low-income countries. In comparison, less than 50% of low-income nations use these telehealth technologies (Brunier and Drysdale, 2020).

China is faced with a serious dilemma due to the COVID-19 virus’s rapid proliferation. Healthcare experts working to control this extraordinary crisis must decide how to most effectively coordinate the medical resources used in widely flung areas as the regular capacity of Chinese hospitals is exceeded. Due to the high danger of infection and the feature of human-to-human transmission, many Chinese cities have implemented a lockdown1. Patients are not the only ones who have been neglected; many physicians working in remote hospitals have limited access to the expert consultations and treatment recommendations they require from provincial-level institutions to manage pneumonia cases brought on by COVID-19. Just depending on conventional communication methods, including doctor office visits or in-person consultations within the network of healthcare professionals, could result in considerable costs and health risks as long as the crisis persists. During the COVID-19 period, telemedicine is regarded as one of the most attractive web applications. The telemedicine systems can provide practical support for the rescue and treatment of wounded people in an emergency or under specific conditions. Telemedicine application allows physicians and other health professionals to remotely access patient records, order lab tests, administer medications, and perform procedures from any location with internet access. Along with protecting the safety of medical staff, it is important to save as many lives of patients and medical staff as possible.

Telemedicine not only achieves the widest range of high-quality medical resource sharing but also offers great value in alleviating the difficulty and expense of medical treatment. Specially, In China, the medical system adopts a hierarchical diagnosis and treatment system guided by the priority of disease and the difficulty of treatment (Li and Fu, 2017). Different medical institutions undertake different treatments. The large and medium-sized hospitals gradually divide the general outpatient service, rehabilitation and nursing undertaken into basic medical institutions, which promote the division and cooperation of medical institutions at all levels. Under the hierarchical diagnosis and treatment mode, hospitals are divided into three levels (primary hospitals, secondary hospitals and tertiary hospitals)(World Health Organization, 2015) . Community and township hospitals are basic medical institutions. There are key positions in the Chinese healthcare system as the patients’ first diagnosis point. When the state of an illness is beyond the diagnosis and treatment ability of the general practitioner shall be transferred to the second-level hospital by the general practitioner (World Health Organization, 2015). If the condition exceeds the diagnosis and treatment ability again, the referral to the third-level hospital shall be continued. When the patient enters the stable period, the superior doctors will transfer the patient back to the basic medical and health institutions for rehabilitation treatment. The application of a hierarchical diagnosis and treatment system in China, which has a large population and a vast territory, alleviates the problems of difficult, expensive and disorderly medical treatment. At the same time, it improves the medical service mode, optimizes the allocation of medical service resources, and reduces the expenditure of medical expenses.

1.2 Conceptual background

The study of Enterprise Systems (ES) fit has seen significant evolution, predominantly focusing on comprehending the choices involved in configuration and implementation, as delineated in Weber’s seminal work in 1997. Recognising the pivotal relationship between the appropriateness of an ES (i.e., ‘fit’) and the subsequent success of the project, researchers have been motivated to investigate this intricate connection further. One prominent study that emerges in this context is that of Hong and Kim (2002), who adopted the misfit definition as proposed by Soh et al., (2000). Their research findings shed light on the crucial role of fit in influencing the outcomes of ES projects and how misfits could potentially derail these complex undertakings.

Deepening the dialogue on ‘misfit’, Sia and Soh (2007) expanded upon this topic by employing Wand and Weber’s model from 1990. Their work centred on the exploration of misfit structures in ES, distinguishing between ‘deep’ and ‘surface’ structures. Deep structures relate to the underlying mechanisms and the fundamental principles that an ES is built upon, whereas surface structures denote the visible and often user-interactive features of the system. This distinction is critical because misfits at these different levels can have varied impacts on the effectiveness of the ES and require diverse strategies for resolution. Sia and Soh’s research not only elucidated the existence of these disparate misfits but also offered insight into potential resolution strategies.

Building upon the work of Wand and Weber (1990), Strong and Volkoff (2010) made significant contributions to the field by extending the model to comprehend the ES artefact during its actual utilisation better. Their research emphasised understanding how users interact with ES artefacts, how these artefacts are embedded within organisational contexts, and how misfits can occur during their usage. These insights have broader implications for how ES artefacts are designed, implemented, and managed in organisational settings, thus contributing substantially to the body of knowledge on ES fit.

## 1.3 Research context

Telemedicine is characterised by Swanson et al., (2012, p.144) as ‘a promising health information technology (HIT) tool that can connect providers to patients in geographically disparate locations increasing access to specialty and expert care.’ Previous telemedicine systematic review has predominantly identified five components: effective of telemedicine (Ekeland et al., 2010 ; Grigsby et al., 1995), telemedicine systems and technology (Garg and Brewer 2011; Klaassen et al., 2016 ; Scott et al., 2018), services, applications (García‐Lizana and Muñoz‐Mayorga, 2010; Petersen et al., 2021; Galea, 2019), and benefits (Hailey et al., 2002; Hjelm, 2005). Telemedicine has gained widespread development and application across the globe, achieving broad sharing of high-quality medical resources and significantly reducing the difficulties and expenses of medical treatment. Existing telemedicine service models can be categorised into two classes, based on the primary recipients of the medical services: Doctor-to-Patient (D2P) and Doctor-to-Doctor (D2D) (Pani et al., 2013). The D2P model offers direct patient care services such as telemonitoring, emergency ambulances, online counselling, and telemedicine for specific incidents (e.g., flights, disasters) (Pani et al., 2013). The D2D model facilitates interactions between medical professionals, encompassing teleconsultations, teleradiology, and distance training (Pani et al., 2013). This research presents a case study of a successfully implemented D2D telemedicine model that employs a five-level linkage service innovation system in the largest and most advanced demonstration of telemedicine, based in the Chinese context.

However, it must also be acknowledged that the current level of development of China’s medical and healthcare services does not align with the people’s health needs and the prerequisites for coordinated social and economic development, resulting in pronounced disparities (Dong et al., 2021). Due to the uneven distribution of medical resources, China’s health sector experiences prominent issues of difficult and costly access to healthcare. From a resource allocation perspective, the imbalance in the development of China’s urban, rural, and regional healthcare services is primarily reflected in the irrational distribution of healthcare resources (Ao et al., 2022). High-quality healthcare resources are excessively concentrated in major cities and large medical institutions, while remote areas face a severe deficit of medical resources, including skilled physicians and quality-assured medications. This vicious cycle leads to progressively poor medical conditions in remote areas and significant difficulties for patients in accessing timely and effective medical services.

Conversely, in areas with relative surpluses of medical resources, particularly in large cities, substantial amounts of these resources remain idle and are not effectively utilised, resulting in considerable waste. The discrepancy between the relative abundance of healthcare resources in large cities and the absolute scarcity at the grassroots level significantly impedes healthcare development. From the grassroots patient’s perspective, due to limited medical resources, the service capacity and quality of local medical institutions are often low, prompting patients to seek medical treatment from larger, distant hospitals. This not only increases the financial burden on patients but also exacerbates the inefficient utilisation of healthcare resources. This often results in under-utilisation of primary level healthcare resources and overburdens large hospitals. A substantial number of resources is expended on the treatment of common diseases, making it difficult to leverage quality resources to tackle complex cases, thereby contributing to the notable problem of difficult and costly access to medical services. Resorting to scientific and technological means to resolve the uneven distribution of healthcare resources offers a promising approach to alleviate and overcome the issue of difficult and costly access to healthcare, as well as to address the challenging problem currently impeding the development of healthcare in China.

At the same time, it should also be noted that the current level of development of China’s medical and health services is not in line with the people’s health needs and the requirements of coordinated social and economic development, and the contradiction is still prominent. Based on the imbalance in the allocation of medical resources, the problem of difficult and expensive access to health care is prominent in China’s health sector. From the perspective of healthcare resource allocation, the imbalance in the development of China’s urban and rural and regional healthcare undertakings is mainly reflected in the unreasonable allocation of healthcare resources, with healthcare resources, especially high-quality healthcare resources, concentrated excessively in large cities and large medical institutions, while there is a serious shortage of medical resources in remote areas and a shortage of doctors with good business skills and quality-assured medicines. The result of this vicious circle is that the medical conditions in these remote areas are becoming increasingly poor and patients have difficulty accessing timely and effective medical services. On the other hand, in areas where there is a relative surplus of medical resources, especially in large cities, a large number of medical resources are left idle and not used effectively, resulting in a huge waste of resources. The contradiction between the relative excess of healthcare resources in the big cities and the absolute shortage of healthcare resources at the grassroots level has largely hindered the development of healthcare. From the perspective of the grassroots patient, due to the lack of medical resources at the grassroots level, the capacity and quality of services provided by medical institutions are not high, and grassroots patients have to travel long distances to large overseas hospitals when it is difficult to get effective medical treatment locally. This on the one hand increases the financial burden on patients, and on the other hand further exacerbates the inefficient use of healthcare resources, under-utilising health resources at the primary level and increasing the burden on large hospitals. Too many resources are used for the treatment of common diseases, making it difficult to take advantage of quality resources to solve complicated cases, thus leading to the prominent problem of difficult and expensive access to medical services. Seeking scientific and technological means to resolve the uneven distribution of health care resources is a way to alleviate and overcome the real problem of difficult and expensive access to health care, as well as to solve the difficult problem that currently restricts the development of health care in China.

Telemedicine service developments face many challenges, which, from the socio-technical perspective, reflect issues rooted in infrastructure and technology, implemented information systems, and inter-organizational management. The telemedicine service depicts a complex telemedicine system that is composed of various sub-systems. Also, Telemedicine systems involve the operations of multiple hospitals and multiple departments within each hospital organization. One of the challenges that telemedicine systems face is inter-divisional, inter-departmental, and inter-departmental integration and coordination of processes. One way to improve inter-organizational, inter-departmental communication and coordination are to make information flow smoothly across organizations. In addition, the acceptance of telemedicine member hospitals to new technology and their understanding of telemedicine will influence the implementation of telemedicine systems. The main barriers to implementing and promoting telemedicine systems are the inability of telemedicine member hospitals to perceive new things coming from the outside world, their reluctance to accept innovation, as well as their lack of understanding of telemedicine.

According to earlier research, one important problem with the telemedicine service is ‘rooted’ in information technology (IT) systems. In order to improve the quality of healthcare services and boost patient satisfaction and efficiency, telemedicine systems are created. As a result, many nations have made an effort to develop and operate numerous telemedicine systems. But only software and hardware advancements were responsible for these information system applications performance gains. Organizations of ultimate goal was to replace functionally oriented and poorly linked historical software with an integrated information system, which would lower the cost of infrastructure support (Hendricks et al., 2007). The literature on inter-organizational information systems also recommends integrating the data processed by these independent systems such that the combined data has the characteristics of all of the earlier distinct applications (Litan et al., 2011). Inter-organizational information systems are now required by organisations as a result.

The telemedicine system is built upon socio-technical conditions. Within the context of inter-organisations, evaluated the systemic functionality, data, usability, inter-organizational roles, inter-organizational control, and inter-organizational culture, technological conditions, which contributed to operating effectively based on the needs of the inter-organization (Strong and Volkoff, 2010). The fact was highlighted that partner selection and effective communication, inter-organizational understanding, trust, and management across organizations.

An integrated system of functionality, data sharing, and data usage depend on technical capacity, as well as improvements in organizational cultures and government policies relating to data use (Wang and Byrd, 2018). In comparison with past isolated information systems, the integrated system has changed not only technologies but also organisational key roles, control, and culture. In other words, it is important to focus not only on the technical aspects of inter-organizational information systems (such as system architecture, deep structure, surface structure) but also on the social aspects, which emphasize the changes brought about by technology whereas in human interaction and participation a process of integration is formed (Mumford, 2000). In this regard, it is imperative that the telemedicine system be designed according to a socio-technical system perspective.

At the organisational management level, it is a great challenge for the co-operators to choose and build trust across organisational systems. Because the telemedicine system is based on cooperation among different hospital organizations, the cooperation degree of partners and the cooperation pattern among organizations should be considered as the decision-making basis for implementing the telemedicine system. In general, joining the telemedicine system is of value to every hospital, so every hospital must promote the implementation of the telemedicine system. But the benefits are not distributed equally, and if one of the participants refuses or hesitates to join, the organizations that benefit the most will encourage them to do so. This is the external motivation of the collaborator. The motivation of organizations to participate in the implementation of IOS is mainly internal and external, and different motivations make each organization play different roles in the process of participation. The organization that is about to get the most out of it will function as a driver, taking responsibility for organizational implementation and oversight, while others will act as a responder. Such a clear division of labour can effectively reduce the conflict between the partners, avoid the lack of cooperation or the uneven distribution of interests and lead to the breakdown of cooperation. In the context of telemedicine researchers, the issue of unequal benefits in IOS has been addressed before, with most respondents implementing telemedicine systems at the request of the drivers. If there is a significant gap in the willingness and level of implementation, it will render the system inefficient. In addition, the degree of internal automation of partners should also be considered. Where there is a mature automation environment, there is a relatively high degree of willingness to work across organizational systems; conversely, not only is there a low degree of willingness to work, but maybe even resistance.

In the aspect of infrastructure and technology, the performance of the original information management system and infrastructure of telemedicine member hospitals has a key influence on the implementation difficulty and result of the telemedicine system in Henan province. The fundamental goal of the telemedicine system is to realize the smooth transmission of remote data and information. Inevitably, the success of telemedicine systems depends on at least two systems, one for the input of information (the original health information management system of the member hospital) and one for the utilization of information (telemedicine system). Telemedicine systems can only exchange data, and the purpose of exchanging data is to make better use of data. Only an internal information system can realize the medical value of data. At present, the integration of telemedicine systems is poor, and the fusion of hardware and software needs to be improved. At the same time, the data exchange standard of telemedicine information systems is different, forming many ‘Information Islands’, high-quality medical resources cannot be shared and play the greatest role. Therefore, the potential value of a telemedicine system can be realized only when the telemedicine system is highly integrated with the internal information system. After all, the value that telemedicine creates, such as faster response times, and better data integration, is a direct reflection of society to improve the effective use of medical resources rather than a pure cross-organizational system use.

## 1.4 Research gap

Citing scholarly references to validate identified research gaps contributes to a deeper understanding of Organizational-Enterprise System (Org-ES) fit theory.

Research Gap 1: A Novel Context - Previous research has employed the Org-ES fit theory in traditional industries such as North American manufacturing (Strong and Vorkoff, 2010) and Singaporean public hospitals (Soh et al., 2000). Investigating the application of the Org-ES fit theory in the context of telemedicine could provide pivotal insights into the adaptation and functionality of organisational systems within healthcare technology ecosystems. The inherent intricacies of inter-organisational activities, notably within layered and complex systems like telemedicine, can be more thoroughly deciphered through the prism of fit and misfit within the Org-ES fit theory. This perspective might unravel the multifaceted network of interactions and dependencies amongst healthcare providers, policymakers, and technology platforms involved in delivering telehealth services. Potential enhancements in telemedicine service delivery and user satisfaction may emerge from the solutions shaped by these insights.

Moreover, transitioning from a singular organisational structure (Strong and Vorkoff, 2010; Soh et al., 2000) to an inter-organisational model within the theoretical framework accurately mirrors the practical realities of telemedicine services. This shift accentuates that telemedicine is not a solitary venture, but a collaborative effort involving various stakeholders. These may encompass hospitals, clinics, government health departments, insurance companies, and telecommunication firms that facilitate the infrastructure for remote care. By viewing through this inter-organisational lens, the Org-ES fit theory could notably augment its applicability and pertinence in analysing and resolving system misfits within telemedicine and analogous contexts.

Research Gap 2: Theoretical Framework - Addressing the existing limitations in comprehending the mechanisms of various misfit types could initiate more refined and effective strategies to manage and mitigate these misfits. The novel theoretical framework, incorporating the strengths of Weber’s model (1997), Strong and Volkoff’s model (2010), and Sia and Soh’s model (2007), delivers a more comprehensive understanding of the misfit phenomenon. This exhaustive framework charts a detailed roadmap to trace the origins of different misfit types, illuminating the root causes of system failures, user dissatisfaction, or inefficiencies in system utilisation.

Furthermore, this expanded framework might propose practical solutions to rectify the identified misfits, considering the complex network of interdependencies within the Org-ES. As these solutions are informed by a comprehensive understanding of the distinct misfit types and their underlying causes, they can be more targeted, holistic, and sustainable. Essentially, enhancing this theoretical framework facilitates a more initiative-taking and pre-emptive approach to managing Org-ES misfits, thus leading to optimised system performance, enriched user experience, and increased overall organisational effectiveness.

## 1.5 The research questions, aim and objectives

### 1.5.1 Research questions

Q1: *How does misfit form in the inter-organizational use of telemedicine systems?*

Q2: *How and in what mechanisms can misfits developed in telemedicine system be mitigated?*

### 1.5.2 Research aim

This study aspires to deliver a unique viewpoint on the information technology artefact by investigating it through the lens of telemedicine. This dual-pronged exploration of the telemedicine system, viewed as a socio-technical system, is set to be an invaluable asset to the field, adeptly blending both the technical and social aspects. In this model, the technical system encompasses the technological tools and infrastructure, whereas the social system embodies the human actors, organisational structures, and processes. Each telemedicine service encapsulates a myriad of interactions and coordination activities, mediated by technical systems amongst individuals and across organisations (Kling, 2000).

An innovative theoretical approach is proposed within the context of telemedicine in China using the Org-ES fit theory. By expanding the theory of fourth structural level to encapsulate inter-organisational relationships rather than exclusively intra-organisational structures, this research aims to cultivate a more comprehensive understanding of telemedicine of complexity (Zhu and Kraemer, 2005).

Even though fit is an essential concept within the Org-ES fit theory, it often remains somewhat abstract and elusive, typically offering little assistance in directly revealing the dynamics of Org-ES interaction (Chan, 2002). Consequently, this research endeavours to delve deeper into the spaces where misalignments arise — these misfits serve as tangible instances that highlight areas of conflict and incompatibility within the socio-technical system. Identifying and rectifying these misfits could be instrumental in driving transformation, allowing real-time telemedicine systems to progress from a state of misfit to a state of fit.

Aside from contributing to theoretical knowledge, this research is anticipated to wield significant practical impact. By proposing strategies to surmount misfits in telemedicine systems, this study aims to furnish invaluable insights capable of steering the development and deployment of more efficient and effective telemedicine services, in both developed and developing nations. Hence, this research carries substantial potential to augment the global field of telemedicine, ultimately contributing to enhanced healthcare outcomes worldwide (Wootton, 2001).

### 1.5.3 Research objectives

In this present research study, the telemedicine service provides many different types of interaction and coordination via technical systems between people and inter-organization. I build a theoretical perspective from Organization - Enterprise System (Org-ES) fit theory (Strong and Volkoff, 2010) and integrate this with a telemedicine service system in China. The concept of fit is ‘only one criterion for selecting and implementing an Enterprise System’ (Strong and Volkoff, 2010, p.745). Using the idea of fit and misfit identify interaction issues and solutions between the social system and the technical system.

* *Research objective 1:  to identify the misalignment of type these interactions and coordination among people, inter-organization, physical system, and task.*
* *Research objective 2: to provide solutions that enable real-time telemedicine to shift from misfit to fit.*
* *Research objective 3: to offer actionable strategies for healthcare practitioners (practitioners) and healthcare policy makers to increase the effectiveness of D2D telemedicine in developing countries.*

## 1.6 Contribution

This research constitutes a noteworthy contribution to the domains of organisational enterprise systems and interorganisational management, specifically within the telemedicine sector. In this research propose an alternative perspective to the prevailing discourse, identifying data standardisation as a principal catalyst for data misalignment within telemedicine systems, as opposed to an exclusive emphasis on data accuracy (Strong and Volkoff, 2010; Yen et al., 2011; Van Beijsterveld and Van Groenendaal, 2016).

In the field of interorganisational management, this study offers novel insights into Information Systems (IS) avoidance phenomena concerning shorter geographical distances. In this research additionally illuminate the Chinese enterprise of predilection for formal control mechanisms in domestic buyer-supplier relations, a characteristic aligned with the early stages of the telemedicine sector (Li et al., 2010). This research underlines the impact of reward expectations on interorganisational relations, illuminating high reward expectations as a pivotal determinant (Liang et al., 2013).

Within the telemedicine context, this study foregrounds two key theoretical contributions. Using technology to enhance physician’s patient care capabilities and service efficiency, this study highlights the importance of knowledge transfer in training and consultation. (Hu et al., 1999). This research also elucidates how telemedicine systems influence professional conduct in healthcare, addressing wider societal issues such as health disparities and poverty (Miscione, 2007).

This research advocates that healthcare practitioners and policymakers integrate strategic initiatives in telemedicine management into their operational paradigms. These initiatives should encompass the formulation of uniform information standards, the development of a robust feedback ecosystem, the widespread acceptance of telemedicine systems, and active investment by hospital managers. Further, this research recommends refining data sharing procedures, redefining job responsibilities, and endorsing a laissez-faire supervision style. Enforcing interoperability standards, safeguarding data privacy, and applying technologies such as blockchain constitute further recommended strategies. The creation of health informatics standards, the integration of telemedicine service performance into hospital assessments, the resolution of technical bottlenecks, and the adoption of scientific project management approaches are also crucial. Balancing the costs associated with telemedicine services with their benefits to healthcare providers is strongly encouraged.

## 1.7 Structure of the thesis

This thesis comprises seven chapters. Chapter 1 offers an overarching view of the research, including the challenges facing contemporary healthcare services, the current state of telemedicine services, and the resultant research gap. It outlines the research aim and objectives accordingly and provides a brief introduction to the literature review, philosophy, and research design.

Chapter 2 delves into the facets of telemedicine systems and reviews the use of telemedicine in IT adoption and collaboration, focussing on trust and relationships, operation, and processes. It also examines telemedicine in China, providing in-depth analyses of telemedicine technology, disease-specific applications, and cost-benefit analyses. Notably, few studies have explored telemedicine systems at a technical-organisational level, underpinning the research gap for this paper as identified by the existing literature. Also, it presents the theoretical framework for this study, examining the theories and concepts underlying MIS studies. It discusses the definition of fits, the relevant theories of fits, the evolution of The Enterprise System Artifact and Associated Misfits, and related telemedicine literature. It evaluates the literature from a techno-social perspective and approaches the design and execution of research in a specific setting from a philosophical standpoint.

Chapter 3 details the research methods, described as inductive and qualitative in alignment with the philosophical underpinnings. It identifies the longitudinal case study as the methodology for this study, explaining the case study protocol and providing the historical context of telehealth and the specific deployment setting in Henan. The chapter also details the five participant categories representative of the study’s diverse telehealth system user roles. Data collection comprised focus group discussions with telehealth system users, semi-structured interviews with significant telehealth system stakeholders, and participatory observation in daily telehealth centre activities. Thematic analysis was employed for data interpretation.

Chapter 4 expands on the results and findings of the longitudinal case study and provides details of the coding results. It introduces new categories of misfits, explaining each misfit definition, and establishes a research model informed by Weber (1997) and Strong and Volkoff (2010). This chapter elaborates on misfit resolution based on the case study findings and furnishes detailed information about the coding results.

Chapter 5 synthesises the findings of this study in comparison with the literature review of analogous studies. It further elucidates the paper’s contribution after contrasting it with previous literature. The identified misfits and resolutions offer practical strategies for telemedicine project implementation and policy makers considering similar projects.

Chapter 6 concludes the thesis by summarising the longitudinal case study, presenting the research limitations, and outlining theoretical and practical implications. It concludes with recommendations for further investigation.

# Chapter 2 Literature Review

## 2.1 The Definition of Telemedicine

The term ‘telemedicine’ is often interpreted as denoting remote treatment (Jnr,2020; Anker et al., 2011). This implies the utilisation of networked information and communication technology (ICT) to extend access to medical services and information, thereby enhancing patient care outcomes (Abo-Zahhad et al., 2014). However, authoritative organisations in the realm of telemedicine, such as the World Health Organization (WHO) (2010) offer distinct definitions of the term.

Given the rapid and dynamic evolution of telemedicine, facilitated by technological innovation, the interpretations and encompassed elements of the concept remain in a state of flux. Viewed from a qualitative perspective, the definition proposed by the WHO’s (2010) definition leans towards remote health and the broader sphere of telehealth.

There are fundamental similarities between the two conceptions. Both frameworks generally encompass remote diagnosis, consultation, and treatment of patients via videoconferencing and image transmission. Moreover, eHealth systems comprise client interfaces, remote signal monitoring, medical education and training, client wireless applications, and nurse call centres. The notion of telehealth systems shares considerable overlap with Health Information Technology (HIT), though the latter typically encompasses electronic medical records and similar information systems, while telehealth concerns the utilisation of ICT for the provision of remote diagnostic and therapeutic services.

The breadth of these definitions, however, varies. Jnr (2020) and Anker et al., (2011) confine their focus to the treatment aspect of telemedicine, whereas the WHO widens its scope to incorporate general health, including elements of diagnosis, consultation, medical education, and training. Given the brisk pace of evolution within the field, it is evident that the definitions of telemedicine are subject to change and expansion. The context-dependent nature of these definitions should be critically noted. For example, an analysis focused exclusively on treatment might align more with the definition proposed by Jnr (2020), whereas a study probing into the broader implications of technology in healthcare might resonate more with the WHO’s definition.

Depending on the context of my research, I might opt for a definition with a narrower focus on treatment, as presented by Jnr (2020) and Anker et al., (2011), or adopt a more comprehensive definition, as per the WHO. An alternative course of action might involve the formulation of a new definition, one that amalgamates these varying interpretations and aligns more closely with the objectives of my research.

## 2.2 The Taxonomy of D2D Telemedicine

The taxonomy proposed by Tulu et al. (2007) offers a robust framework for investigating the application of telemedicine, rendering it an invaluable instrument in this study of the D2D model. The implementation of the D2D model in this research assumed considerable significance. This model, predominantly used for remote consultations, radiology, and professional training within telemedicine (Pani et al., 2013), facilitates a broad spectrum of communication amongst healthcare practitioners, promoting the exchange of expertise and engendering a more collaborative healthcare milieu.

The five dimensions of the taxonomy, namely application purposes, application areas, environment settings, delivery options, and communication infrastructure, intersect with and overlap the workings and practicalities of the D2D model, proffering meaningful insights into its functionality and potential within telemedicine. Within this study’s framework, this model furnished invaluable perspectives on the interactions among healthcare professionals within a telemedicine setting. Consequently, this enabled us to explore how such interactions might be optimised to enhance patient outcomes. Moreover, the study was conducted across hospitals of varying tiers – national, regional, and local. Within such a structure, D2D interactions prove indispensable in ensuring that expertise and knowledge are shared effectively, irrespective of geographical constraints or resource discrepancies.

The dimension of application purposes in the taxonomy aids in identifying and comprehending the aims and objectives of the D2D model within telemedicine. It demarcates the specific purposes behind initiating D2D interactions, such as consultations, training, and specialist knowledge exchange among healthcare professionals (Pani et al., 2013).

Application areas, as delineated in the taxonomy, underscore the medical specialities where D2D interactions are most prevalent. A study consisting of 211 subjects found the ten most frequently utilised areas of telemedicine application were mental health, cardiology, dermatology, paediatrics, radiology, home health, orthopaedics, oncology, and general surgery (Tulu et al., 2007). These areas also form the focal point in this subject study. Since the COVID-19 outbreak in 2019, the D2D model has been widely deployed in the diagnose and treatment of public health (COVID-19) in China.

Environment Setting: The majority of telemedicine initiatives are executed within contexts such as hospitals, academic health centres, and outpatient clinics (Tulu et al., 2007). This study echoes a similar setting, where provincial hospitals, possessing superior medical resources and providing telemedicine consultation services, are categorised as national-level hospitals. In contrast, regional and local level hospitals with limited resources form the demand side of telemedicine consultation services and are also included in this research.

Delivery Option: This pertains to the channels and methods employed to send, transmit, or receive data or information (Tulu et al., 2007). Delivery options depend on the timing of the transmitted information and the interaction between health professionals, or between health professionals and patients. The taxonomy facilitates an analysis of how information is transferred between doctors within the D2D model, which can be divided into two types: store-and-forward (asynchronous) and real-time (synchronous) methods (Allely, 1995). The former involves data transfer for review at a convenient time, while the latter necessitates a live presence for real-time health information transfer, such as consultation via live video conferencing. Both types are used in the D2D model for health information transfer (Allely, 1995; WHO, 2010).

## 2.3 The telemedicine literature reviews

A comprehensive literature review was conducted, focusing on telemedicine in the context of Management Information Systems (MIS) as represented in high-impact journals in the field of information management from 1996 to 2020. The term ‘telemedicine’ was used as a key search term, which culminated in the retrieval of eighteen relevant papers from these leading information management journals. After meticulous analysis of the abstracts, all eighteen articles were deemed to meet the predefined literature criteria and were subsequently included in the review.

The collation and review process led to the classification of these eighteen studies into three primary themes, determined by their objectives, methods, settings, results, conclusions, and any discernible methodological limitations. These themes encompassed IT adoption (Grisot et al., 2014; Kane and Labianca, 2011; Hu et al., 1999; Chau and Hu, 2002; Kelley et al., 2011; Savoli et al., 2020), collaboration, with emphasis on trust and relationships (Paul, 2006; Overby and Konsynski, 2010; Paul and McDaniel, 2004; Miscione, 2007; Brown et al., 2004), and operation and process (Rajan et al., 2013; Peters et al., 2015; Steinhauser et al., 2020; Singh et al., 2011; Srivastava and Shainesh, 2015; Li et al., 2020; Sun et al., 2020).

The theme of ‘operation and process’ emerged as a major focal point, featuring in six papers, thus representing 30% of the articles reviewed. Two of these articles (Singh et al., 2011; Peters et al., 2015) emphasised how the telemedicine industry leveraged business models to enhance clinical and financial outcomes. Telemedicine’s role in mitigating emergency department overcrowding through efficient information exchange and flexible allocation of medical resources was also underlined (Sun et al., 2020). Another study (Li et al., 2020) underscored the crucial role of field operators in establishing effective communication links between patients and physicians in the telemedicine setting. Importantly, it was found that the value of telemedicine does not necessarily correlate directly with distance from the hospital, when compared with traditional on-site visits. Furthermore, telemedicine has been identified as a significant change in the competitive landscape between specialist hospitals and community hospitals. Rather than maintaining competition, it was found that both types of hospitals could reap substantial benefits from providing complementary care to patients with chronic conditions (Rajan et al., 2013).

A majority of the themes (six papers) focused on collaboration in the context of telemedicine, with an emphasis on trust and relationship (30%) (Chau and Hu, 2002; Hu et al., 1999). The aforementioned studies examined doctors’ intentions to adopt telemedicine, where physicians compared the ease of use of the technology to its utility in order to make acceptance decisions. It is common for doctors to prioritize the compatibility of the technology with their practice. The telemedicine training programs primarily aimed to enhance patient outcomes and deliver high-quality care. One way this was achieved was through facilitating online communication between patients and their physicians, which alleviated the challenges of self-care for individuals new to the health management system (Kelley et al., 2011).

In a recent study, Savoli et al. (2020) explored the impact of cognitive perceptions, emotional responses, and feedback on the success or failure of self-management in patients with chronic conditions. The authors adopted a similar framework of discipline and monitoring for self-management, where patients were encouraged to adhere to the prescribed program through the monitoring structure of an online portal. This system feedback resembles the online communication highlighted in the study by Kelley et al. (2011). As chronically ill patients take an initiative-taking approach to utilizing the self-management system, they can derive benefits from it while enhancing their own awareness.

## 2.4 Theoretical Background

### 2.4.1 Definition of fit from contingency theory

The concept of ‘fit’ has found utility in numerous areas of management research. Underpinned by structural contingency theory, ‘fit’ is understood as the alignment between two or more factors, resulting in an organisational outcome. Drazin and Van de Ven (1985) pinpointed three specific approaches to ‘fit’: congruence, interaction, and internal consistency. These ideas were later expanded upon, resulting in six perspectives on ‘fit’ in the strategy literature, namely: mediation, moderation, matching, gestalts, co-variation, and profile deviation (Venkatraman, 1989). Venkatraman’s (1989) perspectives offer a classificatory framework for explicating these six conceptualisations, each examined by their degree of theoretical relationship specificity and the particular criterion variable against which the concept of ‘fit’ is evaluated.

Mediation: The mediation perspective posits the existence of key mediating mechanisms, such as organisational structure, and result variables, for instance performance, between antecedent variables, like policies (Venkatraman, 1989). Consequently, adjustment delineates the varied influences of an independent variable on a dependent variable as a function of regulation, highlighting an intermediate or indirect effect between an antecedent variable and its subsequent dependent variable.

Moderation: The moderation perspective argues for an interaction between two variables when a certain connection exists. In Venkatraman’s (1989) terms, the influence of the predictor on the standard variable hinges on the level of a third variable, the regulator. The congruence between the predictor and the regulatory factor emerges as the primary determinant of the standard variable. This viewpoint is cited by researchers when the underlying theory asserts that the effects of predictors, such as strategies, vary across different levels of regulatory factors, such as the environment. Broadly speaking, the moderator can affect predictive variables, including strategies, and dependent variables, like performance, in relation to categories (e.g., type of environment, product lifecycle stage, organisation type) or characteristics (e.g., business relevance, competitive intensity).

Matching: From the matching perspective, fit is theoretically conceptualised as the alignment between two relevant variables. This perspective distinguishes itself from the moderation and mediation approaches as it identifies fit without any explicit reference to a criterion variable. Following this, its impact on a set of criterion variables may be scrutinised. To put it differently, a measure of fit between two variables is constructed independently of any performance benchmark, marking a departure from the previous perspectives.

Gestalts: The gestalt perspective is multivariate, focusing on the degree of internal coherence among a suite of theoretical attributes. As Miller (1981, p. 5) eloquently puts it, ‘Instead of looking at a few variables or at linear associations among such variables this we should be trying to find frequently recurring clusters of attributes or gestalts’.

Covariation: The covariation perspective perceives fit as a pattern of internal consistency among a group of underlying theoretically linked variables. For instance, in a business context, the most effective strategy may be best represented by a consistent, concurrent allocation of resources to areas such as research and development, design, manufacturing, and marketing. In this case, no single area is sufficient in itself to produce an effective strategy; rather, there is a requirement for consistent attention across all areas.

Profile Deviation: According to the profile deviation perspective, ‘fit’ applies to externally specified profiles (Drazin and Van de Ven, 1985). For instance, considering an ideal policy profile (such as resource deployment in a specific environment across a range of strategic decisions), the degree to which a business department aligns with this profile can be gauged. If compliance is high, there is likely to be a level of strategic coordination with the environment, which can closely correlate with performance. Conversely, a deviation from this profile may imply poor environmental strategic coordination, potentially resulting in a negative impact on performance.

### 2.4.2 Managing Fit from a socio-technical perspective

The Socio-Technical Systems Theory posits that when devising an organisational system, both social and technical facets constitute crucial parts of a complex, interdependent system (Bostrom and Heinen, 1977). This theory postulates that any organisation comprises interacting subsystems. Within these organisations, individuals possessing specific skills work towards set goals, adhere to established processes, use technology, operate within a physical infrastructure, and subscribe to certain cultural norms and assumptions.

Neglecting to consider both the social and technological aspects can impede the capacity to effect meaningful change within the organisation. Comprehension and enhancement necessitate input from all key stakeholders across the system. Adopting a socio-technical system perspective, the information system is regarded as a broader concept of the work system, rather than a traditional information processing system from the Management Information Systems (MIS) perspective (Alter, 2008).

This work system comprises two interconnected subsystems: the technical system and the social system (Bostrom and Heinen, 1977). The social system encompasses two components: individuals and organisations. The social system is defined as a framework wherein people complete work tasks without a friendship system (Bostrom and Heinen, 1977). Moreover, social systems focus on human attributes, such as attitudes, skills, and values, the relationships amongst individuals essential for task completion, reward systems, authority structures, and the derivation of satisfaction from work (Bostrom and Heinen, 1977).

Furthermore, the social system may manifest person-organisation fit, defined as the congruence between the norms and values of organisations and those of individuals (Chatman, 1989, p339). Katz and Kahn (1978) contend that values are a fundamental and enduring aspect of both organisations and people. People-organization fit enhances predictive abilities regarding how an individual’s values will change as a result of their membership in a company, and how they will adhere to the rules of the company.

Organisational membership can shape and modify individuals’ values (Whyte, 1959). For instance, Mortimer and Lorence (1979) found that certain work values (e.g., people orientation, autonomy) changed as a function of work experiences. Specifically, individuals adopted the values rewarded in previous organisations or occupations. Likewise, Weiss (1978) discovered that people aligned their values with those of their leaders if they perceived their leader to be considerate, competent, and successful. Calibrating person-organisation fit also enables us to ascertain the probability of individuals effecting changes in an organisation’s values.

The technical system, on the other hand, includes the equipment and methods used to transform raw materials into products or services (Cummings, 1994, p. 268). The technical system is dedicated to a means for directly determining certain information needs, concerning the processes, tasks, and technology needed to transform inputs into outputs (Bostrom and Heinen, 1977; Alter, 2008).

The early research into the Socio-Technical Systems theory introduced an important finding: the development of semi-autonomous work groups within organisations can bolster productivity and worker satisfaction (Emery and Trist, 1965). Emery and Trist (1965) argue that if the social system fails to support its members and manage the pressure they are under, enhancements in the technical system may not necessarily result in increased productivity or efficiency. The aspiration for organisational development should be the harmonisation of the social and technical systems for productivity and efficiency.

This argument uncovers the implementation of the ‘fit’ prototype idea in the socio-technical system. Information Systems (IS) researchers have extended this ‘fit’ prototype idea to elucidate the success and failure of information systems. In the following section, this research will discuss three types of ‘fit’ related to information systems.

图示

描述已自动生成

Figure 1. Socio-technical system (Adapted from Bostrom and Heinen 1977)

### 2.4.3 Fit taxonomy

#### 2.4.3.1 People-technology fit

The influence of the human factor is undeniably crucial in the context of an information system. This influence is evident in the Information System Success Model proposed by DeLone and McLean (1992), which explicates the interrelationship between technological aspects - System Quality, Information Quality, and Service Quality - and human factors, such as Information Use and User Satisfaction. Users of information systems need to accept, comprehend, and adopt information technology, which must, in turn, cater to diverse user groups (Davis et al., 1989). This necessity underscores a key research priority within the field of information technology.

The Technology Acceptance Model (TAM) devised by Davis et al., (1989) postulates system design characteristic variable as an external determinant for individuals choosing to use or refrain from using an information system. This factor significantly influences the perceived ease of use, which along with perceived usefulness, shapes attitudes towards utilising information systems. Such attitudes, paired with perceived usefulness, sway the behavioural intention to use information systems. This intention ultimately determines actual system usage.

Given the relatively nascent stage of information technology development during Davis et al.,’ s research (1989), the emphasis of their model was predominantly on its foundational structure. Their study participants were primarily enterprise employees, and their research methodology primarily involved questionnaires. The researchers incorporated a set of social influence variables - Subjective Norm, Voluntariness, Image, and Experience - and eliminated the attitude towards agreement, thus modifying the influence proposed by the initial TAM. The perceived usefulness of TAM is influenced by subjective norms, image, job relevance, output quality, and results demonstrability.

A review of pertinent literature reveals key themes and findings concerning technology usage and attitudes’ impact on individual performance. DeLone and McLean (1992) posited that individual performance is shaped by both technology utilisation and user attitudes. They proposed six success criteria, encompassing a myriad of specific Information System (IS) measurements.

Investigating 151 software development projects across eight companies, McKeen, et al., (1994) observed a direct relationship between user participation and satisfaction. They suggested that this relationship hinges on four crucial contingency variables. The research offers valuable insights into the dynamic between user engagement and satisfaction in diverse settings, aiding in understanding this relationship. The findings bear substantial implications for system developers and academic researchers seeking to illuminate the when, how, why, and where of necessary user interaction.

Through two distinct case studies, DeLone and Mclean (2004) scrutinised the competition between Barnes and Noble and Amazon.com in online book sales and examined the business strategy of ME Electronics, a consumer electronics retail chain. Both cases exemplified the efficacy of the modified model’s six components as an efficient framework for categorising e-commerce success measures drawn from literature. The studies further demonstrate how this model can steer the identification and specification of distinct success measures for e-commerce, thus providing valuable insights for both business practitioners and researchers.

In summary, the analysed literature underscores the significant roles of technology usage, user attitudes, and engagement in shaping both individual and business performance. This body of work also affirms the importance of well-defined models and frameworks for comprehending and forecasting success in diverse technology-associated contexts. These insights illuminate the intricate relationship between human and technological elements in information systems, providing invaluable guidance for researchers, system developers, and business practitioners alike. Continued investigation into these facets, particularly within the rapidly evolving field of information technology, will be crucial for further theoretical development and practical application.

### 2.4.3.2 Task-technology fit

After comprehensive analysis of a plethora of scholarly articles, this research discerns key themes and findings relating to task-technology fit (TTF), system quality, user performance and utilisation across diverse contexts. Goodhue and Thompson (1995) introduced the seminal Task-Technology Fit (TTF) model, marking a significant paradigm shift that highlights the importance of technological advances in augmenting personal performance (Larsen et al., 2009). Their research moderately supports the hypothesis that user evaluations of TTF are contingent upon system and task characteristics. Notably, their compelling evidence underscores the inclusion of both TTF and utilisation as pivotal predictors of performance.

Through their ethnographic study on faculty end-users of the Integrated Information Centre (IIC), Lending and Straub (1997) have articulated its effects on end-user working practices. Furthermore, Dishaw and Strong (1998) broadened the scope of the TTF model to software maintenance, illuminating a link between task-technology fit and enhanced tool use. Within the context of Group Support Systems (GSS), Zigurs and Buckland (1998) expanded the TTF model, associating task complexity with relevant GSS technology dimensions.

Focusing on telecommuting and performance, Belanger et al., (2001) established that telecommuters’ performance was influenced by the extent of accessible information system technologies, concurrently observing a negative impact of increased communication ties within the workplace on perceived outcomes. Using a modified Technology Acceptance Model (TAM) and TTF/TAM, Klopping and McKinney (2004) demonstrated their capacity to predict online purchasing behaviour. Staples and Seddon (2004) substantiated the effect of TTF on performance, attitudes, and beliefs about usage in both voluntary and required usage contexts.

Murthy and Kerr (2004) shed light on how specific technologies for Computer-Mediated Communication (CMC) could facilitate information exchange within audit teams. Building upon Bergeron et al., (1995)’s findings, Lippert and Forman (2006) identified and empirically validated the relationships between antecedents to TTF and the perceived long-term consequences of technology use. Kositanurit et al., (2006) recognised system quality, utilisation, and ease of use as fundamental factors influencing individual performance in ERP environments.

Key determinants for the success of Spatial Decision Support Systems (SDSS) were conceptualised by Jarupathirun and Zahedi (2007), emphasising TTF and perceived goal commitment. Chang (2008) underscored the significance of perceived usefulness (PU) and perceived ease of use (PEOU) in motivating the intention to use online auction websites. Fuller and Dennis (2009) suggested that initial estimates of TTF are transient as teams innovate and adapt, necessitating a redefinition of ‘fit’ in the context of teams leveraging technology.

The substantial impact of TTF on learners’ perceptions of the Learning Management Systems’ (LMSs) influence on learning was demonstrated by McGill and Klobas (2009), despite a marginal effect on student grades. To tackle regulatory compliance issues, Glowalla and Sunyaev (2014) advised firms to adjust systems in response to changing work environments and heighten awareness of data quality. In conclusion, the TTF theory proves to be a versatile and powerful framework for exploring how technologies cater to the needs of users and tasks in various settings, ranging from telecommuting to ERP systems, and Learning Management Systems to Group Support Systems. This theory has been further expanded by researchers, validating its effectiveness in forecasting the efficiency of technology use in a wide range of environments.

## 2.5 Misfit and misalignment foundations

### 2.5.1 Ontological structure of ORG-ES misfit

Weber (1997) segmented the misfit framework into three structural categories. Surface structures pertain to ‘the facilities that are available in the information system to allow users to interact with the information system’ (p. 78). As articulated by Sia and Soh (2007), surface structure misfits manifest when the system’s interface fails to accommodate users’ desired input or access to information, in alignment with the conceptualisation of usability misfits. Deep structures represent scripts that mirror real-world systems, encompassing ‘entities,’ their ‘ attributes’ and ‘ states,’ and the ‘ transformations’ that modify these states (Wand and Weber, 1990; Weber, 1997). Deep structure misfits transpire due to a dearth or inadequacy of entities and business rules (Sia and Soh, 2007), falling under the purview of functionality and data misfit. Furthermore, Weber introduces a third category, physical structure phenomena, alluding to the manners in which deep and surface structures are superimposed onto the underlying physical technology. However, both Weber and Wand (1990) did not delve into this topic, and it was similarly disregarded by Sia and Soh (2007).

Expanding on this, Strong and Volkoff (2010) presented two types of Org-ES fit constructs that proffer a unique concept, encompassing what they term a latent structure. They build upon Sia and Soh’s (2007) contentions (the severity of misalignment and appropriate resolution) and Weber’s (1997) framework (surface structure, deep structure, and physical structure), defining it as a second-order structure. The latent structure is composed of three misfit elements: roles, control, and organisational culture, which constitute an integral part of the ES.

These elements are presented separately from the other three as they do not conform to the scripting of deep structures but emerge from the interactions of all other scripts combined. Although each misfit in the findings was experienced as an issue within a single misfit domain, its origins can be traced to multiple domains due to the interconnected nature of the ES structures that precipitate these problems. Hence, resolving any specific misfit, particularly if it imposes rather than lacks, is likely to impact more than one of six misfit domains and perhaps more than one of the four ES structures. This research emphasis on the problems encountered by users, rather than the discrepancies between the organisation and the ES, elucidates the latent structures. Focusing on discrepancies tends to conceptualise misfits as deficiencies to be rectified by adjusting the ES or the organisation, leading to a subsequent perception of fit as coverage. This corresponds with Wand and Weber (1990)’s depiction of an IS as a reflection of the world in terms of deep and surface structures and their criteria for the ‘ goodness’ of an IS’s deep structure, centring on the accuracy and completeness of that representation, which resonates with the concept of coverage. The data regarding user problems not only unearths deficiencies but also impositions. These impositions on work conduct necessitate the expansion of the concept of fit to incorporate how the ES enables and restricts the organisation. Therefore, this research must envision the ES not only in terms of its explicitly scripted deep and surface structures, which may or may not be deficient (incomplete or inaccurate), but also in terms of latent structures that emerge from the amalgamation of various scripts which collectively create the inherent ES characteristics that facilitate and limit the design of roles, the exercise of control, and the overall organisational culture.

### 2.5.2 Identification of misfit

The concept of misfit is recurrent in the discourse related to enterprise systems, with seminal contributions from Soh et al., (2000), providing the foundational definition of the term. Misfit, as defined by Soh and colleagues, pertains to the disparities between the system’s offered functionality and the adopting organisation’s requirements (2000, p.47). Their conceptualisation dissects misfit into three constituents: data, functional, and output.

Sia and Soh (2007) have made notable contributions to the dialogue surrounding enterprise system (ES) misfits, with their primary attention devoted to the divergences between ES packages’ functionality and the requirements of organisations, with an emphasis on addressing these misfits through ES configuration. Their position is in line with Strong and Volk off’s (2010) approach, but it specifically underscores the extent and severity of ES misfits.

Four categories of misfits, based on the severity levels, are identified: imposed-deep, imposed-surface, voluntary-deep, and voluntary-surface (Sia and Soh, 2007). They also propose techniques for reconciling these divergences, suggesting that software developers construct information systems based on their unique perspectives, influenced by their specific institutional environments. Recognising that diverse organisations operate within varying institutional contexts; they argue that packages conceived under certain institutional conditions may not align with the needs of other institutions.

Their argument stems from Institutional Theory (Scott, 1987), distinguishing between two structural forms: imposed and voluntary. Voluntary configurations, or misfits, are more readily amendable by adjusting the system, contrasting with imposed configurations which are frequently influenced by external variables such as governmental regulations.

To substantiate their framework, Sia and Soh (2007) use data gleaned from the documented alterations necessitated by the ES, thus allowing them to calculate the total number of recorded misfits. While this methodology facilitates accurate quantification and the computation of percentages, it could potentially instigate bias by only incorporating formally documented alterations.

Their insights extend to potential solutions for divergences. Although they do not explicitly tackle fit issues, they argue that recognising overlapping ES structures when discrepancies are found might indirectly prompt considerations of fit. They suggest that externally enforced and voluntarily adopted structures correspond to the ‘ must-have’ concepts in IS literature.

In their initial research, Sia and Soh (2000) partitioned misfit into three categories: data, function, and output. This model was subsequently extended to include data ownership, data entry, workflow, work scope, reporting, and revenue processing (Soh et al., 2003). Later research delved into strategies for resolving misfit, probing whether deep or surface structure ES resulted in misfit and whether this was attributable to voluntary or externally imposed organisational structures (Soh et al., 2000). Their misalignment assessment framework measures the relative severity of each discrepancy and its associated mechanisms. Essentially, they analyse where misfits transpire, the causes thereof, and then select solutions to address the problem early in the ES implementation process, such as modifying the ES or the organisation.

This definition was revisited and elaborated by Strong and Volkoff (2010), who portrayed misfits as gaps between organisational needs and the information system’s characteristics. This expanded understanding of misfit encompasses six components, namely, data, functionality, usability, control, role, and organisational culture. The evolvement of misfit components from three to six demonstrates an enhanced understanding, encapsulating a more comprehensive view. This view incorporates data and functionality, along with human-computer interaction (usability), governance (control), organisational roles, and culture, reflecting the increasingly intricate role information systems play in contemporary organisations.

In an enterprise system (ES) context, data misfits arise when data characteristics required or stored by the ES lead to data quality issues such as inaccuracy, inconsistency, inaccessibility, lack of timeliness, or inappropriateness for users’ contexts (Strong and Volkoff, 2010, p737). Two data misfit types within enterprise resource planning (ERP) systems are distinguished: input data misfits and output data misfits (Yen et al., 2011). The former encompasses incompatible input data formats, insufficient data visibility, and inaccurate data, whereas the latter comprises incompatible output data formats, poor output quality, and complex interfaces, amongst others.

Similarly, Van Beijsterveld and Van Groenendaal (2016) identified data misfit types and repercussions by analysing ERP implementation cases. Data misfits were found to predominantly stem from incompatible input data at the operational level, leading to the creation of incorrect inputs and intricate reports. At a tactical level, poor visibility of data and a lack of accurate information primarily caused data misfits, potentially resulting in inaccurate or incorrect decisions.

In specific, functionality misfit refers to an existing system’s failure to meet the organisation’s business requirements (Liu et al., 2011; Sia and Soh, 2007; Soh et al., 2000). From an organisation-enterprise system fit viewpoint, Strong and Volkoff (2010) describe functionality misfit as ‘a scenario where the manner in which processes are executed using the ES leads to reduced efficiency or effectiveness compared to pre-ES outcomes’ (p. 737). Functionality misfit may persist until enterprise systems are tailored to user needs, necessitating high levels of functionality (Howcroft and Light, 2010).

Role misfit is another concept, defined by Strong and Volkoff (2010) as an occurrence when roles in the ES create workload imbalances, generate mismatches between responsibility and authority, or are inconsistent with available skills. This notion is further refined in the healthcare context by Mettler (2016), denoting the situations when role misfits emerge due to misalignments between healthcare professionals’ responsibilities, skills, and assigned roles.

Control misfit is another aspect, defined as ‘a situation where the ES’s embedded controls inhibit productivity or fail to facilitate the appropriate assessment or monitoring of performance’ (Strong and Volkoff, 2010, p. 737). This often transpires because users’ needs evolve gradually, and it may take time for the system to be adjusted to meet those needs (Howcroft and Light, 2010). In the telemedicine context, control misfits may occur when the system exercises too much control, hindering productivity, or exerts too little control, preventing accurate assessment or monitoring of the quality of care

# Chapter 3 Methodology

## 3.1 Research context

Health care is an important aspect of a country’s social development. In China, a medical and health service system covering both urban and rural areas has basically been formed, and the ability to prevent and control diseases has been continuously enhanced. The population covered by medical insurance has been gradually expanded, and the level of health science and technology has been rapidly improved, and the people’s health has been significantly improved.

### 3.1.1 The background of Chinese healthcare system

China is a country with a vast population and land area. Given this, the level of its medical treatment has obvious regional differences, especially in the vast rural areas and remote areas. The development of telemedicine in China is necessary and urgent. China began to explore telemedicine in the 1980s. As early as the mid-1980s, the construction of three major telemedicine projects nationwide began various networks. The Ministry of Public Health led the Golden Guard Project (GHN), there was also the IMNC network and the Chinese People’s Liberation Army telemedicine network (Xue and Liang, 2007). With technological innovations, the Chinese government invested funds establish regional telemedicine centres (Zhai et al., 2020; Cui et al.,2020). Each regional centre has the core telemedicine providers who are regional central hospitals that offer high-quality medical services (Cui et al., 2020). This present research target is Zhengzhou University, the first affiliated hospital in Henan province, which is the regional telemedicine centre for that province. They have started to share medical resources with remote rural areas Furthermore, there is provincial telemedicine network construction for the province’s remote rural medical patients which provides high-quality medical service to resolve the problem of insufficient and uneven distribution of high-quality medical resources in the province.

It is clear that the telemedicine system is improving in practice, but the implementation of telemedical applications still contains a lot of immaturity and even more failures. There are still a number of aspects of the telemedicine system that need to be addressed. It is particularly important to consider operating standards, technical standards, laws, and regulations, as well as the cost of the compensation scheme. Several factors can negatively impact the initiative of patients and doctors of all parties to use the telemedicine system, including the protection of patient data privacy, the robustness and security of the transmission of medical image information, and the division of responsibilities in the event of medical accidents. Besides, there must be a lot of information transmission between various medical imaging systems and hardware networks. However, there is still a lack of a standardized interface for data exchange, resulting in communication barriers between equipment networks. As a final note, there are still a lot of management issues in the telemedicine system, including strategic management, operations management, and system evaluation.

### 3.1.2 TCSP structure

There are nine subsystems of the Chinese telemedicine system, according to the Chinese Ministry of Health. Sub-systems include Teleconsultation sub-system, Tele-appointment sub-system, Two-way referral system, Tele-imaging diagnosis sub-system, Tele-cardiology diagnosis sub-system, Tele-medicine education sub-system, High-end telemedicine service sub-system, Tele-surgery demonstration sub-system, and Tele-pathology diagnosis sub-system (Zhai et al., 2020). The purpose of this study is to examine telemedicine consultation systems. Teleconsultation is a process where the applicant applies to the specialist for a teleconsultation and the inviting party accepts the application, conducts the teleconsultation and issues a diagnostic opinion and report.

Graphical user interface, application, Word

Description automatically generated

Figure 2. Telemedicine system Architecture(Resource: Author)

**National level (Front-end and back-end)** The highest tier of medical cloud services for major, national healthcare organisations that support medical supervision, management, and operation. It is in charge of all coordination and management functions. Regional and local level clouds manage national medical cloud operations and applications. They are in charge of communicating with the national level clouds and overseeing regional medical activities. In main medical institutions, resident edge clouds manage data storage and transaction processing. The delivery of real-time services may be done more effectively by permitting local transactions and real-time processing. Moreover, when they fulfil strict processing power requirements, collaborative services provide uploading operations to the regional-level centre. Data will be calculated and processed at the municipal centre.

**Applications and Devices** At this layer is the end user facing elements. The telemedicine consultation service platform has a series of endpoints and mobile application. The Multi-Channel HD immersive equipment provide real-time, high-resolution video images, resulting in a poor in-person experience. The 1080p 60 fps dual-stream dynamic image technology is used at consultation equipment, which is delivering fast, crisp video experiences. Moreover, multi-Channel HD equipment transmits HD-quality, panoramic video streams of medical data and surgery details.

**The Interface** The interface is a middleware to realize the interconnection, information transmission and information sharing between the telemedicine system and the health information platform at all levels.

**Network and Data base Infrastructure** Based on network slice and virtualization technology, it constructs exclusive channels, preferential channels and ordinary channels to adapt to differentiated network demands of medical services and realize medical service support and network operation management. This layer uses 5G medical virtual private network. This core network offers telemedicine system and cloud collaboration service system fast, simple, flexible. 5G medical virtual private network is compatible with 3G, 4G LTE, IOT and other existing network modes.

**Cloud collaboration service system** include the telemedicine consultation system and Consultation schedule system build on the network and compute infrastructure. The telemedicine consultation system connects to medical devices using standard interfaces: composite and component video, Video Graphics Array (VGA), Digital Visual Interface-Integrated (DVI-I), High-Definition Multimedia Interface (HDMI), Serial Digital Interface (SDI), and High-Definition-SDI (HD-SDI). The system supports a maximum of 19 channels for electronic medical records, examination reports, images, and patients’ vital signs. This system also simultaneously displays 4-channel signals to support expert diagnoses. In addition, the telemedicine consultation system provides open, standard interfaces for third parties. This system provides a comprehensive and integrated medical platform, which can connect with different medical information systems based on third party vendors. Cloud collaboration service system is oriented to different levels of medical institutions and B2B medical application scenarios. It enables to process and analyse data in real-time or fast, reduce network traffic, improve security of local data. The multiple levels of edge cloud achieve multi-level medical institutions network collaboration, resource collaboration and service collaboration.

**Data layer**

**1) Image information.** To support the acquisition of patient’s image information from standard DICOM interface imaging devices or PACS systems, storage, reproduction and corresponding post-processing operations. Establish a teleradiology consultation system based on DICOM protocol, B/S architecture and WEB browsing, supporting post-processing, key image labelling and saving of image data, supporting writing and publishing of image consultation reports, and supporting report template functions. Support for real-time interactive operation of medical images (including static and dynamic) by multiple parties during the tele-imaging consultation. Support for remote imaging consultation by remote experts at any location with Internet security authentication. The transmission of image information is based on the DICOM 3.0 WADO specification.

**(2) ECG information.** It supports the acquisition of ECG information from digital ECG machines, and lossless data transmission, storage and reproduction, and the transmission of static ECG data from the primary hospital to the higher-level hospital consultation experts. It supports the interpretation and printing of ECGs by specialists and the writing and publishing of reports. The digital ECG supports the transmission of ECG data via Internet, GPRS, telephone lines, etc. Digital ECG data can be stored in XML, DICOM and other common data formats. Analysis and comparison of different cases and historical data is supported. For digital ECG data stored in XML format, the following is required: ECG data basics: date and time of the ECG recording, unique patient identifier (number), name, gender, year of birth. Digital storage: All ECGs should be recorded and stored in digital form, and the data should contain four parts: equipment information area, patient information area, measurement data area and waveform data area (waveform data and composite waveform data). Sampling rate: The sampling rate of the ECG machine should meet the adult ECG sampling rate of not less than 500 hz. Acquisition length: The recommended standard for lead synchronous ECG recording is not less than 10 s. Data leads: The ECG recording should include at least the conventional leads. The correct lead electrode position should be ensured, and ECGs of acceptable quality (low noise, no baseline drift) should be acquired. Digital transmission: The ECG machine must have communication capabilities. ECG data should be transmitted in a manner such as. Compression techniques should ensure that the original ECG signal can be accurately reproduced. Data format: ECG data should be stored and transmitted in a common XML plaintext format, with the file containing four sections of data: device information, patient information, measurement data and waveform data (waveform data and composite waveform data).

**(3) Pathology information material**. Digital scanning technology is used to convert pathology sections into digital sections in JPEG, JPEG 2000, or 56 DICOM format. The fully automatic microscope for pathology sections must comply with national regulations for medical devices. Support for scaling of virtual digital sections, marking and saving of key images, writing and publishing of pathology graphic reports. Pathology section scanning, patient information upload, expert consultation and report download are all operated and managed on the remote pathology consultation platform. In the process of remote pathology diagnosis, if digital pathology slides in JPEG and JPEG2000 formats are used, the following specifications should be followed: Image acquisition: traditional glass slides are scanned and seamlessly stitched together to produce a digital slice with a full field of view, with a clear image acquisition, eliminating blurring, jaggedness, misalignment and other phenomena; intelligent skipping of blank areas and scanning of tissue areas only. ROI image acquisition: on the low magnification full field of view scanned image, the image is scanned with a low magnification, and the image is scanned with a low magnification. The ROI image acquisition system can be used to select multiple areas of interest on the low magnification full field of view scans to generate ROI images with less storage space for easy storage, transmission and communication. For detailed functional specifications of the Remote Pathology Diagnostic and Quality Control System, please refer to the Functional Specifications of the Remote Pathology Diagnostic and Quality Control System. Digital Imaging and Communications in Medicine (DICOM) Supplement 122: Specimen Module and Revised Pathology SOPs are used in the DICOM format for remote pathology diagnostics. Classes’.

**(4) Standardization of physical data.** Scanners convert physical data into digital form, including lab sheets, graphic reports, and patient medical records on film and paper. The system enables the reading, transferring, and storing of scanned documents. The system enables the manual input of medical records as well as the transmission, storage, and viewing of ad hoc materials. It is advised that the film be converted into a DICOM image file and processed using a medical scanner. A typical flatbed scanner is used to process paper data, and the scanned files are stored in JPEG format.

### 3.1.3 Defining the telemedicine key roles and workflow

Any successful telemedicine deployment is coordination outcome of three basic elements people, process and technology. The technology stuffs have been discussed at the system architecture part. The process and people will be discussed at this section. The workflow could be judged true right and wrong because each organization has their special background and features. This workflow is based on the service-oriented model. Teleconsultation is a process whereby an expert from a higher-level hospital and the doctor in charge of the patient at the primary hospital discuss the patient’s condition together through remote technology to further improve and formulate a more targeted treatment plan. Relying on the teleconsultation platform, small illnesses can be resolved in the community, while difficult and acute illnesses can receive services from specialists through the teleconsultation system and, if necessary, teleconsultation can be conducted again to truly achieve the purpose of resource sharing.

图示

描述已自动生成

Figure 3. Telemedicine key roles and inter-organizational structure(Source: Author)

#### 3.1.3.1 Defining the telemedicine key roles

The platform director is a person who supervises and manages the telemedicine services provided through the platform by the telemedicine service and resource supervision centres.

There are two specific roles for administrative staff: triage staff and consultant assistants. The Triage staff needs to strictly review the application form of remote consultation and supervise the application form filled in a standardized way. In addition, the medical record information of the consultation patients is checked by the triage consultant. Furthermore, the purpose of preliminary diagnosis and consultation should be consistent with the applied departments. The triage consultant verifies those two-information match.

The Consultant assistant is mainly responsible for daily management of telemedicine services and the coordination of work among various partners through the system, developing service resources and time agreements, providing timely feedback to telemedicine business implementers, and ensuring that telemedicine services are delivered on time.

IT Support should perform unified operation and maintenance on the telemedicine server, data centre, infrastructure, and IT equipment to ensure that the telemedicine information system is operating reliably and efficiently.

Healthcare Consultants /regional and local doctor refers to medical institutions, departments, medical staff of all levels and types that conduct telemedicine operations medical staff. Telemedicine can be categorized into two categories, response and application.

a) Reginal and local doctor (Application users): Users who are responsible for submitting telemedicine applications, preparing telemedicine related information, participating in the telemedicine process and receiving reports on the telemedicine results.

b) Healthcare Consultants (Invited user): Users who receive telemedicine invitations, review telemedicine applications, provide consultants and consultation times, and provide telemedicine services such as diagnostic and treatment advice.

#### 3.1.3.2 Telemedicine consultation service platform workflow

Diagram

Description automatically generated

Figure 4. Telemedicine workflow (Flow chart of telemedicine service requirements in Henan Province)

**Step 1: Consultation appointment**

For telemedicine consultations, the TCSP Receiver must apply through the telemedicine consultation service platform to the TCSP Provider. There are several components to the telemedicine consultation application form, including the reason for the consultation, the purpose, the time schedule, the patient’s relevant medical history, and the qualifications of the physician.

**Step 2: Consultation scheduling**

Upon receiving the consultation request, the Telemedicine consultation service platform stores it in the data centre, along with the patient’s electronic medical record. The triage staff of the TCSP Provider logs into the system to view the consultation request for which a consultation is needed. TCSP Provider’s triage staff arranges consultations according to the requestor’s request for a consultation specialist or according to the disease characteristics that warrant a healthcare consultant.

**Step 3: Consultation preparation**

After the consultation has been scheduled, both doctors will receive a text message confirming the approval of the consultation request. Administrative staff from regional and local offices encourage consultation applicants to prepare pertinent test results and information about the patient’s condition. The remote consultation will be conducted at a time and place to be arranged between both consulting parties on the day of the consultation. Regional and local administrative staff will open the patient’s medical records and relevant electronic data and inform the applicant physician again of the consultation schedule and prepare for the appointment. 15 minutes before the meeting, both administrative staff will verify the equipment is working.

**Step4: Online consultation**

As part of the interactive consultation, only the healthcare consultant and regional and local doctor the patient needs to open their patient’s records and conduct video conversations with the patient; the TCSP Provider provides telemedicine services in accordance with the requirements of relevant laws, regulations and treatment norms, informs the inviting party of the treatment opinions in a timely manner, and issues a treatment opinion report signed by the appropriate physicians. A diagnosis and treatment plan are determined by the TCSP Receiver based on the patient’s clinical data and the TCSP Provider’s opinion regarding the diagnosis and treatment. During the consultation, the healthcare consultant can control the regional and local doctor’s camera remotely and perform panning and zooming operations.

**Step 5: Consultation record and report**

It is the responsibility of the TCSP Provider and TCSP Receiver to work together to complete the medical records in compliance with the rules and regulations governing medical records. Neither the inviting party nor the inviting party will keep paper copies of case information and diagnostic recommendations in the same file. It is possible to send telemedicine-related documents by fax, scanned documents, and electronic documents with electronic signatures.

## 3.2 Research Philosophy

Saunders et al., (2007) posit that research philosophy forms the initial layer of the research ‘onion’, encompassing all its core elements. This study is underpinned by the philosophical framework of interpretivism, which purports that reality is the product of how individuals interpret specific events and circumstances. The ontological premise of interpretivism suggests that reality is subjectively constructed by the human mind rather than objectively existing in an unchangeable form (Oliver, 2012). Such a standpoint can be observed in various domains, including the classification of biological species and the categorisation of different types of socioeconomic systems.

Interpretivism’s epistemology asserts that comprehending the complexities of the world is best accomplished by understanding the perceptions of its inhabitants. Consequently, researchers are urged to immerse themselves in this reality to comprehend, elucidate, and reconstitute these ideas using scientific methods and terminology. Research methods such as interviews and participant observation exemplify this approach (Lopez and Willis 2004).

Within the interpretivist paradigm, the complexities of the world cannot easily be converted into highly structured data. It perceives the human being as a complex entity with varied cognitive perspectives within a convoluted world. Certain patterns between the thoughts and behaviours of a population can be discerned using standardised statistical methods (Easterby-Smith et al., 2015). However, the analysis of these statistics is influenced by the personal factors of the researcher, implying that conclusions may not always be drawn with absolute certainty.

Ontology, from an interpretivist perspective, tends to uphold a social constructionist view of reality. This view purports that reality is not objectively existing in the external world but is generated through the interaction between individuals and society, as well as the construction of subjective meanings ((Easterby-Smith et al., 2015). It suggests that reality is formed based on individuals’ and society’s concepts, interpretations, and cultural backgrounds. As such, interpretivism emphasises the subjectivity and relativity of reality (Saunders et al., 2007). Social constructivists argue that understanding of the world is constructed through language, symbols, and social consensus, leading to the conclusion that reality is not an unchanging objective fact but is influenced by social collective meanings and social norms (Saunders et al., 2007).

When studying the Organisation-Enterprise System (ORG-ES) fit, a longitudinal case study approach is deemed appropriate as it facilitates the direct emergence of theoretical concepts. The phenomena under investigation must be considered in their context, that is, within the inter-organisation and its novel function of the telemedicine system. This study examined the telemedicine consultation system in Henan Province, China, over three years. The Henan telemedicine system underwent its first upgrade since inception during this period. This research cross-referenced the interview data with the system upgrade logs to identify ‘misfits’ before and after the upgrade, which allowed us to identify persistent issues as well as those that emerged over time. The upgrade logs further provided a partial solution to the telemedicine misfits.

## 3.3 Research approach

Research approach is a strategy that encompasses steps from broad hypotheses to specific methods for data collection, analysis, and interpretation (Ghauri et al., 2020). There are two fundamental approaches in data analysis: deductive and inductive methods. Both approaches cater to different types of research problems (Ghauri et al., 2020). Deductive method applies to quantitative data, whereas qualitative data analysis necessitates an inductive approach. In this research, theory is generated through the inductive approach, encompassing data collection and data analysis findings. Hermeneutics underpins induction. A smaller sample size is more suitable for studies using induction due to their intense focus on the context of events.

During research, if a researcher uses a deductive approach, it means they have developed hypotheses that need to be confirmed or rejected (Ghauri et al., 2020; Toloie-Eshlaghy et al. 2011). The deductive approach applies hypotheses that are evaluated during the research process, generalising from the general to the specific (Ghauri et al., 2020; Toloie-Eshlaghy et al., 2011). Critics, often proponents of induction, argue that deductive methods frequently lack a structure allowing an alternative interpretation of the research’s occurrences (Bell et al., 2022). In this sense, even though the deductive process reaches a definitive conclusion on theory selection and hypothesis definition, alternative theories may still be proposed. However, a structured research design may limit these.

The inductive approach targets a deep understanding of events and a comprehensive comprehension of the research context (Bell et al., 2022). It is used for qualitative data collection, allowing for alterations in research focus as the research progresses. Reality researchers participate in the research process in this approach, benefitting from its flexible structure (Bell et al., 2022).

Conversely, the inductive approach engages with the research without pre-set hypotheses, not aiming to evaluate them. It seeks to develop a theory or identify a pattern of meaning on the basis of the data. Inductive researchers begin with clear research questions, refined during the research process. They might be guided by a theoretical lens, which provides a framework for their investigation. The inductive approach, often referred to as a bottom-up method, generalises from specific to general (Jebreen, 2012). Based on the choice of an inductive approach (Gioia et al., 2012), this study aims to gain a deeper understanding of a particular phenomenon.

Earlier studies have examined misfits within a single organizational structure from three roles’ perspectives (Strong and Volkoff, 2010, Sia and Soh, 2007). In contrast, this study explores misfits and solutions in telemedicine systems from the perspectives of five key roles within an inter-organizational context, drawing on the ES-Org fit theoretical framework. This approach aims to achieve a deeper understanding of misfits and solutions. Furthermore, the inductive approach allows the researcher to scrutinise data collection from multiple perspectives (five key roles) and refine existing theoretical frameworks.

## 3.4 Research design

In line with the research onion model outlined by Saunders et al., (2018), this part delves deeper into the next three layers: research strategies, methodological choice, and time horizon. These three layers can be considered a survey of the research design process. The research design serves as a blueprint guiding researchers on how to address the research question (Sanders et al., 2019). A comprehensive research design incorporates the following elements: A clear purpose that addresses the research question. An extensive description of data sources that the researcher plans to collect. A consideration of the inevitable constraints such as access to data, time, location, funding, and ethical considerations.

Researchers should provide solid reasons for their decisions regarding the research design. One crucial question to answer in a research design is: Why did you choose this specific research design? Why did you select this particular research subject? These reasons should directly relate to your research questions and objectives and must align with your research philosophy.

In the context of this study, these questions can be further extended to ask: Why was Henan Province Telemedicine Centre chosen as the research site? How will data be collected? How long will the data collection process take? Is this telemedicine centre a unique case or representative of a broader phenomenon? These considerations will ensure that the research design is comprehensive, logical, and methodologically sound. It is also important to reflect on these questions throughout the research process, to ensure that the methodology remains appropriate and that the research objectives are being adequately addressed.

### 3.4.1 Research strategy

Undertaking an in-depth examination of a social phenomenon within its environmental context is feasible through the utilisation of case study research (Bryman, 2016). The conditions under which case study research is appropriate have been significantly elucidated. Researchers using case studies typically comprehend or elucidate the ‘ what’ and ‘ how’ of social contexts (Yin, 2009). As case studies are recognised for their potential to transcend the limitations of quantitative methodologies, offering comprehensive and profound explanations of social, individual, and communal matters, they have garnered increasing interest among social scientists (Bryman, 2016).

Case studies are frequently employed for theory development or the inductive exploration of hitherto unexplored phenomena. Nonetheless, deductive theory testing via analytical generalisation has also been advocated, particularly by Yin (2013). Ketokivi and Choi (2014) champion a third variant of case study, arguing for their legitimate use in elaborating theories. This type of case study equally utilises both induction and deduction. The duality criterion, as referred to by the two authors, is an indispensable factor applicable to all three types of case studies. Consequently, while each case study scenario is distinct, empirical analysis must invariably be accompanied by a broader theoretical examination. The goal of the case study should dictate the establishment of a distinct research strategy.

Undoubtedly, case studies offer distinct advantages when delving into the investigation of complex phenomena within their natural contexts (Yin, 2013). This research methodology demonstrates its exceptional utility when addressing research issues deeply rooted in a particular environment, where the phenomenon under examination and its context are inextricably interwoven. Case studies enable an exhaustive exploration of intricate systems and phenomena. Case studies are notably well-suited for interrogating ‘how’ and ‘why’ questions and are adept at revealing the underlying dynamics and processes at play. Given their grounding in real-world situations, case studies can generate valuable insights that are not only meaningful but also bear a high degree of applicability to analogous circumstances and environments.

A significant strength of the case study approach lies in its capacity to generate rich qualitative data. Employing methods such as interviews, observations, and document analysis, case studies can deliver a nuanced understanding of the context and the interplay of various factors within it. Furthermore, case studies are compatible with longitudinal research, wherein the same case or cases are observed over an extended period. This facilitates tracking changes and developments over time, thereby providing insights into the dynamics and evolution of the phenomenon under scrutiny. This is particularly beneficial when studying processes, relationships, and alterations within a system.

In the context of this study, adopting a case study design to examine misfits and their resolution within the telemedicine system enables a profound understanding of the complex interactions between various system elements and how these interactions metamorphose over time. This could not only augment the comprehension of the issue but also inform practical strategies and solutions for addressing similar challenges in the future.

### 3.4.2 Research methodological choice

Numerous quantitative and qualitative analytic techniques have been developed by researchers to examine issues as precisely and comprehensively as possible (Bell et al., 2022). Each analytical strategy harbours its limitations, such as the depth of objective data collection or the accuracy of subjective evaluations. These limitations will inevitably impact the validity and reliability of the study. The triangulation method serves as an effective tool for addressing issues unreachable through a single approach. By applying triangulation, a researcher can attain a comprehensive perspective on a subject, thus enhancing the depth and breadth of their research (Sekaran and Bougie, 2016).

The research question underpinning this study aimed to comprehend the mismatches and potential solutions that manifest when implementing computer systems in a cross-organisational context. Participant observation was employed as the initial step in the data collection process to address this question. This was succeeded by focus group interviews, which served as a follow-up to the preceding semi-structured interviews. A comparison between focus groups and individual interviews is warranted as both methodologies are qualitative in nature. Archival data in this study offset the longitudinal temporal limitation of the interviews, enabling examination of misfit-style telemedicine systems and their solutions from inception to the present. Historical data could facilitate the identification of early misfit telemedicine systems, and interviewees could validate the existence of these misfits and provide insights into how they were addressed in the past.

Composite Triangulation was applied in this in-depth case study (Adams et al., 2014). This study implemented data triangulation and within-method triangulation for data collection. Data triangulation, which involves gathering data from multiple sources, enables a more comprehensive representation of the research subject.

Three more nuanced forms of triangulation include time, space, and people (Adams et al., 2014). Time triangulation involves data collection at different points in time, suggesting that time is a variable affecting the change of the measured object, presenting different states at varying time points. This study analysed three years’ worth of data, using multiple interviews and system logs to track issues and solutions in the telemedicine system. Place triangulation requires data collection from the same object at two or more locations to detect multisite aggregation and facilitate cross-validation (Bougieand and Sekaran, 2019). In this study, the third-level telemedicine centre was selected as the interview site, and the telemedicine system was examined for misfits at different organisational levels. Person triangulation involves data collection from varied sizes of people compositions – individuals, groups (such as couples, families, or teams), and communities (like businesses and organisations) (Bougieand and Sekaran, 2019). Data collection for this study comprised one-on-one interviews and focus groups (consisting of 5 to 12 participants).

This study employed within-method triangulation, specifically, the qualitative method combined more than two of the same type of approach to measure the same variable. Participant observation and archival data analysis preceded the interviews. Information gleaned from these two methods guided the conduction of the interviews. Archival data provided static and historical information that researchers could utilise to examine the depth of interviewees’ knowledge. Participant observation offered dynamic and real-time information for the semi-structured interviews.

Triangulation is a robust research method involving the application of various forms of investigation. Adams et al., (2014) identified three refined forms: time, space, and person triangulation. Time triangulation involves data collection at disparate time points, underscoring time as a variable influencing the evolution of the studied phenomenon. This results in the phenomenon manifesting differently at various time intervals. This study analyses three years of data, utilising multiple interviews and system logs to monitor problems and solutions associated with the telemedicine system over this period.

Space triangulation entails collecting data from the same object at two or more locations to identify multisite patterns and facilitate cross-validation (Bougieand and Sekaran, 2019). In this study, the third-level telemedicine centre was selected as the research setting, allowing the investigation of telemedicine system use and misfits at different organisational levels.

Person triangulation involves gathering data from different groups of varying sizes -- individuals, small groups (e.g., couples, families, or teams), and larger communities (e.g., businesses or organisations) (Bougieand and Sekaran, 2019). Data collection in this study incorporated one-on-one interviews and focus groups (comprising between 5 to 12 participants).

The study also employed within-method triangulation, which integrates more than two techniques of the same type to measure the same variable. In this case, the qualitative approach combined participant observation and archival data analysis, both of which preceded the interviews. These methods provided a basis for the interviews: archival data offered static and historical information, which researchers used to gauge the depth of interviewees’ knowledge, while participant observation furnished dynamic and real-time data for the semi-structured interviews. This combination of techniques enhances the comprehensive understanding and interpretation of the phenomena under study.

The study’s duration is a crucial consideration in the research plan, helping researchers determine whether they aim to capture a snapshot of a specific time frame or document a continuous period, akin to maintaining a diary. Snapshots encompass studies of certain phenomena within a defined, cross-sectional period. The majority of research endeavours are bound by such temporal constraints. In contrast, diary-like studies capture changes and developments over time, providing a vertical perspective of the research subject (Gournelos et al., 2019). Assuming the process itself does not induce change, the subjects or phenomena observed will naturally evolve over time, allowing researchers to monitor variable alterations. A pivotal question in longitudinal studies is whether and how the subject has evolved over time?

In this investigation, this research employed a longitudinal approach, collecting and analysing data over a three-year span. This research tracked misfits and corresponding resolutions in telemedicine systems from the system level to the inter-organisational level. Through a case study, this research presents the system’s evolution from its inception to maturity, providing a detailed chronicle of its development over time. This approach offers a richer understanding of the longitudinal trends and patterns in the operation of the telemedicine systems, illuminating how challenges are addressed and adaptations occur over time.

图片包含 日程表

描述已自动生成

Figure 5: Longitudinal data collection timeline (Source: Author)

## 3.5 Data collection

In this investigation, this research utilised five sources for data collection, namely participant observation, semi-structured interviews, focus group interviews, archival data, and system log data. The multiplicity of these sources facilitated data triangulation, engendering the necessary data to address this research objective. This study adopted a sampling approach rooted in two crucial principles: 1) Representativeness, and 2) Saturation (Saunders et al., 2018). These principles guide the selection process, ensuring a comprehensive understanding of the research phenomenon and the generation of meaningful and robust findings.

Given the unique character of this research, it was primarily interested in scrutinising the complexities and interplays within an inter-organisational environment where a telemedicine platform is in operation. The primary aim was to gather in-depth insights into the roles of key actors, including the platform director, administrative personnel (such as triage staff and consultation assistants), IT supporters, and healthcare consultants. These consultants encompass provincial, regional, and local physicians (Table1). These roles symbolise the crucial stakeholders engaged in the administration and upkeep of the telemedicine platform.

The focus on representative sampling is integral to ensuring that this study faithfully reflects the reality of the demographic under investigation. In this specific scenario, the demographic of interest encompasses the primary stakeholders engaged in the functioning of the telemedicine platform. This study meticulously curated the chosen representative sample to incorporate individuals from each role, thereby accurately reflecting the dynamic operation of the platform (Saunders et al., 2018). This design approach ensures a comprehensive understanding of the varying perspectives within the platform’s ecosystem, thus enriching the validity and reliability of the research findings.

The role of the Platform Director is integral to this study, primarily due to their responsibility for providing overarching direction and governance for the platform, thereby representing the strategic decision-making process. The Triage Staff and Consultant Assistants, as the first line of engagement, manage the lion’s share of day-to-day operations, thereby possessing invaluable practical insights about the platform’s functionality. IT Support personnel underpin the successful operation of the telemedicine platform by ensuring the efficient and effective function of the technical aspects, and consequently, are pivotal to the operation. Finally, the Healthcare Consultants, along with Regional and Local Doctors, provide the necessary medical expertise and user experience, making their role vital for a comprehensive understanding of the platform’s operation . The concept of saturation refers to the juncture in data collection where accruing additional data fails to yield further insights into the research inquiries (Charmaz, 2006). In the context of this study, saturation was attained when subsequent interviews with additional platform directors, administrative staff, IT support, and healthcare consultants/regional and local doctors ceased to provide novel comprehensions about the inter-organisational dynamics of the telemedicine platform.

Saturation was achieved in distinct phases for each role. For example, following a series of interviews with Platform Directors, a point was reached where no additional themes were emerging, signalling that this research had achieved saturation for this particular role. A similar pattern was observed for the Triage Staff, Consultant Assistants, IT Support, and Healthcare Consultants/Regional and Local Doctors. This multi-level approach to saturation ensured that the dataset was both rich and comprehensive, spanning all roles involved in the operation of the telemedicine platform.

By centring the attention on representativeness and saturation, this research succeeded in gathering a diverse and comprehensive dataset, thereby enabling the generation of a holistic understanding of the dynamics within inter-organisational telemedicine platforms.

Table 1. Summary of data source

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Source** | **Quantity** | | | **Role in analysis** |
| Semi-structure Interview | National- level | Regional - level | Local level | Identify misfits and resolutions. |
| 5 hospitals | 1hospital | 3 hospitals |
| Focus group | 1 hospital | 1 hospital | 1 hospital |
| Participant observation | 6 working days (48hours)  Participant observation log (50pages) | | | Understand The workflows of key roles within telemedicine consultation service platforms and how the platform operates during consultations and scheduling. |
| Log data | TCSP upgrade | Requirements log list (143 customer requirements) (Created on December 15, 2020; List updated on June 5, 2021)  The telemedicine consultation platform feedback problem schedule (August 26, 2021)  The telemedicine consultation system pending requirement confirmation form (November 26, 2021)  The telemedicine consultation system pending requirement confirmation form (December 30, 2021) | | Identify misfits and resolutions. |
| Archival data | Report | China Hospital Telemedicine Services Effectiveness Survey and Analysis Report (Nov 2019)/ (55 pages) | | Identify misfits. |
| National documents | The Guidelines of Telemedicine Service Management (17 July 2018) (2 pages) | | Identify telemedicine service standards, workflow. |
| Health Industry Standard of the People’s Republic of China | 1. WS/T 529—2016 Basic functions specification of telemedicine information system (25 pages) 2. WS 539—2017 Basic dataset of telemedicine service (12 pages) 3. WS/T 545—2017 Technical specification for telemedicine information system (19 pages) 4. WS/T 546—2017 Interactive specification of telemedicine information systems and unified communications platform (30 pages) | | Identify the telemedicine consultation service platform structure, database. |
| Province documents | Guidelines for the conduct of telemedicine sub-centre consultation administrators (2018) (1 pages)  Flow chart of telemedicine service requirements in Henan Province (15 pages) | | Identify telemedicine service standards. |

### 3.5.1 Participant observation

The current study utilises participant observation as a key research method, emphasising the pursuit of understanding the underpinning meanings of people’s behaviours, a strategy strongly recommended by Saunders et al., (2007). This involves immersing the researcher in various social contexts to unearth the root causes of observable phenomena (Gill and Johnson, 2002). A more intricate level of involvement may see the researcher thoroughly integrating into the lives and activities of the participants, becoming a part of their team or community, facilitating not only observation but also the communication of experiential understanding (Delbridge and Kirkpatrick, 1994).

Participant observation offers the researcher a unique vantage point to discern subtle nuances in participant behaviours. As the researcher immerses themselves in the research environment, sharing in the lives of the participants, a deeper appreciation of the symbolic world of the subjects is gleaned (Delbridge and Kirkpatrick, 1994). This level of immersion contrasts with structured observation, which traditionally prioritises quantifiable frequency measures of people’s behaviours. In the latter approach, subtleties in participant responses and the contexts influencing them may be overlooked (McClurg, 2006). Participant observation, therefore, offers a rich complementarity to other research methods, enriching the research data and serving as a font of inspiration for further researcher reflection (Kawulich, 2005).

The research question underpinning this study sought to understand the mismatches and potential solutions that arise when employing computer systems in a cross-organisational context. To address this question, participant observation was employed as the initial step in the data collection process. The primary rationale for this approach was to gain intricate insight into the organisational inner workings of the Henan Telemedicine Centre, thereby facilitating the identification of mismatches that occurred when deploying the computer system across the organisation. This observational method rendered a comprehensive understanding of the inter-organisational coordination in the realm of telemedicine and familiarised the researcher with the primary telemedicine system procedures (Whitten and Adams, 2008).

A secondary benefit of participant observation in this study was the facilitation of deeper interview questions and the classification and interpretation of interview results (Maxwell, 2012). Through observation and personal experience, the researcher gained in-depth knowledge of the working environment at the Henan Telemedicine Centre, the daily tasks of the support team and specialists, frequent challenges they encountered, and the major processes connecting the different organisations. This knowledge, gained as part of an internship, informed the development of subsequent interviews, enhancing researcher credibility and prompting interviewees to provide more detailed responses (Murchison, 2010).

Finally, participant observation allowed for the establishment of trustworthy relationships with participants and provided a unique perspective on the experiences of individuals within the telemedicine system (Kusenbach, 2003). This comprehensive understanding of the telemedicine service will contribute significantly to the analysis and findings of this study. In this study, full participant observation was conducted at the Henan Province Telemedicine Centre and produced 50-pages fieldnotes. Field observations were conducted as interns at the Henan Province Telemedicine Centre for a period of six days a week (the telemedicine centre’s working days were Monday to Saturday). During this activity, the work hours of the Henan Telemedicine Centre (8: 00a.m-9: 00p.m) are synchronised with the start and end of the working day of the staff, and three main positions are performed to practice accompanying triage and technology. This three-position duty is an important part of the smooth running of the telemedicine service. 8:00am-8:30am Print and make sure the consultation equipment and network are running smoothly for all cases that need to be consulted today. The teleconsultation usually starts at 8:30am and ends at 3:30pm. During this time, I work with the chaperone to ensure that the hospital chaperone who requested the consultation collaborates to ensure that the consultation starts on time and that other consultation units are alerted to delays. Assist the specialist in switching between consultation units during the consultation. At the end of the consultation, the specialist’s handwritten consultation report form (mainly including the specialist’s diagnosis and treatment recommendations) is entered and saved. 3:30-5:30, I go into triage. The work includes reviewing the applicant’s case, contacting the corresponding specialist and setting up a time. After a short break, from 6:00-9:00, I work with the technical staff to check the hardware, software and network used by the teleconsultation clinic and review the back-office error log. Subsequent to the commencement of office hours at 9:00, I meticulously organised and systematically categorised the accumulated observational data from the day's proceedings. The primary impetus for this approach was to secure the preservation of invaluable information and to prevent any inadvertent memory lapses of crucial data. By taking these steps, I ensure that no key insights gleaned from the telemedicine management field are inadvertently omitted or forgotten. (Delbridge and Kirkpatrick, 1994). The observational logs, integral to the study, encompassed two primary data categories. The first category comprised my direct observations as the primary investigator. These observations detailed the behavioural patterns and job-related activities of the four core role-holders in their professional capacity. It encapsulated their general work demeanour, their responses to encountered issues, their individual and collaborative problem-solving strategies, as well as their modes of communication. This included both intra-organisational interactions and inter-organisational communication.

The second data category encapsulated conversational exchanges during my tenure as an intern at the telemedicine centre. These dialogues, framed as informal 'interviews', were conducted with the staff members of the telemedicine centre, providing rich contextual and experiential data for analysis. These insights gained during my interactions enhanced my understanding of the telemedicine environment, the challenges faced, and the overall functioning of the organisation.

### 3.5.2 Triangulation Interview

Between December 2019 and December 2022, this research undertook qualitative interviews to gather data from the quintuple-layered structure of telemedicine systems within a specified province. This five-tier system reflects the Chinese administrative hierarchy, encompassing the province, city, county, township, and village levels. It is noteworthy to mention that the township and village tiers are presently equipped with a rudimentary video communication system and lack full incorporation of critical roles and the complete telemedicine process. This research elected participants from the province, city, and county tiers.

The research deployed a mixed-methods approach, also referred to as triangulation, combining structured, semi-structured, and open-ended interview techniques, to facilitate a more comprehensive exploration of the topic (Creswell, 2014). Capitalising on the advantages of structured interviews, a standard set of queries allowed for quantitative data collection, such as quantifying satisfaction levels on a scale of 1 to 10, thereby generating data susceptible to statistical analysis (Bryman, 2016).

Additionally, semi-structured interviews were utilised. These provided a delicate balance between pre-set questions and the elasticity to delve deeper into the respondents’ narratives, engendering a conversational flow and subsequently unveiling nuanced insights (Drever, 1995). For example, respondents were asked to elaborate on their experiences using our product.

Lastly, the inclusion of open-ended questions within the interview structure offered respondents the liberty to express their perceptions and ideas freely, thereby enriching the qualitative data collection (Fontana and Frey, 2000). Such questions, for instance, could invite suggestions for product improvements.

Thus, this triangulated interviewing methodology optimised the gathering and interpretation of both quantitative and qualitative data. This approach culminated in an extensive and comprehensive understanding of the research domain (Denzin, 2017).

Furthermore, this research examined pertinent archival documents and participant observation notes, which significantly influenced the formation and framing of the interview questions. These questions were organised into distinct sections according to the research objectives, with each section initiating with broader queries and gradually narrowing down to more specific ones. This approach was designed to create a conducive environment for the participants and encourage them to share their insights. The structured interview questions are expounded in Table 3 and Table 4. Moreover, this research crafted probing questions tailored to individual interviewees’ responses, prompting them with requests like, ‘ Could you kindly provide an example or elaborate on the details?’

The interviews were orchestrated in two rounds to align with the research goal of discerning potential inconsistencies and suggesting remedies within the inter-organizational telemedicine system. The initial round of data collection, from December 2019 to January 2021, comprised 52 semi-structured interviews (Table 2) aimed at identifying potential misfits. The second round, extending from February 2021 to December 2022, consisted of 10 semi-structured interviews with platform managers and technicians, intended to unearth potential solutions.

The interviewees embodied the core roles and responsibilities within the telemedicine service, encapsulating the triage consultation officer, the coordinator officer, the doctor, the IT staff, and the manager. These roles conformed to the specifications for telemedicine service as prescribed by the Chinese government in 2018, with each role uncovering various mismatch content from different aspects of the telemedicine service.

Each interview began with a review of the Information Consent Form (Appendix 2), wherein this research addressed any queries or doubts about the research. Following the provision of comprehensive information, interviewees were requested to sign the consent form (Appendix 2). Each interview, conducted within the telemedicine centres, ranged from 40 minutes to an hour. For the sake of accuracy, interviews were digitally recorded and supplemented by contemporaneous field notes. Subsequent transcription of these recordings facilitated further analysis.

Table 2. Interview summary

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Hospital level** | **Healthcare consultant (HC)** | **Admin staffs (AS)** | **IT support (IT)** | **Managers (M)** | **Department/Job title** | **Interview method (duration)** |
| PH-1 | 3 | 3 | 3 | 1 | Respiratory medicine: Chief Physician [HC] | Face-to-face (55 mins) |
| Neurosurgery: Associate chief physician [HC] | Face-to-face (65 mins) |
| Tumour: Associate chief physician [HC] | Face-to-face (63 mins) |
| Senior admin staff [AS] | Face-to-face (60 mins) |
| General admin staff [AS] | Face-to-face (55 mins) |
| General admin staff [AS] | Face-to-face (53 mins) |
| Senior IT support staffs [IT] | Face-to-face (60 mins) |
| Hardware IT support staffs [IT] | Face-to-face (60 mins) |
| Software IT support staffs [IT] | Face-to-face (56 mins) |
| Online (275 mins) |
| Centre Director [M] | Face-to-face(96mins) |
| Online (200 mins) |
| PH-2 | 2 | 1 | 1 | 1 | Internal: Chief Physician [HC] | Face-to face (55 mins) |
| Associate chief physician [HC] | Face-to face (54 mins) |
| General admin staff [AS] | Face-to face (60 mins) |
| IT support staffs [IT] | Face-to face (70mins) |
| Vice President[M] | Face-to face (60 mins) |
| PH-3 | 1 | 1 | 1 | 1 | Children Respiratory: Chief Physician [HC] | Face-to face(65mins) |
| General admin staff [AS] | Face-to face (58mins) |
| IT support staffs [IT] | Face-to face (64 mins) |
| Deputy director[M] | Face-to face (67mins) |
| PH-4 | 1 | 1 | 1 | 1 | Rehabilitation: Associate chief physician [HC] | Face-to face (70 mins) |
| General admin staff [AS] | Face-to face (54 mins) |
| IT support staffs [IT] | Face-to face (59 mins) |
| Deputy director[M] | Face-to face (56 mins) |
| PH-5 | 1 | 1 | 2 | 1 | Obstetrics and gynaecology: Chief physician [HC] | Face-to face (54 mins) |
| General admin staff [AS] | Face-to face (50 mins) |
| IT support staffs [IT] | Face-to face (53mins) |
| IT support staffs [IT] | Face-to face (52 mins) |
| Vice President[M]  Deputy director[M] | Face-to face (50 mins) |
| PH-6 | 1 | 2 | 2 | 1 | Infectious diseases: Chief physician [HC] | Face-to face (59 mins) |
| General admin staff [AS] | Face-to face (55 mins) |
| General admin staff [AS] | Face-to face (58 mins) |
| IT support staffs [IT] | Face-to face (60mins) |
| IT support staffs [IT] | Face-to face (51 mins) |
| Deputy director[M] | Face-to face (53 mins) |
| City-1 | 3 | 3 | 2 | 1 | Thoracic surgery | Face-to face (57 mins) |
| Urology | Face-to face (63mins) |
| General surgery | Face-to face (64 mins) |
| General admin staff [AS] | Face-to face (55 mins) |
| General admin staff [AS] | Face-to face (58 mins) |
| General admin staff [AS] | Face-to face (60 mins) |
| IT support staffs [IT] | Face-to face (65mins) |
| IT support staffs [IT] | Face-to face (50 mins) |
| Vice President[M] | Face-to face (51mins) |
| City-2 | 2 | 2 | 1 | 1 | Internal medicine | Online (63 mins) |
| Hepatobiliary surgery: | Online (63 mins) |
| General admin staff [AS] | Online (55 mins) |
| General admin staff [AS] | Online (55 mins) |
| IT support staffs [IT] | Online (53 mins) |
| Deputy director[M] | Online (57 mins) |
| County-1 | 1 | 1 | 1 | 1 | Anus and intestine surgery | Online (54 mins) |
| General admin staff [AS] | Online (52 mins) |
| IT support staffs [IT] | Online (58mins) |
| Deputy director[M] | Online (60 mins) |
| County-2 | 1 | 1 | 1 | 1 | Cerebral surgery | Online (55 mins) |
| General admin staff [AS] | Online (53 mins) |
| IT support staffs [IT] | Online (51 mins) |
| Deputy director[M] | Online (55 mins) |
| County-3 | 3 | 2 | 2 | 1 | Hepatobiliary surgery | Face to face(54mins) |
| General admin staff [AS] | Face-to face (58 mins) |
| IT support staffs [IT] | Face-to face (55 mins) |
| Vice President and Deputy director[M] | Face-to face (54mins) |
| County-4 | 1 | 1 | 1 | 1 | Intensive care unit | Online (53 mins) |
| General admin staff [AS] | Online (53 mins) |
| IT support staffs [IT] | Online (52 mins) |
| Deputy director[M] | Online (55mins) |
| Total | 21 | 19 | 20 | 12 | 72 | **Total time: 4496mins**  **Average time: 62.44mins** |

Note: NH: National level hospital. Regional: Regional level Hospital. Local: local level Hospital. HC: Healthcare consultant. AS: Admin staffs. IT: IT support staffs. M: manager.

Table 3. First-round interview questions (Identify misfits)

|  |
| --- |
| **Background questions** |
| * What are your main responsibilities in your department and what are your daily tasks? * What are your main responsibilities in your department and what are your daily tasks? * How do you feel about the current state of telemedicine? * What was telemedicine’s previous state? * What is the future of the telemedicine system? |
| **Physical structure** (software/hardware/network/infrastructure support for telemedicine centres and sub-centres) |
| * Did the telemedicine centre encounter any problems when it was first set up, in terms of software, hardware, network, or infrastructure? What steps were taken to resolve these issues? * During initial setup of the telemedicine subcentre, what problems were encountered with software/hardware/network/infrastructure? Was this problem resolved in any way? * In setting up the telemedicine system, what management guidelines were followed? * Are there any problems still present? What solutions do you think can be found to these problems? |
| **Surface structure (**Operating interface of the telemedicine system) |
| * Have you encountered any difficulties using the telemedicine system in terms of its operation? What steps were taken to resolve these issues? * What problems were encountered with the front-end operating platform of the telemedicine system and how were they resolved? * Can a telemedicine system be operated by just one person? * Can you tell me how long it takes for commands to be processed by the system? * How does the telemedicine consultant service platform operate? Is there a fixed device involved? Or is it a combination of mobile and fixed devices? |
| **Deep structure (**Telemedicine consultant service platform functionality and back-end data) |
| * How are these functions designed based on an information system? * What functions can be added to future telemedicine systems to optimise their functionality and efficiency? * What problems related to medical data are encountered in telemedicine systems? How can these problems be solved? * What are the guidelines for managing data uploaded/transferred/acquired/recorded/stored/analysed? * How long before the consultation does the sub-centre upload the case data? How is the case data transferred to the central doctor? How is the case data shared between the two doctors’ hardware during the consultation? * How are the entire images of the consultation recorded and stored during the session? * Who has access to the telemedicine data? What are the challenges and difficulties in managing telemedicine data? * How is telehealth data classified? * What analysis methods are used to analyse telehealth data? * How is telehealth data analysed and how are the results applied in practice? |
| **The Inter-organisational structure (**Three -level linkage system and virtual alliance) |
| * What management guidelines are followed in the telemedicine system? * What are the organisational objectives of the telemedicine centres and sub-centres? * What are the responsibilities and duties of the telemedicine centres and sub-centres? * How are the telemedicine centres and sub-centres coordinated in the telemedicine system? * What are the criteria for selecting cases for treatment at the telemedicine centre? * How long does it take for the telemedicine centre to accept and arrange cases from sub-centres? * What are the criteria for reporting cases to the sub-centres? * What special mechanism does the Telemedicine Centre have in place to deal with urgent cases? * How does the telemedicine centre arrange to coordinate the time of the centre doctors and sub-centre doctors? * How does the Telemedicine Centre contact/inform doctors of the exact time? * How does the central doctor and sub-centre doctors work together? * When the centre and sub-centre doctors disagree on the diagnosis of a case? * How do centre and sub-centre doctors establish guidelines for giving and receiving constructive advice? (specific/reliable advice/avoid personal attacks/set positive goals, etc.) * Once the telemedicine diagnosis has been made, what follow-up procedures occur to ensure the effectiveness of the telemedicine? * What are the challenges and difficulties in the organisation and management of telemedicine centres and sub-centres? |

Table 4. Second-round interview questions (Identify resolution)

|  |
| --- |
| **Resolution interview question** |
| **Data resolution** |
| * How many optimisations have been made to the data management of the telemedicine consultation system since 2013 and what were the main specific optimisations? * Why was the decision to optimise made (specific events, timing)? * What triggered the optimisation? * What were the objectives to be achieved in each of the optimisations? * What are the government documents guiding case interconnection (information sharing)? * Why is there no way to enforce interoperability? Please explain in detail. |
| **Functionality resolution** |
| * How many times has the system functionality of the telemedicine consultation system been optimised since 2015, and what were the main optimisations? * Why was the decision to optimise made (specific events, timing)? * What triggered the optimisation? * What were the objectives to be achieved in each of these optimisations? |
| **Role resolution** |
| * What training has been provided to doctors and consultation managers at each level since 2015? * What were the reasons that triggered these trainings? * What was the purpose of conducting each of these trainings? * Were they achieved at the end of the training? (Example: telemedicine knowledge competition held this year) |
| **Control resolution** |
| * How have you promoted the assessment of consultation managers at all levels (national, regional , local )? * What obstacles have you encountered in the process? Please explain in detail. * How many times has the consultation process been optimised since 2015? * What are the details? * What were the reasons that triggered the optimisation? * What was the purpose of the optimisation? |
| * **Interorganizational resolution** |
| * How did the interconnection between the telemedicine consultation system and the electronic medical record systems of 3000 hospitals progress step by step? (According to the information I have so far, the first step you and your team took was to use co-streaming technology to achieve instant interconnection in the telemedicine consultation system, in the absence of government mandated documents for interconnection and without extra funding for interface modification, and since 2021, 150 units with high frequency of teleconsultations have been selected for interface modification.) * Could you please describe in detail how you and the team did this? * What has been achieved at each step? * How have you promoted the assessment of consultation managers at all levels (provincial, municipal and county)? * What obstacles have you encountered in the process? Please explain in detail. * From 2015 to the present, with the gradual increase in the number of telemedicine members, a cross-organisational collaborative working pattern has developed? * How does the Henan Provincial Telemedicine Centre manage cross-organisational working? * How does it provide feedback and assessment on cross-organisational collaborative work? * What efforts have you and your team made since 2015 to familiarise the regional- and local- level with telemedicine processes? * Can you please clarify what specifically and when? |

### 3.5.3 Focus group

Focus groups played a pivotal role in this investigation, renowned for providing insights into individuals’ perspectives, nuanced behaviours, and motivations (Morgan and Krueger, 1998). The use of focus groups offers a compelling tool for comprehending complex actions. Additionally, the ‘group effect,’ referring to the influence of group interactions, enhances the exploration of intricate motivations (Carey and Smith, 1994). A significant advantage of focus groups lies in the consensus generated among participants through group interactions, surpassing ambiguous claims of ‘synergy’ (Morgan and Krueger, 1998). The group setting provides an unparalleled platform to gauge consensus or discord among respondents. Consequently, researchers can elicit participants’ personal experiences and perspectives rather than aggregating individual data to evaluate disparities.

In the present study, focus groups were conducted as a follow-up to the preceding semi-structured interviews. Comparisons between focus groups and individual interviews are warranted as both methods are qualitative in nature. Researchers often integrate individual interviews and focus group approaches, leveraging the former for in-depth exploration and the latter for a broader approach (Morgan, 1996). Focus group interviews facilitate the analysis of insights derived from individual interviews. This methodology allows for a wide range of responses from diverse participants within a relatively condensed timeframe. Consistent with Morgan’s (1992) findings, the results of such studies can be enhanced by employing focus groups that utilize follow-up interviews to delve deeper into specific observations and personal experiences, thereby curating narratives that reflect ongoing personal experiences. This approach identifies a range of experiences and ideas from the interviews and as needed, explores them further within a focus group to add depth. Hence, the integration of individual interviews and focus groups, depending on the qualitative study’s depth and breadth, poses no significant challenges.

Typically, focus groups consist of four to twelve participants, with the precise number determined by factors such as participants’ characteristics (Table 5), subject matter complexity, and the interviewer’s proficiency. Generally, as the subject matter becomes more complex, the number of participants decreases, with selection often based on nonprobability sampling to serve specific purposes (Morgan, 1996). In this study, participant recruitment was role-specific within the telemedicine system, ensuring representation from each role in at least one focus group discussion. Given the convener’s managerial position within the sub-centre, the number of participants in this focus group was determined prior to commencement. The selected group members, comprising key telemedicine practitioners with a shared understanding of the research subject, formed a homogeneous group, enabling a more focused identification of misfits compared to conventional focus groups.

Table 5. Focus group summary

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Hospital level | Healthcare consultant/ RL-Doctors [CP] | Admin staffs  [AS] | IT support staffs [IT] | Managers[M] | Duration |
| P-7 | 2 | 2 | 1 | 1 | 145mins |
| Regional-3 | 3 | 2 | 2 | 2 | 140mins |
| Local-5 | 4 | 2 | 2 | 3 | 125mins |
| Total | 9 | 6 | 5 | 6 | 410mins |

### 3.5.4 Archival data

This study utilized data derived from approximately 187 pages of both internal and external archived documents spanning the period from 2016 to 2019. The internal archival documents consisted of various materials, including meeting records, annual reports, and the established rules and regulations of the national telemedicine centre. Noteworthy public archival documents included the Health Industry Standard of the People’s Republic of China, National Documents, the Telemedicine Industry Analysis Report, and Provincial Documents. These archival materials were gathered from official websites of the Chinese Government and the Henan Provincial Telemedicine Centre. It is important to note that the period of archival data collection coincided with participant observation.

These documents served as a vital source of historical information, allowing for the examination of past events and practices that participants might not have been able to recall (Jones, 2010). Furthermore, these sources significantly contributed to understanding of the research context (Barnes et al., 2018) and shed light on the evolutionary trajectory of the telemedicine system, including technical standards, operational guidance, data flows, and functionalities. Ultimately, the archival data provided substantial practical details regarding telemedicine in China and informed the refinement of interview questions (WS/T 529—2016). The internal documents also provided additional insights into the appropriate structuring and implementation of telemedicine services.

### 3.5.5 System log data

System log data serves as a primary source of information regarding the system’s health and the initial stages of potential issues (He et al., 2016). The analysis of this data, particularly when human and organisational activities are intertwined with an information system, can provide insights into prevalent human behaviours and organisational patterns over an extended period (Lindberg, 2015).

In the context of the telemedicine consultant service platform upgrade, the system log data offered invaluable insights into the research. This data was collected after the initial analysis and coding of interview data, providing an additional layer of research validation. The system logs from the upgrade period between December 2020 and July 2022 - a span of 1.5 years - were particularly instrumental in examining system misfits.

The system logs were inclusive of the telemedicine consultation platform feedback problem list, requirements log list, and pending requirements confirmation list. The feedback problem list featured issues identified during the upgrade process. The requirements log list was categorised into interface requirements, functional requirements, and system errors, which were then summarised by the software vendor for further adjustments involving various stakeholders like triage staff, consultant assistants, technicians, and doctors at different levels. The pending requirements confirmation list comprised unresolved system issues that required attention.

Analysing the telemedicine system upgrade log data corroborated the functionality, data, and usability misfits that surfaced in the interviews. This served to validate the reliability of the interview data. Furthermore, the analysis of the upgrade log data facilitated the identification of misfits not previously mentioned in the interviews, thereby enriching the findings of the research.

## 3.6 Data analysis

### 3.6.1 Content analysis

Content analysis is a research method that allows for systematic coding, identifying themes, concerns, parallels, and differences in participants’ narratives, providing a deeper understanding of the world from the perspective of the participants (Elo and Kyngäs, 2008). In the current study, this research employed the content analysis approach established by Gioia and colleagues (Gioia, and Pitre, 1990; Gioia, and Pitre, 1991; Gioia et al., 2012). This method operates on three fundamental assumptions.

Firstly, it suggests that the organisational world is a social construct, which implies the importance of individual perspectives in interpreting and forming the organisational reality (Smircich and Stubbart, 1985).

The second assumption regards interviewees as ‘knowledge agents’, individuals within the organisation who are aware of their goals and actions and can articulate them effectively (Gioia and Pitre, 1990). This position places significant emphasis on the explanations of the interviewees and positions the researcher as a ‘journalist’, aiming to understand the experiences of the interviewees thoroughly. It supports the notion of not imposing pre-existing structures or theories on the interviewees, but rather understanding their experiences (Gioia and Pitre, 1991).

The third premise is about the researcher. It presumes that the researcher is quite knowledgeable, capable of identifying patterns in the data and bringing to light theoretically relevant concepts and relationships (Gioia et al., 2012).

Gioia’s approach underlines the meticulousness that qualitative researchers need to exercise while gathering data, and also the systematic method required for its analysis (Gioia and Chittipeddi, 1991). Critics often point out two major concerns regarding qualitative research: the lack of a visible trail of evidence leading to conclusions, and the propensity for qualitative researchers to offer inventive theory that is not solidly grounded in evidence (Gioia and Chittipeddi, 1991).

In the initial stages of data analysis, researchers seldom aim to derive categories, as numerous terms, codes, and categories from respondents emerge during the middle and early stages (Van Maanen, 1979; Gioia and Chittipeddi, 1991; Strauss and Corbin, 1998). With the goal of this research in mind, this research focused on interpretations by the five pivotal roles and on feedback and complaints about their work, relating to the telemedicine systems in use and inter-organisational cooperation. During the first stage, feedback and complaints concerning the systems and inter-organisational collaboration are collected. This process aids in preserving the integrity and authenticity of the underlying data to the greatest extent possible.

At the commencement of the study, the quantity of categories tends to burgeon. In the first 10 interviews of this investigation, 75 first-level categories surfaced, and the number of initial-level categories continued to rise with successive interviews. When faced with an overwhelmingly large set of first-order categories, researchers might find themselves entangled in the ‘I am lost’ spiral. However, becoming ‘lost’ at this stage is vital—as Corley and Gioia (2004) highlighted, the initial step towards finding oneself is to lose oneself in the data analysis.

As the research progresses, the second phase of analysis, termed ‘second-order analysis’, is conducted. This focuses on themes, concepts, and dimensions from the researchers’ perspectives (Van Maanen, 1979; Gioia and Chittipeddi, 1991; Strauss and Corbin, 1998). Second-order analysis adeptly addresses the issue where large first-level categories of data appearing during the analysis seem disjointed. This research commenced by comparing first-order categories, seeking similarities and differences. Consolidation of analogous content resulted in a reduction of the final first-level categories to a more manageable number. A series of themes emerged from this process, signifying the inception of the second-order categories.

Adhering to Gioia’s approach’s second premise, this research considered researchers knowledgeable agents capable of (and indeed, obligated to) think at multiple levels concurrently—both at the level of the interviewee’s terminology and codes, and at a more abstract, second-level theoretical perspective of themes, dimensions, and broader narrative level. Two pivotal questions are addressed at this stage: theoretically, ‘What’s going on here?’ and analytically, ‘Are there any deeper structures embedded in this array?’ . The initial category tags are analysed at this second-order level.

The final stage of second-order analysis propels us into the domain of theory as this research scrutinize whether newly developing fields furnish insights that can assist in characterizing and elucidating phenomena. As posited by Corley and Gioia (2004), emerging concepts might not seem to have sufficient theoretical foundation in the literature, contrasting with existing concepts that ‘pop out’ as they are germane to the ongoing research. Upon establishing a useful collection of themes and concepts, researchers might evaluate whether they can further distil emerging second-order themes into second order ‘aggregate dimensions’ (Corley and Gioia 2004).

With a complete collection of first-order terms, second-order themes, and aggregate dimensions, this research lay the foundation for constructing data structures. It allows researchers to visualize the data, as well as represent the transition from raw data to terms and themes in the analysis - an essential aspect of validating qualitative research’s rigor. (Pratt, 2008; Tracy, 2010).

### 3.6.2 Digital trace analysis

In a diachronic perspective, data can be visualized and theorized in terms of the change of process over time (Tralie and Perea, 2018; Berente et al., 2019). With the aid of digital trace data, the processes and dynamics of change in organizational and information systems can be analyzed, explained, and theorized (Pentland et al., 2021). The researcher captured the telemedicine consultant service platform upgrade, tracing 203 events during the telemedicine consultant service platform’s requirements upgrade log process from December 2020 to December 2021. In this research, the telemedicine consultant service platform can be visualized and theorized in terms of the telemedicine consultant service platform’s change process over time.

These upgrade system logs applied Pentland et al.’s (2021) method to analyse telemedicine system log data. Pentland et al., (2021) were inspired by Tralie and Perea’s (2018) analysis of ordered pixels and dynamic social networks (Moody et al., 2005; Rosetti and Cazabet, 2018). The basic time slice method was transformed into a digital trace analysis method. This approach involves five steps.

Retrieving digital trace data: This research obtained a full year’s worth of telemedicine centre upgrade system logs from the initial stage to the final test stage through collaboration with IT staff and the system vendor. A total of 203 time-stamped records describes upgrade system requirements and upgrade system solutions from December 1, 2020, to December 31, 2021, in the upgrade data set.

Choosing a lexicon: It is essential for researchers to identify the event code for their data (Berente et al., 2019). In this study, six types of lexicons appear in the trace data as a theoretical framework. These include data, functionality, and usability (deficiencies and impositions) at the surface level and deep level in the telemedicine consultant service platform.

Selecting a temporal unit of analysis: A time step needs to be selected before this data can be analysed. This research follows the telemedicine consultant service platform upgrade log since it also has a natural time record expressed in months.

Compute a process graph for each unit of analysis: Using the algorithm developed by Pentland et al., (2021), This research transformed the sequence data for each clinic-day into a weighted, directed graph with vertices (Vclinic-day) and edges (Eclinic-day).

Visualizing the system log data: Once a sequence of graphs is constructed, it can be visualized, compared, and analysed in many ways (Moody et al., 2005). Telemedicine system log data is visualized in a graph by month.

### 3.6.3 Trustworthiness of findings and analysis

Credibility, transferability, dependability, confirmability, and integrity were the factors that were considered while determining the trustworthiness and validity of this research (Flint et al., 2002). Demonstrates that the data and analyses met these criteria(Table 6).

Table 6. Trustworthiness of study and findings (Flint et al., 2002, p106)

|  |  |
| --- | --- |
| Trustworthiness criteria | Method for addressing trustworthiness in this study |
| ‘Credibility: extent to which results appear to be an acceptable representation of these data. (Flint et al., 2002, p106)’ | * An internship of one week to build relationships with selected candidates before interviews. * Three-year engagement in a field environment with multiple data sources. * Results: presented for external feedback and the emergent theoretical model benefited from feedback that participants bought into interpretations. |
| ‘Transferability: extent to which findings from one study in one context apply to other contexts. (Flint et al., 2002, p106)’ | * A theoretical sampling was used to select five key roles at three levels of the hospital. * To ensure that all levels of the hospital included data that supported the theoretical concepts and models. |
| ‘Dependability: extent to which findings are unique to time and place, and explanations are stable or consistent. (Flint et al., 2002, p106)’ | * The major stakeholder (five key roles) of the hospital and data sources all participated in triangulating the facts and interpretation. * Results were consistently interpreted. |
| ‘Confirmability: extent to which interpretations are the result of participants and phenomenon as opposed to researcher biases. (Flint et al., 2002, p106)’ | * Author and supervisor team involved in independent coding and data analysis. * Data analysis procedures described and recorded. * In-depth discussions with telemedicine centre manager with expertise in telemedicine clarify data. * There was a high level of agreement between all three coders, and the results were unlikely to be skewed by the diverse perspectives of the three codes. * Result: coding and interpretation were refined. |
| ‘Integrity: extent to which interpretations are influenced by misinformation from, or evasions by, participants. (Flint et al., 2002, p106)’ | * Data triangulation accomplished through interviews, archival data, focus group, log data. * This research conducted professional interviews and focus groups in an anonymous, non-threatening environment. * Author and supervisor team followed ethical guidelines for working with vulnerable populations. * Result: no obvious bias from participants or attempts to mislead the author and supervisor team. |
| ‘Fit: extent to which findings fit  with the substantive area  under investigation. (Flint et al., 2002, p106)’ | * Gioia's analysis approach is used to address credibility, dependability, and confirmability. * The results of this project are a deeper understanding of concepts and a less linear integration of theory, capturing the complexity of social interaction uncovered in the data. |
| ‘Understanding: extent to which participants buy into results as possible representations of their worlds. (Flint et al., 2002, p106)’ | * Participants (key roles) were asked to respond to a summary of findings that reflected their daily activities. * A summary was presented to the supervisory team. * The findings were accepted by participants and supervisors. |
| ‘Generality: extent to which findings discover multiple aspects of the phenomenon. (Flint et al., 2002, p106)’ | * In-depth interviews elicited many complex aspects of the phenomenon and related concepts because they were long and open. * An opinion polling technique was created that involved the interaction of participants' opinions for the creation of focus groups. * Archival data can be used to uncover past events and practices that respondents may not be able to recall. * Log data was the primary source of feedback on system health and issues in the initial stages. * The result was a multifaceted picture of the phenomenon based on several sources of data. |
| ‘Control: extent to which organizations can influence aspects of the theory. (Flint et al., 2002, p106)’ | * It would be possible to give some degree of control to both participants and coders. * CDVC can be influenced by participants and coders. |

## 3.7 Ethical issues

Prior to the commencement of fieldwork for the investigation of the telemedicine consultation service platform in November 2019, ethical approval was duly obtained for the study. The Research Ethics Committee at the University of Sheffield’s Management School was provided with necessary documents, encompassing both an application form and consent forms from participants. The application delineated in detail the methodology to be adopted for the case study, including the approach to data collection and analysis, and the proposed research design strategy. The researcher underscored that no procedures would be initiated until the institutional approval of the application. For further insight, the appendices provide comprehensive information on the participant consent form and the ethics application form (University of Sheffield’s Management School Research Ethics Committee, 2019).

### 3.7.1 Data collection ethical issues

Full participation may indeed engender certain ethical considerations. Firstly, whilst it provides an avenue for profound organisational comprehension, it also carries a considerable likelihood of precipitating role conflicts (Saunders et al., 2007). During my one-week internship at the telemedicine centre, this research actively participated in two telemedicine consulting assignments. My responsibilities encompassed facilitating the smooth operation of remote consultations and recording the healthcare consultant’s assessments post-consultation. Additionally, this research was involved in scheduling – a meticulous process whereby each patient’s request was matched with an apt healthcare consultant, in accordance with the patient’s symptoms and diagnostic reports.

This research design necessitated interviewing colleagues with whom my worked during my internship, a scenario that presents potential ethical challenges. It is conceivable that these colleagues could exhibit resistance or distrust towards me, given the dual roles I held. Secondly, significant time investment is an inevitable facet of this participatory process. The trust extended to me by my internship supervisor granted us access to insights that others were oblivious to, thereby enabling us to delve deeper into this research topic than I initially envisaged.

It is fundamental to comprehend the inherent tendency of a subject to resist a phenomenon, as this understanding may transform us into integral participants in the research process. Moreover, I have always been captivated by research queries and objectives that are predicated upon methodological correctness. Achieving an in-depth understanding of a phenomenon within an organisation demands considerable time and effort. Hence, a significant commitment of time is often indispensable for acquiring a thorough comprehension of an organisational phenomenon.

This research identified two solutions to address the conundrum of role conflicts. Firstly, in light of the nature of snowball sampling, where some participants are not directly enlisted by the researcher, it is imperative to ensure all participants voluntarily consent to partake in the study. Secondly, this research conducted focus group discussions and interviews in both in-person and online formats, which circumvented any potential issues regarding permission.

Participants were provided with comprehensive information regarding the study’s background and objectives, along with a copy of the research ethics statement. Prior to initiating the focus groups and interviews, all participants signed the requisite permission form. Moreover, I avoided delving into sensitive or private subjects such as sexual orientation, political beliefs, or financial matters during our interactions with the study participants. Therefore, participants were not presented with any queries that they might deem inappropriate. This is consistent with the methodology outlined in the preceding section, whereby research questions were crafted by the researcher and approved by their superiors.

### 3.7.2 Data analysis ethical issues

Utilising a manual transcription service may indeed entail ethical considerations. As stipulated in iFLYTEK’s user privacy policy, they implement security measures that adhere to industry standards. These measures, encompassing effective systems and security technologies, are designed to prevent unauthorised access, alteration of personal information, and data loss or damage. For instance, iFLYTEK’s network services employ encryption technologies such as Transport Layer Security (TLS) protocols and facilitate browsing services via HTTPS and other means, thereby ensuring user data safety during transmission.

This research employs encryption technologies (TLS, SSL), anonymisation processing, and protective mechanisms to encrypt and store user personal information, isolating it through advanced isolation technologies. This research has established a data classification and grading system, a data security management protocol, and a data security development specification to regulate the storage and utilisation of personal information.

Access to personal information is restricted exclusively to iFLYTEK employees, partners, and affiliates who require such information, controlled through stringent access protocols and monitoring mechanisms. Confidentiality agreements are put in place for those with access to the information, mandating adherence to confidentiality obligations. Non-compliance with these obligations could lead to legal repercussions or contract termination with Cyberoam.

### 3.7.3 Data management

During the course of the interviews and focus group discussions, this research will refrain from seeking details pertaining to name, gender, home address, or personal contact information. Furthermore, job titles and hospital names will be associated solely with arbitrary codes. In this thesis replace references to participants with these arbitrary codes as a measure to safeguard their privacy and ensure their anonymity. It is pertinent to note that the audio transcriptions will bear the same code as the original recordings, with only my supervisory team privy to this coding scheme.

In order to facilitate analysis, I transcribed the audio data into text and translated it into English. The transcriptions, translations, and audio data will be utilised for my doctoral thesis. If any information specifically pertains to personal data and privacy or is incapable of complete translation into English, it will be suitably noted. Sensitive information will be represented by an alternative code. Furthermore, all audio and text data will be securely stored on my personal computer, facilitating retrieval when required. My computer’s password is configured in accordance with the digital safety guidelines of the University of Sheffield. A myriad of research data files has been securely stored with password protection on my personal computer.

Lastly, once PhD thesis is completed, all data will be purged. It is not intention to share the analysis results of the interviews and focus groups with the telemedicine service centre.

## 3.8 Summary

Chapter 1 introduces the challenge confronting contemporary healthcare services, alongside the current status of telemedicine services, the study’s aims and objectives. Chapter 2 embarks on an exploration of the corpus of telemedicine research literature. Aspects of telemedicine systems technology, applications specific to certain diseases, cost-benefit analyses, and country-centric systems (with a focus on China, India, and Australia), have all been integral to telemedicine studies. These studies offer comprehensive analyses of telemedicine technology, disease-specific applications, country-focused systems, and cost-benefit analysis. However, few have scrutinised telemedicine systems at a techno-organisational level. Telemedicine systems represent an online cross-organisational collaboration (within the context of D2D telemedicine systems). The research gap for this paper is delineated by the current literature, also elucidating the study’s goals and objectives. Chapter 2’s also engages with literature from a techno-social perspective to frame the theoretical underpinning of this study, but also approaches the design and execution of research in a specific setting from a philosophical viewpoint.

Adhering to its philosophical foundations, this research adopts an inductive and qualitative approach. The longitudinal case study is highlighted as the methodology employed, founded on a discussion of several research techniques. The chapter proceeds to outline the case study protocol, encompassing the history of telehealth and the specific setting of telehealth system deployment in Henan Sheng, before justifying the data collection techniques applied. The study utilised five participant categories, reflecting the five distinct telehealth system user roles. Following focus group discussions with telehealth system users and semi-structured interviews with key telehealth system participants, the study employed observational methods to immerse in the telehealth centre’s daily operations. Thematic analysis was employed to interpret this data. This chapter also presents the rationale behind data collection and analysis, encapsulating the entire research design process, and concludes with a critique of ethical and quality issues in research design, thereby contributing to the creation of high-quality research. The case study offers an in-depth comprehension of the types of misfits in the D2D telemedicine system, based on Org-ES fit theory, and elucidates how to rectify these misfits. The key roles in the telemedicine system will provide their insights into misfits and solutions from their daily work perspectives. Interviews will enable a more detailed understanding of work-related misfits and solutions. Supplementary methods, such as archival document review and participant observation, will aid in identifying key roles within the telemedicine system, understanding its operation, and refining the research questions.

# Chapter 4 Research Findings: Formation of misfits and Resolution of misfit

## 4.1 Data misfit

In the context of enterprise system (ES), data misfits ‘occur when data or data characteristics stored in or needed by the ES leads to data quality issues such as inaccuracy, inconsistent representations, inaccessibility, lack of timeliness, or inappropriateness for users’ contexts’ (Strong and Volkoff, 2010, p737). In the context of enterprise resource planning (ERP) system, Yen et al., (2011) identify two types of data misfit: input data misfit and output data and interface misfit. Among the misfits in the former category are incompatible input data formats, insufficient data visibility, and inaccurate data, while incompatible output data formats, poor output quality or accuracy, incompatible terms and meanings, complex interfaces, and invisibility of output logic and calculations are among the misfits in the latter category. In the similar vein, analysing the ERP implementation cases to identify the types and consequences of data misfit, Van Beijsterveld and Van Groenendaal (2016) define data misfit as the system not being capable of capturing various object attributes or documents in the database of the system. Their study finds that the most common cause of data misfits at the operational level is the incompatible input data, which results in the incorrect inputs and complex reports being created in the system. On the tactical level, the presence of data misfits is mainly caused by poor visibility of data and a lack of accurate information, which can lead to incorrect or inaccurate decisions being made as a result.

In this study, the interorganisational telemedicine consultancy service platform (TCSP), by nature, is a boundary spanning telehealth information system in which patient data is disseminated among different healthcare systems and healthcare institutions, and patient care delivery is coordinated across multiple healthcare institutions (Bunduchi et al., 2015). Overall, this research finds that achieving data legitimacy among systems and institutions remains challenging due to institutional misalignments that occurred in the TCSP(Table 7). In the early stages of platform development, the TCSP encountered data misfits primarily due to poor data quality and lack of accessibility, while, in the later stages, the TCSP suffered technical difficulties tracking patient data in order to access the follow-up consultancy service and integrating a variety of data sources to monitor the platform effectiveness or the quality of the consulting services.

The analysis is based on Strong and Volkoff’s (2010) framework for ES-organisation misfits, which aggregates data-related issues into two misfit dimensions: ***data deficiency*** and ***data imposition***. Deficiencies in data occur when a decision cannot be made effectively due to insufficient, incomplete (Boyer and Pronovost, 2010; Hausser, 2020; Liu et al., 2017), or untraceable data (Strong and Volkoff, 2010). Data impositions are caused by incompatibilities of data format between the requirements and the system package (Wu et al., 2007) and a lack of data integration and standardization (Strong and Volkoff, 2010).

***Data deficiencies***. This research find that data deficiencies are caused by the lack of healthcare system synergies across all of the participating hospitals (e.g., hospitals in the regional or local levels) in the TCSP(Figure 6). Achieving cross-unit IT synergies requires IT users’ coordinated responses to technological changes or commitment to coordinated IT investments (Karhade and Dong, 2021; Tanriverdi, 2006). However, in this case, tele-consultation service providers and requesting regional and local hospitals did not have a unified IT infrastructure, policies, and standards for hardware and software and IT management processes at the earlier stage of TCSP deployment. This results in a limited level of data accessibility, traceability, and completeness. The data show that healthcare consultants at national level hospitals (P-HC) had limited access to TCSP patient data. Specifically, P-HC only allowed to read the patients’ EHR data displayed on the screen shared by the during tele-consultations. Prior research has suggested that sharing screen practice during medical tele-consultations facilitates two-way interactions (Kumarapeli and Lusignan, 2013) and involvement in the medical decision-making process (Milne et al., 2016). However, the interviewees (e.g., P-HC in the gynaecology department) indicate that there needs to be a change in the way consultants are able to control screen sharing from their end of the process. They state that the existing sharing screen approach is not effective and redesigning the data access process remains a challenge due to concerns regarding patient confidentiality among participating hospitals. A gynaecological consultant further describes her/his concern when access to EHR data is restricted. This deficiency is also evident from the field note.

‘After *reading the patient record through screen-sharing, we need to provide them (the doctors from the demand side) with diagnostic decisions within a few minutes. This process is challenging because timely decisions need to be made during e-consultation. Reviewing the EHR records prior to the e-consultation enabled me to guide them in doing some tests I need for the patients. Then, based on the results of the tests, I can provide accurate diagnosis. In the absence of all this, I only suggest a few diagnostic possibilities and then ask them to conduct the tests I need before booking the next e-consultation.*’  *-* A gynaecological consultant at the national-level hospital.

The completeness of data is a crucial condition for a robust IT infrastructure, and the primary indicator of data quality (Bharadwaj, 2000). Data completeness is the extent to which the data is not missing and is of sufficient breadth and depth for the task at hand (Adolfsson and Rosenblad, 2011; Liu et al., 2017). The system log reports indicate EHRs in the TCSP did not provide complete information regarding patients’ medical history or previous treatments. For example, patient information does not reflect health conditions (e.g., patients with critical illness) and priority (patients who need emergency care). A lack of completeness in patient data led to many delays in consultation arrangement, more follow-up consultations and even influence accuracy of medical decision made by consultants.

To ensure diagnostic accuracy, quality medical images are essential to tele-consultations (Strong et al., 1997). Despite TCSP’s support for real-time acquisition of patient image data (e.g., computerised tomography image) via DICOM 3.0 interfaces, image quality is sporadically poor due to unstable connectivity. This raises ongoing concerns such as delay in the diagnosis process and inaccuracy clinical decisions. The observational field notes taken at the National Telemedicine Centre showed,

‘ *Respiratory specialists rely on clear lung imaging data to diagnose patients. When the respiratory physician reviewed the lung image, it was not clear enough to make a diagnosis. He used his diagnostic experience to guide the doctors [who requested e-consultation] in the identification and diagnosis of the lung image data.*’ - Observational field notes taken at the National Telemedicine Centre

***Data impositions*.** A challenging data importation issue that arose from the administrative staffs at the national-level hospitals (P-AS) had to do with the transition from handwritten tele-consultation records to the TCSP(Figure 6). The reason for this is that it was difficult to synergize healthcare systems among participating regional and local hospitals. Regional and local doctors (RL-D) utilised in-house healthcare information system, which is disconnected with the TCSP. After consultation is finished, doctors need to fill in the consultation records manually. This procedure was inefficient and error-prone caused by complex medical terms written by P-HC, resulting in inaccurate medical records when transiting. A senior P-AS stated that

‘ *The consultants are required to handwrite the diagnosis and file it. The front-line supporting staff typed the medical records into TCSP. Input errors will be visible as a result of the consultant’s scrawled handwriting. I [a senior P-AS] need to periodically review the EHR input and modify the errors I found.*’ - A senior P-AS

Another challenging data importation issue that arose from data integration. Incorporating EHR data from multiple sources and systems is conducive to generating medical narrative reports that allow health care practitioners to take informed decisions and actions (Bardhan et al., 2020; Hoopes et al., 2018). However, the TCSP by default merely allows one-off consultation focusing on addressing current issues doctors from demand side face. Thus, patient data cannot be tracked by P-HC (e.g., treatment progress) due to insufficient data integration. For any follow-up, a new request needs to be made. As one consultant pointed out and the field notes showed,

‘Generally*, patients get relief or cure from their mild condition after an e-consultation based on the suggested treatments. For critically ill patients, however, several follow-ups are required to monitor treatment progress. The system cannot support this. If any issues arise, consultants will ask the doctor from the demand side to make direct contact in order to monitor treatment progress.*’  *-* A consultant at the national-level hospital and observational field notes taken at National Telemedicine Centre.

* A1-1: Limited level of accessibility
* A1-2: Lack of completeness in EHRs
* A1-3: Unstable quality in image data transformation

A1: Data deficiency

* A2-1: Unstandardised data format when transmitted.
* A2-2: lack of trackability due to insufficient data integration

A2: Data imposition

First-order concepts

Second-order themes

Aggregated themes

Figure 6. Data structure of data misfit

Table 7. Data structure of data misfit

|  |  |
| --- | --- |
| First-order concepts | Selective quotes[[1]](#footnote-1) |
| A1-1 | * P-HC could not obtain the EHR directly from TCSP. EHR is provided by RL-D through screen sharing. (Source: interviews from P-HC) * Consultation cases are not able to be stored centrally in the TCSP for unified access and data sharing among users (Source: archival data). Once the consultation is completed, EHR data cannot be accessed and retrieved by P-HC (Source: observational field notes) * Medical examination cannot be transferred appropriately and stored in the TCSP for earlier view. P-HC need to instant decision during the consultation, resulting in higher work stress. (Source: interviews from P-HC) |
| A1-2 | * EHR in the TCSP did not provide comprehensive information regarding patients’ medical history, influencing accuracy of decision making by P-HC (Source: interviews from P-HC) * Patient information does not reflect their health status and priority, resulting in delays in consultations (Source: system log report) |
| A1-3 | * Although TCSP supports the acquisition of patient image data (e.g., CT) from digital image and communication in medicine (DICOM) 3.0 interfaces with aid of DICOM gateways in a real-time manner, image quality is low due to unstable connectivity (Source: archival data). This raises ongoing concerns such as delay in the diagnosis process and inaccuracy clinical decisions (Source: observational field notes data). |
| A2-1 | * P-AS needs to manually transit the handwritten consultation record into the TCSP. (Source: interviews from P-AS). * IP-house healthcare information systems used by RL-D are disconnected with the TCSP. After consultation is finished, P-HC needs to fill in the consultation records manually. This may cause typing errors or typos on the records (Source: interviews from P-AS). |
| A2-2 | * P-HC do not have a way to track the patients’ journey (e.g., treatment progress and follow-ups). Tele-consultation is more likely to a one-off service and focuses on addressing current symptoms that patients face. P-HC fails to move forward with patients’ treatment plan or a follow-up consultation (Source: interviews from P-HC and system log report) |

## 4.2 Functionality misfit

In general, functionality misfit is defined as the existing system does not meet the business needs of the organisation (Liu et al., 2011; Sia and Soh 2007; Soh et al., 2000). From the organisation-enterprise system fit perspective, Strong and Volkoff (2010) define functionality misfit as ‘the way processes are executed suing the enterprise system (ES) leads to reduced efficiency or effectiveness as compared to pre-ES outcomes’ (p. 737). Soh et al., (2000) also delineates functionality misfit as an incompatibility between user requirements and technology-based processing procedures. As an enterprise system develops gradually, its functionality may not be clearly articulated until it is customized to meet user needs (Howcroft and Light, 2010). There is a high need for the enterprise system to be enhanced in terms of functionality, as otherwise alternative options such as modifying business processes to fit the requirements of the system will have to be explored if it does not meet unmet needs (Scott and Kaindl, 2000).

In the TCSP, this research finds that functionality misfits can be attributed to the deficiencies and impositions of platform functionality. ***Functional deficiency*** is the absence of needed functionality within a system, while ***functional imposition*** is known as inherent system features that in conflict with organizational norms and practices or negatively influence organizational performance (Strong and Volkoff, 2010). In Figure 7, this research summarises the first-order concepts and second-order themes (i.e., functionality deficiencies and impositions) of functionality misfits and provide meaningful examples paraphrased from the data sources (Table 8).

***Functionality deficiencies***. In the case of using TCSP at the interorganizational level, our results indicate that functionality misfits occur when the functions of TCSP cannot meet users’ expectation for tele-consultations, including consultation scheduling, notification and feedback mechanisms, and consultation records. Specifically, deficiencies in functionality occur when the scheduling process for tele-consultations is not flexible to the users (e.g., P-NCs and RL-Ds) who request them and there is no immediate feedback (e.g., reply to requests) regarding scheduling. For example, patients that have been assigned to a specific consultant could not be rescheduled, even if another patient has an emergency priority. Even though hospitals have a procedure for dealing with emergency cases, TCSP does not support this request, which requires calling the supporting officers instead, resulting in a delay when dealing with emergent patients. According to one P-AS and system log report:

‘*In normal circumstances, the applicant for e-consultation sent the application within 24-48 hours of the working time arrangement of e-consultation. There are two special situations in which consultation can be arranged right away: First, the applicant must notify the supporting officers who oversee scheduling by phone that the patient’s condition is urgent and needs professional consultation immediately or within 12 hours. In addition, the supporting officers audited the patient’s HIS and matched them with an expert for e-consultations, finding that the patient was in an urgent situation. They contact the applicant to confirm the patient’s status and arrange for an emergency consultation.*’ - A P-AS at the National telemedicine Centre

In addition, some minor functionality deficiencies are shown in the system log report that can be easily addressed. For instance, TCSP does not support keyword searching function (e.g., consultant profile and expertise), resulting in increasing workload of manual matching demand and supply side of service request. A RL-D described this issue as follows:

‘We *joined the Henan telemedicine platform about a month ago, and we were not familiar with the consultants. Due to the lack of keyword search function about consultants, we had to tick the box to be ‘subject to provincial command’. The availability of consultants at the time of application would be helpful.*’ *-* A RL-D at a regional hospital

When scheduling and matching requests between P-HC and RL-D, one P-AS described the problem as follows:

‘*With an increasing number of e-consultation requests, many RL-Ds are unsure which consultants might be available to match their case requests. The volume of applications is 200 to 300 per day, with more than half of them subject to allocation. We [supporting officers] need to read applications and, based on our judgement, access the hospital’s website to check the consultant’s main area of expertise and clinic hours before contacting them by telephone.*’ - A P-AS at the National telemedicine Centre

***Functionality impositions*** challenge TCSP’s ability to interoperate across healthcare institutions, clinical units, and platform users. Doumbouya et al., (2014) defines system interoperability as ‘*a state between two applications when, for a specific task, an application can accept data from the other to perform this requires appropriate and satisfactory manner without this an external operator intervention*’ (p.649). Since information is generated across boundaries, a key challenge to interoperability is a lack of functions to support information exchange. At the technical level, in the TCSP case, this research fine that some functions for the exchange of healthcare information is missing. For instance, for notification function, users (e.g., RL-D, P-HC, and P-AS from National Telemedicine Centre) cannot receive automatic notifications to administer consultation tasks, resulting in a low level of agility when responding to requests. According to one P-AS:

‘*When I handled matching and accompanying duties in the telemedicine service, my main responsibility was to assist doctors in successfully submitting telemedicine applications, as well as to help them complete consultations. Nevertheless, I am sometimes involved in my offline role of organizing various training activities for our doctors as new processes emerge in the telemedicine system. I sometimes cannot receive notification from TCSP to inform me oncoming requests or events. I was unable to respond immediately to provide feedback, causing some delays in the e-consultation process*.’ - A P-AS at the National telemedicine Centre

Likewise, when consultation is arranged by P-AS, there is no notification sent to consultants, doctors, and patients who request a consultation for confirmation. One of the supporting officers described the problem as follows:

‘*TCSP should automatically send SMS reminders to the applicant's doctor, supporting staff, and consultants to confirm the consultation time. Sometimes, the applicant’s doctor or supporting officers do not receive SMS reminders, resulting in teleconference delays or cancellations.*’ - A P-AS at the National telemedicine Centre

In addition to system interoperability, telemedicine system should facilitate the accessibility of information (e.g., shared medical records and consultant profile) to users from multiple hospitals, with a variety of purposes (Rho et al., 2014). Increased accessibility has led to faster delivery of care, shorter healthcare waiting times, and more accurate monitoring by doctors at a lower cost (Whitten et al., 2005). It was found that TCSP has some functional impositions because it does not provide completed consultant working patterns and timetables as well as the consultant basic information (e.g., clinical expertise and contact information) in the profile section. In the absence of complete information, P-AS will need to contact the consultants to find out whether there is a conflict between the consultation time and office visit, resulting in difficult to match demand and supply side of service request. This results in an increasing operational cost due to insufficient information accessibility. Consequently, TCSP may appear to have numerous functional impositions that reduce the effectiveness of tele-consultation process according to telemedicine system log reports, but most of them can be rectified with system upgrades and modification. As evident in the system log report, this research found 65% of the functionality misfit events are attributed to functionality impositions.

* B1-1: Inflexibility of consultation scheduling
* B1-2: Not offer keyword search function
* B1-3: No instant feedback function

B1: Functional deficiency

* B2-1: Notification function is partially missing
* B2-2: The consultation matching function is inefficient due to incomplete consultant information

B2: Functional imposition

First-order concepts

Second-order themes

Aggregated themes

Figure 7. Data structure of functionality misfit

Table 8. Data structure of functionality misfit

|  |  |
| --- | --- |
| First-order concepts | Selective quotes |
| B1-1 | * Patients that have been assigned to a specific consultant could not be rescheduled, even if another patient has an emergency priority (Source: system log report and P-AS interviews). |
| B1-2 | * The TCSP does not provide searching function (e.g., consultant profile and expertise), resulting in increasing workload of manual matching demand and supply side of consultation service requests. (Source: P-HC and P-AS interviews) |
| B1-3 | * On the scheduling function, TCSP does not generate instant feedback when time slots are scheduled, or meeting rooms are booked conflictingly (Source: P-AS interviews). |
| B2-1 | * When consultation is arranged by P-AS, there is no notification sent to P-HC as well as RL-D and patients who request a consultation for confirmation. (Source: P-AS interviews) * There is a lack of push notification feature in the TCSP. The users cannot receive the automatic and customised notifications to manage the consultation tasks, resulting in a low level of agility in responding to the requests (Source: P-AS, P-HC, and RL-D interviews |
| B2-2 | * The consultant profile section in the TCSP only displays consultants’ job title (without, for example, clinical expertise and contact information), resulting in difficult to match demand and supply side of service request. (Source: P-AS interviews and observational field note) * TCSP does not provide consultants’ working pattern and timetable. The P-AS need to contact consultants to see if there is a clash between consultation time and office visit (Source: P-AS interviews and observational field note) |

## 4.3 Usability misfit

System usability refers to the extent to which a system can be used by specific users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use (ISO 9241-11, 1998). The other also widely known definition is presented by Nielsen (1993), who states that the two most important issues for usability are the users’ tasks and their individual characteristics and differences. In the healthcare setting, system usability is defined as ‘the efficiency, effectiveness, and satisfaction with which specific users can achieve a specific set of tasks in a particular environment’ (Landman et al., 2014, p.5).

The Hertzum’s (2010) framework of images of usability depicts six images of usability: universal usability, situational usability, perceived usability, hedonic usability, organisational usability and cultural usability. Different focal points of the images allow us to gain a true understanding of the system’s usability by paying attention to different aspects of its use. There are three images of usability that are specific to the context of the use of interorganisational systems, which are universal usability, situational usability, organizational usability. Universal usability entails ‘embracing the challenge of making systems for everybody to use’ (Hertzum, 2010, p. 568). Situational usability refers to ‘the quality-in-use of a system in a specified situation with its users, tasks, and wider context of use’ (Hertzum, 2010, p. 568), while organisational usability is implied as ‘groups of people collaborating in an organizational setting’ (Hertzum, 2010, p. 568).

From the organization-enterprise system fit perspective, Strong and Volkoff (2010) define usability misfit as ‘occur when the interactions with the ES required for task execution are cumbersome or confusing, that is, requiring extra steps that add no value, or introduce difficulty in entering or extracting information’ (p. 741). le Roux (2014) measured usability misfit by ease of use and the speed and satisfaction of artefact use, which are rooted in the DeLone and McLean model of information system success (DeLone and McLean, 2003). In this study, usability misfits can be attributed to usability deficiencies or impositions based on Strong and Volkoff (2010). ***Usability deficiency*** is the absence of appropriate design of system and user interfaces (le Roux, 2014; Strong and Volkoff, 2010). ***Usability impositions*** are defined as a set of system features that, in the context of a given situation, are in conflict with the quality-in-use of the system as well as its wider context of usage in general (Hertzum, 2010; le Roux, 2014; Strong and Volkoff, 2010). As shown In Figure 8, this research summarizes the first-order concepts and second-order themes (i.e., usability deficiencies and impositions) of usability misfits and provide meaningful examples paraphrased from the data sources(Table 9).

***Usability deficiencies*.** TCSP is built based on a collaboration in the inter-organisational setting. To improve the effectiveness of such collaborations, the performance assessment and metrics need to be developed by integration of functional units and data sources. In the case, however, both platform director at the National Telemedicine Centre

(PD/NTC) and managers in the regional and local hospitals (RL-M) cannot obtain performance metrics for improving the system effectiveness and the quality of tele-consultation service. It allows PD/NTC and RL-M to monitor the effectiveness of TCSP or the quality of tele-consultations if such performance metrics are provided, including the volume of monthly tele-consultations, the duration of patient visits, and satisfaction ratings and feedback from RL-Ds and their patients. The PD/NTC, RL-M and RL-AS pointed out that there is a lack of performance metrics/reports to oversee the effectiveness of telemedicine consultation service.

‘Through *performance metrics we want to keep track of the number of consultations requested on a daily, weekly and monthly basis and which departments are actively using the telemedicine consultation service to help us monitor the effectiveness and quality of the TCSP consultations. Nevertheless, we need a resolute person to manually count the performance metrics, or we need to send a request to the provincial telemedicine centre for performance metrics (e.g., number of consultations per month, doctor consultation hours, patient satisfaction after treatment, etc.). Our telemedicine system does not provide these metrics directly.*’  *-* A RL-M at the regional hospital

‘I *receive requests for key performance metrics data for telehealth services from staff at some sub-centres. During the online coordination meetings, I spoke to the minute staff who had requested key performance metrics data. I found that they [RL-Ms] wanted to use telemedicine key performance metrics data as a reward and sanctions system for sub-centre doctors who use the telemedicine consultation service, as well as to improve the quality of the service.*’ *-* A P-AS at the national hospital

***Usability******impositions***. Usability impositions occur when more additional or unnecessary effort is required to integrate data from different applications within the artefact. In the TCSP, this research find that the process of recording consultation results requires multiple steps to be completed. Usability imposition issues were reported by P-AS at the national and regional-level hospitals, stating that

‘We *[P-AS at a national-level hospital] need to create the consultation report from handwritten doctor notes by the end of day. This is a labour-intensive endeavour, requiring more time than usual and more work force*’.– A P-AS at the national-level hospital

Moreover, it has been identified as a challenging usability problem that arises from low efficiency in relation to the number of resources expended relative to the accuracy and completeness with which users achieve their goals. In the TCSP, consultants cannot fill in the consultation results in an efficient manner. Completing the consultation record requires multiple tasks and users (i.e., handwritten on the paper by consultants, entered into the TCSP by P-AS, and double-checked by another supporting staffs. According to one supporting officer and telemedicine system log report:

‘As *a support staff member, I am responsible for all the work required on a daily basis. Additionally, I am responsible for reviewing the expert input of other support staff and compiling common errors for other staff to fix. It can only improve the accuracy of the entries to a limited extent*’.- A P-AS at the national-level hospital

‘After *3pm and 4pm, the telemedicine consultation service will conclude. The supporting staff will manually enter all expert opinions into the telemedicine system. Handwritten comments from the expert are archived*’. *–* Observational fieldnote taken at National telemedicine Centre

In addition, P-AS needs to intensively conduct a manual check if the required documents (e.g., examination reports) are submitted properly, resulting extra time spent in the consultation matching process. One of the supporting officers described the problem as follows:

‘We *P-AS at the national-level hospital] often received complaints from specialists about the lack of documentation required for consultation cases, such as clear and reliable diagnostic and test reports from the requesting physician. This prevented telemedicine consultations from being successfully conducted. We [P-AS at the national-level hospital] are required to manually check applications for telemedicine services to resolve this problem. It has improved the effectiveness of telemedicine consultations but has increased the workload of support staff and the demand for specialist medical knowledge*’.- A P-AS at the national-level hospital

Assessment of hedonic usability is essential to developing systems that produce pleasurable emotions (Hertzum, 2010). A simple and widely used technique for assessing hedonic usability is to evaluate user satisfaction relating to system use. This research find that RL-D and their patients undergo a long service request process. This long service request process is caused by inefficient data collection. For example, the examination reports cannot be uploaded to the TCSP directly. The request form needs to be filled out by providing over-detailed patient information. According to the RL-AS and RL-D from the demand side complain:

‘When *some information (such as patient medical history) is available on the EHR, the consulting service typically needs to provide over-detailed patient information (which can take up to 20 minutes on average). We were unable to directly transfer diagnoses between our EHR system and telemedicine system using copy-paste functionality*’. *–* RL-D and RL-AS from a regional hospital

As a result of the complexity of the system environment, TCSP sometimes had difficulty allocating a consultation slot. Tele-consultations should be scheduled at the right time in separate consultation rooms by P-AS. This task, however, is complex and requires several steps and considerations (e.g., availability of demand and supply sides, capacity of consultation rooms, and availability of supporting staff) to accomplish. One of the P-AS described the problem as follows:

‘In *the consultation allocation screen, we had to jump through the screens several times to see the relevant consultation times and locations. This means the daily, weekly, and monthly availability of telemedicine appointments and consultation rooms are not viewable simultaneously*’.- A P-AS at the national-level hospital

* C1-1: No summarised performance metrics is provided to oversee the effectiveness of consultation service

C1: usability deficiency

* C2-1: Multiple steps needed to be completed for recording consultation results
* C2-2: Check the documents manually when matching and setting up consultations
* C2-3: A long service request process
* C2-4: Technical difficulty of consultation allocation

C2: usability imposition

First-order concepts

Second-order themes

Aggregated themes

Figure 8. Data structure of Usability misfit

Table 9. Data structure of usability misfit

|  |  |
| --- | --- |
| First-order concepts | Selective quotes |
| C1-1 | * PD/NTC and RL-M who oversee telemedicine consultation service cannot obtain performance metrics by integrating various data sources that help them monitor the effectiveness of TCSP or the quality of consultation (Source: interviews from PD/NTC and RL-M) |
| C2-1 | * P-HC cannot fill in the consultation results in the TCSP in an efficient manner. To complete the consultation record requires multiple tasks and users (i.e., handwritten on the paper by consultants, entered into the TCSP by P-AS, and double-checked by another supporting staffs) (Source: P-AS Interviews and observational field note) |
| C2-2 | * For each consulting case, P-AS need to check manually if the required documents (e.g., examination reports) are submitted properly resulting extra time spent in the consultation process. (Source: P-AS interviews and observational field notes) |
| C2-3 | * RL-D and their patients complain that to request the consulting service needs to provide over-detailed patient information (take up to 20 minutes on average) when some information (e.g., patient medical history) can be found on EHR. (Source: RL-D and RL-AS interviews) * The files of examination report cannot be uploaded to the TCSP. It needs to complete by filling in the request form manually. (Source: system log report and observational field note) |

4.4 Role misfit

From the organization-enterprise system fit perspective, role misfit is defined as ‘occur

when the roles in the ES are inconsistent with the skills available, create imbalances in the workload leading to bottlenecks and idle time, or generate mismatches between responsibility and authority’ (Strong and Volkoff, 2010 p. 737). Role misfits in the healthcare context further elaborated on by Mettler (2016), who describes a misfit situation in which healthcare information technology drastically changes patterns of behaviour, resulting in healthcare professionals’ imbalances between authority and responsibility. Likewise, role misfits occur, when healthcare professionals are assigned roles that are not aligned with their skills, capacities, and responsibilities, and when roles create imbalances in workloads (Van den Hooff and Hafkamp, 2018). Using an EHR system, Van den Hooff and Hafkamp (2018) found two primary reasons for role misfits: increased workload and reduced autonomy, resulting in either clinical process inefficiency or a mismatch between responsibility and authority.

In this study, role misfits can be attributed to role deficiencies and role impositions. In the inter-organisational level, a role deficiency occurs when associated tasks are dispersed across many roles leading to conflict and inefficiency, while role imposition occurs when a particular task is in conflict with skills and knowledge available, a role responsibility that is unclear, or inadequate preparation for the task (Strong and Volkoff, 2010). This research summarizes the first-order concepts and second-order themes (i.e., role deficiencies and impositions)(Figure 9) of role misfits and provide selective examples paraphrased from the data sources(Table 10).

***Role deficiencies***. The role in the TCSP has been authorised to execute the specific set of actions. However, role deficiencies may occur when some roles comply with the National Telemedicine Centre’s TCSP in symbolic and ceremonial ways. In the literature on organizational behaviour (Brown, 1995; Marguis and Qian, 2014; Pachidi et al., 2021), these actions are referred to as symbolic advocacy, defining as symbolic actions that aim to attribute meaning beyond their substantive effect and that may be ‘ deliberately employed in order to direct attention away from certain facts and towards others in order to protect sectional interests, gain resources and maintain or restructure institutional patterns of power and deference’ (Brown 1994, p. 863).

To explore this phenomenon further, I interviewed the managers from the regional-level hospitals who are close to the National Telemedicine Centre (They are in the same city). Several managers point out that symbolic behaviour is motivated by similar reasons in the following quotes.

‘TCSP *provides telemedicine services that we believe can help to improve the quality of our medical care and relieve our patients' suffering, however we want patients to remain in our hospital during their treatment. However, we are 20 minutes away from six national-level hospitals. Having been provided with a consultation by a national-level hospital, patients prefer to consult directly with that hospital instead of staying at our hospital for a remote consultation. In this case, they [National-level hospitals who provide tele-consultation service in TCSP] are no longer collaborators but competitors.*’ - A manager from a regional-level hospital located near a national-level hospital who provide tele-consultation service in TCSP

‘The *mission of TCSP is to share knowledge with all levels of the hospitals in the province in order to improve the quality of medical treatments. However, collaborating with TCSP, we struggle to keep patients in our hospital for follow-up treatments when a National-level hospital who provides tele-consultation service are located in the same city. It is long-term loss of patients that we suffer due to conflict of interest*’ *.* - A manager from a regional-level hospital located near a national-level hospital who provide tele-consultation service in TCSP.

As shown in the interview data, this research find that National Telemedicine Centre play a crucial role in implementing the TCSP project. However, due to the lack of the consideration of conflict of interest among participating hospitals and other stakeholders, a series of avoidance tactics initiated by these participating hospitals are exhibited, including passive coping responses (e.g., a delay in signing the collaboration memo), ceremonial conformity (e.g., participating in activities or events organized by TCSP but not taking any substantive action afterwards), symbolic gestures of compliance (Aakhus, et al.,2014) (no consultation request is made after the collaboration agreement has been signed), and suppression of information dissemination (e.g., refusing to share patient data). I observed that participating hospitals closer to national-level hospitals or the National Telemedicine Centre would avoid actual engagement. Thus, the level of symbolic compliance is determined by the geographical distance between the tele-consultation service provider and the service receiver. Collaboration in telemedicine is more likely to result in conflict if the service provider and the service receiver are located close together geographically.

***Role impositions***. Implementing a new information system requires new actions, tasks, and responsibilities, which increases the workload for system users (Van den Hooff and Hafkamp, 2018). The observation shows that P-HC is increasingly burdened by the TCSP because they still have to conduct office visits with patients physically. Specifically, role integration and interoperability are increased by inter-organisational collaboration. Consequently, coordination activities must be performed by TCSP participants more often and They must have a better understanding of the telemedicine tasks they need to perform. In turn, this significantly increases the workload of the interaction among users and new tasks.

Additionally, the findings pointed towards an increase in workload for P-AS. This especially emerged when P-AS need to monitor whole consultation process. Over 300 participating hospitals involved in the TCSP are served simultaneously by six national-level hospitals. Consultation allocation interfaces receive a great deal of tele-consultation requests each day. Each consultation requires the process of requesting service, matching, addressing technical or medical issues pre-, during, and post-consultation, and issuing the reports. P-AS perform these multiple tasks, which increases their workload, as is illustrated by the two P-AS:

‘We *[P-AS at a national-level hospital] are assigned to monitor entire consultation process from beginning to the end (e.g., requesting service, matching, addressing technical issues during consultation, and issuing the reports), which results in over workload*’.– A P-AS at the national-level hospital

‘Besides *classifying the tele-consultation requests from the requesters [RL-Ds], we [P-AS] also matches it with our consultants who have relevant expertise. As soon as the match is made, contact the consultants to schedule a consultation. We must also contact the requesting physician [RL-D] if the consultants require the applicant to perform required tests in advance.*’  *– A P-AS from National Telemedicine Centre*

Concerning role imposition, this research identifies a mismatch exists between the responsibilities and capacities and the skills and knowledge available of a role. For example, the performing medical triage conducted by P-AS is required to possess a thorough medical knowledge to assign a suitable P-HC to the consultation case, and to be able to communicate well with both sides of telemedicine service. A lack of medical expertise, clinical experience, practical knowledge of system operation makes it difficult for them to perfectly match each case.

‘*Our [P-AS] responsibilities are redefined by the TCSP, requiring us to perform complex* *medical triage tasks to match tele-consultations. Prior to telemedicine, we played only a secondary role in offline healthcare. Now, we are responsible for the smooth operation of telemedicine services. Thus, it is difficult for some colleagues to accommodate due to a lack of medical expertise and practical knowledge of how the system works.*’  *– A P-AS from National Telemedicine Centre*

Moreover, teleconsultations need be completed in a limited amount of time due to back-to-back scheduling. RL-D and P-HC must improve their communication skills in order to complete teleconsultations in a timely manner. The observational fieldnotes and the interview from P-HC pointed out the similar concerns.

*‘There is a distinct gap in expertise and experience between the P-HC and the RL-D. In some cases, tele-consultation cannot continue when RL-Ds fail to communicate effectively and cannot clearly describe the patient's condition. Telemedicine services cannot be completed in a limited time frame if P-HC needs to explain everything in detail*’. *- Observational fieldnotes taken at National Telemedicine Centre*

‘When *I met with the local doctor [RL-D] for the remote consultation, I often found that he was having difficulty describing the patient’s condition or providing the results of necessary tests*.’ - A P-HC at the national-level hospital

TCSP roles are defined as fixed responsibilities without flexibility, as they are intended to carry out fixed or specific tasks. The limitations of authorisation in each role exacerbate this problem, limiting what participants can do and increasing their vulnerability at work. As a result of these limitations, participants only know their responsibilities within the boundary, but not consider the responsibilities from the interorganisational perspectives. For example, in the procedure of matching teleconsultation, several P-AS were authorised to perform the matching. The responsibility for each of them is not well defined, which results in mismatched or overlapped consultations. According to one P-AS complaints:

*‘TCSP, by default, allows many of us [P-ASs] to conduct the consultation matching. Some consultations may be assigned by our two colleagues with different matching results. Scheduling becomes confusing and chaotic as a result due to our responsibility and authorisation is unclear*’.– A P-AS from National Telemedicine Centre

In addition, the P-ITSs responsible for resolving technical issues in the TCSP were unable to address medical questions in the teleconsultation application. However, there are a lot of requests from regional and local hospitals asking them to resolve these problems that require medical expertise and knowledge. There is no clear definition of role responsibility and authorisation, leading to this issue. According to one officer on the P-ITS team:

‘I *[P-ITS] have been requested by the RL-D and RL-AS to deal with the problems of filling the teleconsultation requesting form. Some questions are required medical knowledge to answer. Since my job is to address technical huddles, I cannot assist them [RL-D and RL-AS] on any consultation application problems*’. - A P-ITS at the National Telemedicine Centre.

* D1-1: Symbolic action/compliance due to conflict of interest among roles

D1: Role deficiency

* D2-1: Over workload issues
* D2-2: A mismatch exists between the responsibilities and capacities of a role and the skills and knowledge available
* D2-3: Role responsibility and authorisation is not well defined
* D2-4: Insufficient preparation work prior to the consultation

D2: Role imposition

First-order concepts

Second-order themes

Aggregated themes

Figure 9. Data structure of role misfit

Table 10. Data structure of role misfit

|  |  |
| --- | --- |
| First-order concepts | Selective quotes |
| D1-1 | * A telemedicine system involves three levels of inter-organizational collaboration. The organizational goals and interest of each level are different. In cases where regional- and local-level hospitals are located in the same city as national-level hospitals, a potential conflict of interest is emerged. (Source: RL-M interviews) * As a result of lack of consideration for conflict of interest between participating regional- and local-level hospitals and national-level hospitals, a series of avoidance tactics initiated by these participating hospitals are exhibited, including passive coping responses (e.g., a delay in signing the collaboration memo), ceremonial conformity (e.g., participating in activities or events organized by TCSP but not taking any substantive action afterwards), symbolic gestures of compliance (no consultation request is made after the collaboration agreement has been signed), and suppression of information dissemination (e.g., refusing to share patient data). (Source: PD/NTC and RL-M interviews) |
| D2-1 | * P-AS and RL-AS are assigned to monitor entire consultation process from beginning to the end, which results in over workload (Source: P-AS interviews) |
| D2-2 | * The performing medical triage conducted by P-AS is required to possess a thorough medical knowledge to assign a suitable P-HC to the consultation case, and to be able to communicate well with them. A lack of medical expertise, clinical experience, practical knowledge of system operation makes it difficult for them to perfectly match each case (Source: P-AS interview and observational field notes) * For remote consultations to be successfully completed in limited time, the RL-D must clearly describe the patient’s situation or provide necessary test results. A sufficient communication skill is required. (Source: P-HC interview and observational fieldnotes) |
| D2-3 | * TCSP, by default, allows several P-ASs to conduct the consultation matching synchronously. Some consultations may be assigned by two P-AS with different matching results. Scheduling becomes confusing and chaotic (e.g., mismatched or overlapped consultations; two P-HC were assigned to one case) as a result due to the responsibility and authorisation of P-AS is unclear. (Source: P-AS interview) * The P-ITSs responsible for resolving technical issues in the TCSP were unable to address medical questions in the teleconsultation application. However, there are a lot of requests from regional and local hospitals asking them to resolve these problems that require medical expertise and knowledge. (Source: P-ITS interview) |
| D2-4 | * Insufficient preparation occurs during tele-consultation. For example, the required examinations were not conducted as requested in advance by P-HC) (Source: P-HC interview) |

## 4.5 Control misfit

From the organisation-enterprise system fit perspective, Strong and Volkoff (2010) define control misfit as ‘occur when the controls embedded in the ES provide too much control, inhibiting productivity, or too little control, leading to the inability to assess or monitor performance appropriately’ (p. 737). Control misfit occurs, because the needs of enterprise system users develop gradually, so it may take some time until the system is tailored to fit the needs of the users so that its functionality is clear and comprehensible (Howcroft and Light, 2010). In the telemedicine context, control misfit exists when the system has too much control, inhibiting productivity (e.g., unnecessary teleconsultation paperwork), or too little control, making it impossible to assess or monitor quality of care or the effectiveness of teleconsultations (e.g., limited access to patient data for diagnosis during the teleconsultation).

Control misfits can be attributed to deficiencies or impositions based on dataset. Deficiency of control prevents adequate assessment and monitoring of teleconsultation performance when control is insufficient, while control imposition is the act of exerting too much control by telemedicine platform managers, which makes productivity difficult. In Figure 10, the first-order concepts and second-order themes (i.e., control deficiencies and impositions) of control misfits are summarised and provide selective examples paraphrased from the data sources(Table 11).

***Control deficiencies***. Telemedicine platform extends its reach and scale by increasingly building the partnerships with a wide range of collaborators across hospital networks and medical domains (Barbosa et al., 2021). In this case found that as a result of the intensive collaborations taking place in the TCSP, there is an inconsistent level of control or out of control at different levels of the hospital. For example, P-HC does not have access to track the patients’ journey (e.g., treatment progress and follow-ups). Teleconsultation in the TCSP is likely to be a one-time service focused on addressing patients’ current symptoms. P-HC fail to move forward with patients’ treatment plan or a follow-up consultation. It is inevitable that national-level hospitals lose some control on patient data governance, patient journey tracking, and system usage and compliance to a certain extent. This is evident by the interview from a P-HC at a national-level hospital.

‘*Based on the test results and symptoms described by the requesting doctor, we make our diagnosis. There is, however, no guarantee that a patient’s condition will not change on a daily basis. It may be difficult for us to provide support if the patient’s condition changes after the consultation. It will be necessary to wait for the next consultation request. If we have the opportunity, we would like to know in real-time how the patient is doing during the remote consultation.*’  *-* a P-HC at a national-level hospital.

In addition, quality control mechanism (rewards or punishments) for teleconsultation services is not in place among hospitals participating in the TCSP. In essence, TCSP is a hospital network that provides remote telemedicine services to hospitals at a local and regional level. Yet, quality control mechanism is difficult to implement in the network since the TCSP does not have substantial control over these hospitals. In spite of the policies (e.g., procedures, guidelines, and evaluation criteria of quality control for telemedicine practices, TCSP cannot effectively control the way the participating hospitals adhere to those policies. Thus, since TCSP has little control over its participating hospitals and healthcare professionals, there is only a limited level of substantial engagement in the short term (e.g., low volume of teleconsultation requests). The platform director from National Telemedicine Centre realized that

‘*Despite clear procedures, work protocol, responsibility, and evaluation of telemedicine practices for the participating hospitals, they failed to follow the policies we agreed upon when signing on to the collaboration agreement. Following these policies can help TCSP members to achieve the ultimate goal of TCSP - addressing healthcare disparities in rural areas to achieve optimal healthcare delivery. However, we are struggling to ensure that their actions comply with the TCSP due to conflicting interests, motives, and preferences among TCSP members*’ *-* Platform director from National Telemedicine Centre

A standardisation of system use is established in order to ensure technical interoperability for data governance, business processes, and resource allocation (Lindgren et al., 2021; Zhao and Xia, 2014). In this case observe that there is a high level of inconsistency in system use as a result of poorly controlled compliance behaviours by participating hospitals. In other words, insufficient control was exercised over the standardisation of the TCSP. For instance, interoperability of data governance (e.g., data labelling and patient data may be scattered across different systems) is challenging due to the fact that TCSP members use different healthcare information systems. Data governance refers to the exercise of permissions and controls over data management (Abraham et al., 2019). Data governance aims to add value to data and minimize costs and risks (Abraham et al., 2019). In this study, data governance faces three ongoing challenges. ***First***, during healthcare digital transformation, TCSP members adopted a variety of healthcare information systems. Hospitals and clinical departments have large inconsistency in data use, such as EHR data unit values and mappings of drug names, preventing interoperability. ***Second***, since the TCSP does not have an interface connection to the systems used among the platform members, patient data may be scattered across multiple systems. As a result, a single hospital or department cannot track all aspects of patient care delivery and journey. ***Third***, since TCSP lacks interoperability at the operational, process, and service levels, it is unable to analyse clinical information data and formulate relevant data mining algorithms and statistical knowledge to identify potentially beneficial treatment patterns and decision-making knowledge from the data in order to assist doctors in finding better treatment methods and clinical pathways and hospital decision-makers in adjusting their strategies.

***Control impositions*.** Control impositions occur because of limited flexibility (Strong and Volkoff, 2010). The TCSP’s protocol ensures that the service runs smoothly and maximizes the collective interests of all its participating hospitals. In some cases, such a protocol setup may not be reasonable. Patients may be present or absent during remote consultations depending on the diagnostic requirements. Remote consultations protect the doctor from no-compliance and disagreements related to medical procedures since the consultant does not see the patient. Because of strict controls and a lack of flexibility, experts have difficulty making accurate remote diagnoses. A rehabilitation Medicine P-HC at the national level hospital questions that

*‘We may need to take pictures and videos of a patient's signs to make sure the diagnosis is accurate. The RL-D can do this with their mobile phone. Lighting or camera angle may have caused the low quality of image. We may have to give two or three diagnoses and medications because it is impossible to examine the patient accurately, and we may need to share personal contact information to RL-D to deal with this issue’ -* A rehabilitation Medicine P-HC at the national level hospital.

* E1-1: Fail to trace patient journey.
* E1-2: The evaluation and reward/punishment mechanisms of system usage compliance behaviour is absent
* E1-3: insufficient control was exercised over the standardisation of the TCSP

E1: Control deficiency

* E2-1: Little flexibility about controls were exercised

E2: Control imposition

First-order concepts

Second-order themes

Aggregated themes

Figure 10. Data structure of control misfit

Table 11. Data structure of control misfit

|  |  |
| --- | --- |
| First-order concepts | Selective quotes |
| E1-1 | * P-HC do not have a way to track the patients’ journey (e.g., treatment progress and follow-ups). Teleconsultation is more likely to a one-off service and focuses on addressing current symptoms that patients face. P-HC fail to move forward with patients’ treatment plan or a follow-up consultation (Source: P-HC interview and system log report) |
| E1-2 | * In spite of the policies (e.g., procedures, guidelines, and evaluation criteria of quality control for telemedicine practices, TCSP cannot effectively control the way participating hospitals adhere to those policies (Source: PD/TCSP interview) * Since TCSP has so little control over its participating hospitals and healthcare professionals, there is a low level of substantial engagement in the short term (e.g., low volume of teleconsultation requests). (Source: PD/TCSP interview) |
| E1-3 | * Insufficient control was exercised over the standardisation of the TCSP. For instance, data interoperability (e.g., data labelling and patient data may be scattered across different systems) is challenging due to the fact that TCSP members use different healthcare information systems. * Since TCSP lacks interoperability at the operational, process, and service levels, it is unable to analyse clinical information data and formulate relevant data mining algorithms and statistical knowledge to identify potentially beneficial treatment patterns and decision-making knowledge from the data in order to assist doctors in finding better treatment methods and clinical pathways and hospital decision-makers in adjusting their strategies. |
| E2-1 | * TCSP, in some cases, prohibits the patients from participating in a remote consultation meeting. Although the presence of patients is mandatory at consultation meetings for particular clinical procedures, P-HC cannot force them to attend. (Source: P-HC interview and the archival data) |

## 4.6 Resolution of deep structure misfit in the data and functionality domains

In TCSP, achieving deep structure fit was a challenge as the platform operating across different health organizations is increasingly essential for transferring data and coordinating health care. Data quality is essential for making timely and accurate decisions regarding the health and welfare of patients. When data deficiencies arise, consultants are not able to make effective decisions because of insufficient, incomplete, or untraceable data (Boyer and Pronovost 2010; Hausser 2020; Liu et al., 2017). Consultants’ work is negatively impacted by this. When data imposition occurs, due to incompatible data formats between requirements and system packages (Wu et al., 2007) and the lack of data integration and standardisation (Strong and Volkoff, 2010), both support staff spend a lot of time on manual input. There was a vicious cycle identified in the findings(Figure 11). Several complaints were received from key users (e.g., P-AS and P-HC), including typing errors; inaccurate medical records; and failure to follow up by consultants. In addition, there is an overwhelming workload, error-prone deliverables, and an overall feeling of drowning, indicating by P-HC that ‘*In most cases, we have to make precise diagnoses based on vague, incomplete information about the patient*’.

***Phase 1- Breaking deep structure misfit*.** In order to interrupt the data misfit vicious cycle, the national telemedicine centre survey team broke dysfunctional dynamics. Initially, these actions sought to reduce and eventually halt an actor’s entrenchment in questioning the process and policy of harnessing health records in a social-symbolic context. According to the national telemedicine centre survey report: ‘A well-established process exists for navigating medical records, but it is not enforced.’ As the National Telemedicine Centre survey team went deeper, they realized there were serious challenges to achieving interoperability between institutions. They mentioned two of the most significant difficulties in the survey report: *‘Consultation cases could not be stored centrally in the TCSP for uniform access and sharing of data between users (source: archival data).’ And ‘Once the consultation has been completed, the consultant will not be able to access the EHR data (source: archival data).’*  As a final step, the national telemedicine centre survey team identified the need for a data sharing policy/mechanism/agreement/governance. However, data sharing mechanisms and associated governance protocols were in place but could not be implemented(Table 12).

The National Telemedicine Centre survey team noted in their informal conversations with supporting actors in Phase 1 that their position as ‘paradoxical outsiders’ allowed them to have a deeper understanding of the problems associated with support staff’s use of the system. In the various informal conversations, the main users of the system (P-AS and P-HC) were very cooperative, because they understood that their complaints about the system would help the TCSP upgrade it. When a system is upgraded, they are the ultimate beneficiaries.Two major pain points of data mismatch have been identified by the National Telehealth Survey team. It was surprising to learn that solutions have existed to the data misfits, but they were unable to be implemented. As part of the first phase, the national telemedicine survey team supported the telemedicine system’s transition from a negative state to a breaking state.

***Phase 2- Implementing the resolutions.*** The first phase has a clear definition of the pain points and the solutions that cannot be practiced. Attempting a solution is only possible through this clear definition. In the second phase, the main task is implementing the solution. As a result, neither the national Telehealth Central survey team nor the national Telehealth Central Technical Department were able to practice data exchange and data governance. It eventually becomes necessary to involve software companies in the implementation of data exchange and data governance. According to a National Telemedicine Centre’s director: ‘*Telemedicine’s technical team organized several meetings on data governance in which the top-10 domestic HIT companies participated. Several options were discussed on how to integrate the telemedicine system into the sub-centre’s original case system*’ (Table 12).

To move from cycle break to cycle reversal, mainstream domestic IT vendor and National Telemedicine Centre survey team sought to facilitate new solution. A mainstream domestic IT vendor along with the national telemedicine centre survey team have not produced any breakthrough-worthy solutions during technical exchanges. There is still a misfit in the data, and the domestic IT vendor is proposing a replacement. The participating hospitals’ existing medical records system is connected to TCPS through a cloud interface created by an IT vendor.

This phase of the process relies heavily on the technical staff’s role as insiders to the organisation rather than outsiders to the paradox to resolve to Phase 1. The National Telemedicine Centre argued that, as outsiders, techies from tech companies could be seen as data misfits’ problem solvers and truly capable of finding solutions to data misfits. ‘*We have been able to find solutions to the data misfits’ problems. we are experiencing more quickly by discussing with engineers from several of China’s top software technology companies*’ said one member of the National Telemedicine Centre survey team.

***Phase 3-******Reinforcing virtuous circle*.** After having experimented with interface connection of engaging interoperability synergistically, Data exchange started to adopt some of the new responses in a more systematic way in partial institutional. A virtuous cycle was gaining momentum(Figure 12). In follow-up interviews conducted at national enter one year after the planned action, this research found consultation volume increased at sub-centres with interoperability with provincial telemedicine centres. Several sub-centres achieved the ID number can be used to flow between multiple applications to facilitate cross-system association and data flow. The consultation system may be expedited for patients with critical illnesses depending on their underlying conditions. Specialists have access to patient cases ahead of time for research.

Embedding virtuous dynamics in the data. Telemedicine systems were aimed at ensuring that contextual conditions needed to sustain a virtuous cycle remained over time. This required engagement with sub-centres to garner support. These system upgrade activities started three months into the study but were predominant at the end of the system update and in the following year in IT vendor and national telemedicine centre.

During this phase, the position of IT vendor and national telemedicine centre survey team as insiders to the organization helped facilitate the endurance of a virtuous cycle. As insiders, IT vendor and national telemedicine centre survey could leverage their connection to sub-centre organization-wide systems and people to build social support for interface. They understood the formal and informal networks through which sharing practices, more sub-centres will be able to use the interface. For example, one member of national telemedicine centre survey team mentioned in a meeting, the need to speak with other sub-centres and keep informed the interface benefits. If they could use interface to connect telemedicine system that a strong support their supporting staffs and doctor easy-to -use telemedicine service.

**Breaking deep structure misfit**

* *Realising the challenges of achieving interoperability among institutions (PD1-1)*
* *Questioning the process and policy of harnessing medical records (PD1-2)*
* *Complaints from users received (PD1-3)*

**Implementing the resolutions**

* *Consulting IT vendors to find potential solutions of data exchange/governance (PD2-1)*
* *Alternating the sequence of data sharing procedure (PD2-2)*

**Reinforcing virtuous circle**

* *Achieving system interoperability among partial institutions (PD3-1)*
* *Establishing proper data sharing policies and governance (PD3-2)*

Vicious cycle

Virtuous Cycle

Phase 1

Phase 2

Phase 3

Supporting actors in fostering cycle shifts

National level

Regional and local level

P-HC and P-AS PD/TCSP, P-ITS, P-AS PD/TCSP, P-ITS, P-AS

RL-D, RL-AS RL-D, RL-AS RL-AS, RL-ITS

RL-ITS

Figure 11. A model of deep structure misfit (data and functionality) resolution

Table 12. A model of deep structure misfit (data and functionality) resolution

|  |  |
| --- | --- |
| Code | Deep structure misfit resolution practices |
| PD1-1 | * Consultation cases are not able to be stored centrally in the TCSP for unified access and data sharing among users (Source: archival data). Once the consultation is completed, EHR data cannot be accessed and retrieved by consultants |
| PD1-2 | * P-HC questions that a well-established process for navigating medical records already exists but is not well implemented in TCSP (Source: P-HC interview). |
| PD1-3 | * RL-D utilises in-house healthcare information system, which is not connected with TCSP. Requesting a teleconsultation, RL-D need to fill in the consultation records manually. This may cause typing errors or typos on the records. (Source: system log report) * P-AS needs to transit the handwritten consultation record into TCSP. This approach is inefficient and error-prone caused by complex medical terms written by consultants, resulting in inaccurate medical records when transiting) (Source: P-AS interview) |
| PD2-1 | * There have been technical discussions with mainstream domestic information vendors, and almost all of the top-ranked domestic HIT companies have come to the provincial centre for technical exchanges. |
| PD2-2 | * The existing EHR systems in the regional and local participating hospitals are connected to TCPS through a cloud interface created by an IT vendor. |
| PD3-1 | * The ID number can be used to flow between multiple applications to facilitate cross-system association and data flow. * The consultation system may be expedited for patients with critical illnesses depending on their underlying conditions. * Specialists have access to patient cases ahead of time for research |
| PD3-2 | * The consultation system may be expedited for patients with critical illnesses depending on their underlying conditions. |

## 4.7 Resolution of surface structure misfit in the usability domains

***Phase 1- Breaking deep structure misfit*.** The results indicate that the functionality of the telemedicine system is stuck in a vicious cycle(Figure 12). System users continue to encounter system errors both in the usage of the system and in its core functionality, leading them to more complaints. P-AS were repeatedly asking P-ITS to resolve problems in the TCSP. For instance, these core functional errors are caused by the failure to deliver telemedicine services and scheduled consultations that do not appear, and frequent service interruptions. In addition, the P-AS with unsatisfying user experience, continuously report the malfunctions and their requirements to the P-ITS team who is responsible for the day-to-day operations and the maintenance of the TCSP.

P-ITS engaged in the breaking of surface structure misfits reviewed the issues in the system log reports (e.g., difficulties accessing scheduled consultations). RF-ITS and P-ITS both report errors at various levels. Meanwhile, P-ITS frequently had to deal with system functionality issues. It is common for these problems to occur during teleconsultations, which makes telemedicine services difficult to provide. After this, many complaints were received from support staffs that TCSP was unable to handle their daily work efficiently. The P-ITS team wrote at analysis report, ‘*a strong demand for the real-time push notification of consultation progress from the hospital support staff. It is because their role within their organisations requires intensive multitasking. The notification feature can instantly alert them when there is an update or any pending actions in the online system, thus freeing them from spending unnecessary hours tracking the progress and enabling them to switch smoothly from other administrative tasks.*’ ‘*The searching function that can return a list of doctors matching specific expertise and/or keywords to ease their job of finding the right person for a consultation. Without these features, the first group of support staff users suffered from not only annoying system bugs but also limited productivity*.’ Several of these situations were brought to the attention of the technical staffs. A comprehensive analysis of system errors report, daily log files, and user feedback is conducted by the technical team. In the end, the technical team unanimously decided to post system error report and report to the Director of National Telemedicine Centre(Table 13).

Technicians are passively exposed to a variety of problems associated with systems. As a ‘paradoxical outsider,’ the technician ensures that the telemedicine system works properly, is dependable, and is constantly improved and enhanced to be fully functional. Since the telemedicine centre technicians are not involved in the users of the telemedicine system - that is, have no stake in detecting and reporting functional misfits - they can be seen as neutral when they receive, fix, and analyse errors and complaints about the telemedicine system. Users of the telemedicine system know that technicians at the telemedicine centre assist them when using it. A technician at the Telemedicine Centre stated: ‘*We are responsible for correcting hidden errors found during the use of the telemedicine system and enhancing new functionalities and performance requests made by users, in order to ensure that the telemedicine system remains normally operational. In order to solve problems that arise with the use of telemedicine systems, we are the best partner for users*’(Table 13).

***Phase 2- Implementing the resolutions.*** Technical reports on telemedicine systems ended the vicious cycle of telemedicine and marked the beginning of the reversal of the process(Figure 12). In their analysis report, the technical team concluded that telemedicine systems had entered a vicious circle that could not be reversed just by maintaining the systems. Therefore, the system upgrade becomes a functionally misfit solution. The IT vendor was brought in during the reversal phase to upgrade the telemedicine system to address the vicious cycle. In order to refine the current problems with the telemedicine system, the technical team held meetings with the system users who they are more aware of the limitations of telemedicine systems and discussed current problems with the IT vendor which learn about their solutions. Even though the system users were unsure if the upgrade would help them solve their work dilemma, they actively participated in meetings organized by the technical team.

To move from cycle break to cycle reversal, IT vendor sought to facilitate new responses. The vendor identifies TCSP problems and classify them into existing system bugs and new features that are wanted but not yet implemented in the current release. To do so, the vendor collected as much feedback as possible from the hospital support staff, doctors, and IT operations teams through face-to-face interviews, system log files and monitoring statistics. Based on the information analysis, the vendor and the IT operations team agreed that a big iteration of the TCSP is necessary to fix the existing bugs in the current release and add new features for ease of use and improved efficiency.

Detailed user requirements specification (URS) was updated to satisfy the end user’s requirements. The URS document defines key features, such as doctor profile searching, consultation requesting, appointment booking, and progress notification. It provides detailed guidance on what to fix and what to implement in the next iteration.

Prior to the deployment of the next release in the large-scale IT infrastructure of hospitals and data centres, a controlled small-scale smoke testing was conducted to ascertain that the bugs in the previous version had been fixed and that the critical functionalities of the system were working fine. Bugs, issues and user requirements were still being collected from hospital support staff and operations teams as feedback to keep the iteration cycle running. This period reflects the shift from a cycle break stage to a cycle reversal stage, with the TCSP starting to function gradually.

As an outsider to the organization rather than an insider to the telemedicine centre, the IT vendor serves as the main driver for upgrading the telemedicine system. As with phase one, the technical team felt that, as an outsider, the IT vendor could be seen as neutral and had expertise in upgrading the system. As one member of the technical team explained, ‘*Our mission is to maintain the system and keep the telemedicine system running reliably and efficiently. The IT vendor can fully utilise their skills to eliminate system bugs and enhance system functionality*’ (Interview with a member of the technical team)(Table 13).

***Phase 3-******Reinforcing virtuous circle*.** All system users attend a live online class which was held to explain the new system’s features and to demonstrate it in action. After training on the new system, system users begin using the telemedicine service. A handbook to operating the upgraded telemedicine system was developed by vendor and technical team. The handbook is always available and easy to access. The virtuous circle is forming(Figure 12). In follow-up interviews with support staff two months after the launch of the new system, this research discovered that the upgrade improved efficiency and interoperability, even though it did not meet all the needs of users. An example would be the expert enables automatic retrieval of some EHR telemedicine case using application number.

After the software was upgraded and the acceptance testing was passed, the TCSP began to work as designed and efficiently delivered remote telemedicine consultation services. In this phase, the interactivities between the supporting staff, doctors, technical teams, and the software vendor became natural flows. The vendor generates comprehensive documentation and corresponding video tutorials for users at different levels to help them grasp the knowledge of using the system as quickly as possible. Meanwhile, the vendor continues optimising the online system’s performance in handling excessive concurrent access requests and complex user hierarchy management based on the previous monitoring statistics and feedback from end users at different levels.

In this phase, one demand raised by the end users and solved by the vendor is integrating the legacy EHR system into the TCSP. Manual transfer of patient records from a legacy EHR system to the new TCSP can be tedious and error prone. Automatic retrieval and transfer of such records smoothly link two independent systems and dramatically reduce the time and resources spent on each telemedicine consultation. Like a virtuous cycle, the TCSP works efficiently and effectively, offering remote consultations as expected.The technician team arranged an online class with the IT vendor to explain the new system’s functions. Additionally, the technician prepared an instruction manual with the IT vendor. System users with problems can access the manuals and online videos.

It is the vendor’s position as an outsider in the organization that makes the virtuous circle more durable at this point. Using their expertise in IT, IT Vendor trained system users on the upgraded telehealth system, providing hands-on support. A second step was for IT Vendor and technical team to collaborate on online videos and manuals that provide a hands-on experience with the telemedicine system. As a result of the instructional videos and manuals, the telemedicine system and its users are further boosted into a virtuous cycle.

**Breaking surface structure misfit**

* *Reporting the system errors by supporting staffs from different levels (PS1-1)*
* *Complaining from supporting staffs that TCSP cannot support their daily work efficiently (PS1-2)*

**Implementing the resolutions**

* *Identifying system errors (PS2-1)*
* *Understanding system user needs when resolving the system errors (PS2-2)*
* *Building up requirement log and running a trial testing (PS2-3)*
* *Using focus groups to discuss what kind of functions to incorporate in system upgrade (P2-4)*

**Reinforcing virtuous circle**

* *Training on the use of the new system (PS3-1)*
* *Keep improving system flexibility and interoperability (PS3-2)*

Vicious cycle

Virtuous Cycle

Phase 1

Phase 2

Phase 3

Supporting actors in fostering cycle shifts

National level

Regional and local level

P-HC and P-AS IT vendors, P-ITS, P-AS IT vendors, P-ITS, P-HC

RL-D, RL-AS RL-D, RL-AS, RL-ITS RL-AS, RL-ITS

RL-ITS

Figure 12. A model of surface structure misfit (usability) resolution

Table 13. A model of surface structure misfit (usability) resolution

|  |  |
| --- | --- |
| Code | Surface structure misfit resolution practices |
| PS1-1 | * P-ITS reviewed system error reports, including being unable to access the telemedicine system or unable to view scheduled consultations. |
| PS1-2 | * P-ITS received several system user’s complaints, for example: they need the real-time notifications by mobile phone to improve efficiency of daily work or does not provide searching function (e.g., consultant profile and expertise). |
| PS2-1 | * The IT vendors meet with P-ITS team to know more about system errors. * After discussing and analysing the system error reports, the IT vendors and P-ITS team confirmed that it was defined as a system upgrade, which add some features not previously available, as well as fixing system bugs. |
| PS2-2 | * The IT vendors and the leader of P-ITS interview supporting P-AS, P-HC, RL-AS, and RL-D to collect their needs. |
| PS2-3 | * The IT vendors builds up requirement log from five dimensions including *Consultation request*, *Consultation scheduling*, *Consultation Management*, *Consultation quality control*, and *Statistical queries*. * The IT vendor upgrades a copy of the live site, which identify any code and/or database conflicts and where further work will be required. |
| PS2-4 | * After a trial testing, the system users give feedback what kind of functions should be altered by IT vendors. |
| PS3-1 | * A handbook to operating the upgraded TCSP was developed by IT vendors. * The IT vendor offers all system user a live online training workshop which was held to explain the new system’s features and to demonstrate it in action. |
| PS3-2 | * The expert enables automatic retrieval of some EHR telemedicine case using application number. |

## 4.8 Resolution of latent structure misfit in the role domain

***Phase 1- Breaking latent structure misfit in the role domain.*** The supporting staffs and demand-side doctors are caught in a vicious cycle in the finding of role misfits. The role impositions dominate the content of role misfits. and are so overwhelming that they increasingly equate the negative aspects of their jobs. Firstly, over workload issues. With increasing numbers of telemedicine consultation applications, both support staff and doctors have more work to do. However, the number of support staff and doctors has not increased. Secondly, role responsibility is not well defined. Thirdly, the supporting staff and the doctor from demand side have inconsistencies exist between roles and skills/knowledge. Lastly, RL-D is available insufficient preparation on demand side prior to the consultation.

To interrupt the supporting staffs and demand-side doctors’ vicious cycle, management investigation team and centre manager engaged in the breaking of dysfunctional dynamics(Figure 13). Through these efforts, the underlying causes of role misfits can be uncovered and defined, reducing and ultimately stopping them in the future. Firstly, management investigation team regularly understand TCSP’s user experience in various roles through surveys, phone call investigations, or face-to-face meetings. For example, management investigation team create the questionnaire for understanding TCSP’s user experience in various roles. Doctors and support staff from primary care hospitals who applied for telemedicine were asked to fill out the questionnaire. The questionnaire was about the quality of expert and support staff accompanying services and areas for improvement. Secondly, management investigation team were conducted with the random selection interview of relevant personnel in the sub-centre by phone calls. The random telephone interviews had two important directions. The first direction in the interviews focused on how to deal with the tough issues in telehealth service work. The second direction in the interviews focused on the use of telemedicine systems, the quality of services provided by telemedicine systems, and the challenges faced by telemedicine systems at the sub-centre. There are two types of communication between the Centre Director and the support team: group meetings and one-on-ones. Thirdly, the supporting staff received complaints from consultants, who considered the doctors at primary hospitals lacked clinical domain knowledge and experience, as well as their lack of preparation for their roles. In view of this frequent complaint, the supporting staff reported this situation at an internal meeting of the National Telemedicine Centre.

As an insider to the telemedicine centre, the management investigation team and centre manger serves as the main driver for daily supervision the telemedicine system and inter-organizational collaboration. As with phase one, as the telemedicine system and inter-organizational supervisor, the management investigation team and centre manager could be seen as neutral and had expertise organizational management. The management investigation team and centre manager can fully utilise their investigation tools to identify organizational bugs and enhance inter-organizational collaboration.’ (Interview with a member of the management investigation team)(Table 14).

***Phase 2- Implementing the resolutions.*** Role involved actors’ social-symbolic work: Facilitating new responses. To move from cycle break to cycle reversal, IT staffs, the management investigation team and IT vendor sought to facilitate new responses(Figure 13). Firstly, the IT staff and IT vendor redefine the job responsibilities and standardising the entire consultation process to reduce the workload among supporting staffs at the interorganisational level and centre level in upgrade system. Previously, a consultation room has been scheduled for a number of consultations in the morning, but the equipment breaks down. Moving the consultations to another room will require the support staff to move them one by one. A batch selection of consultations can now be made, then they can be moved to another consultation room in the system. Support staff should be able to work more efficiently as a result of this.

Additionally, IT staff and IT vendors gathered support staff requirements regarding efficiency. It was developed as a mobile telemedicine system. The provincial support staff has used to mobile-based telemedicine systems, which are only available for scheduling and access. There is a huge step forward in terms of reducing the workload of support staff. Demand-side requests for teleconsultations are sent randomly.

*‘Just 10 minutes after closing time, the demand side sends a teleconsultation request, and the support staff has already left the workstation. To schedule the consultation with the computer-based operating system, the support staff returned to the workstation and turned on the computer. Single computer-based operating systems increased the workload of support staff, requiring them to spend more time and effort in the special scenarios. With mobile-based devices, urgent requests and emergencies can be made on the phone at any time and from anywhere.’ (Interviewed from supporting staff)*

Thirdly, optimising the appointment schedule and meeting room allocation for the supporting staffs so that each supporting staff has consistent workloads and optimised workload variations in the telemedicine centre. Previously, it was possible for two supporting staff to log in at the same time for simultaneous scheduling, the teleconsultation was repeatedly scheduled twice and unable to locate the specific person responsible scheduling. There is now a stricter permission setting in the system as a result of the upgrade. It cannot be scheduled by another support staff member if one has already clicked on the schedule page and scheduled it. There are three additional types of grouping for remote applications.

Fourthly, the management investigation team advice to establish a 360-evaluation mechanism to ensure employees’ (i.e., supporting staffs at the centre level) performance. Based on the 360-evaluation method, a performance management approach is developed without evaluating the leader in order to reduce pressure on the head of the centre. Under these indicators are also detailed secondary indicators, and an evaluation approach based on measurable KPIs is used(Table 14).

***Phase 3-******Reinforcing virtuous circle*.** There are telemedicine system upgrade, short-term training and 360-evaluation mechanism. The virtuous circle is forming(Figure 13). In follow-up interviews with support staff two months after the launch of the new system, this research discovered that the upgrade improved efficiency and interoperability, even though it did not meet all the needs of users. An example would be supporting staff clear to track job responsibilities(Table 14).

In short term, the National Telemedicine Centre offers supporting staffs training and the essential clinical (on-job) training to doctors. In 2016, an intensive one-week training program for supporting staffs and technicians of municipal sub-centres was carried out in partnership with Huawei, and those who passed the examination received a certificate of completion. This training laid the foundation for municipal telemedicine centres to use the telemedicine system effectively and was fairly successful. A key reason for this training was the completion of construction of the municipal sub-centre in the current year and the centralised work performed to put it into use smoothly.

The consultants regularly provide doctors with the essential clinical (on-job) training to improve the accuracy of diagnostic. For example, in conjunction with the Department of Pathology, two skills training sessions for primary pathology operators were held in 2017. Training focused on the collection of materials, wax block production, sectioning, and operation of the remote pathology diagnostic platform. The goal was to achieve uniformity in the quality of pathology section production.

As an outsider to the organization rather than an insider to the telemedicine centre, the IT vendor serves as the main driver for upgrading the telemedicine system and system training after upgrading. The technical team felt that, as an outsider, the IT vendor could be seen as neutral and had expertise in upgrading the system and system training. As an insider for telemedicine centres, IT staff to maintain the system and make sure it runs smoothly and efficiently. Technical team members can assist with upgrading the telemedicine system, collecting system requirements, and coordinating online training.

In Long term, the telemedicine centre of national level established training programs and hold annual events (Conference. Workshop) (e.g., various stakeholders).The telemedicine online education platform and the mobile education app offered online training programs. The large-scale online training was conducted including the covid-19 rescue guide and the operation of telemedicine system after the upgrade.Thetraining programs for(doctor) are online lectures about specialist topics. Every day, primary care doctors can attend online lectures on specialist topics in order to improve primary care specialist skills in the long term. Over 100,000 doctors have registered to use the mobile education app and platform.

The training program (for support staffs and IT staffs) is an online lecture about communication skills, information system knowledge and operation of telemedicine consultation system. Moreover, the Henan Telemedicine Centre has published telemedicine science materials and training materials on the use of its comprehensive service platform. Regular online courses and targeted system operation manuals help support staff respond better to cross-organisational communication and resolve system operation issues.

Annual events are also divided into two categories, telemedicine diagnosis and remote services. Every year, a network ECG conference is held in conjunction with the Department of Physical Diagnosis to introduce the fundamentals of ECG diagnosis, remote ECG technology, etc. This training is attended by about 200-300 people each year, and it is also quite effective in building up skills in the use of ECG networks. An annual Yellow River Forum on Telemedicine Informatization is held and experts from inside and outside of the province are invited to deliver lectures to improve everyone’s knowledge of telemedicine and to master innovative technology.

It is the consultant’s position as an insider in the organization that makes the virtuous circle more durable at this point. Using their expertise in diagnosis, consultants trained on the upgraded telehealth system, providing hands-on support. A second step was for IT Vendor and technical team to collaborate on online videos and manuals that provide a hands-on experience with the telemedicine system. As a result of the instructional videos and manuals, the telemedicine system and its users are further boosted into a virtuous cycle.

**Breaking latent structure misfit in the role domain**

* *Regularly understanding TCSP’s user experience in various roles through surveys, phone call investigations, or face-to-face meetings (PR1-1)*
* *Complaining (consultants to primary hospitals’ doctors) about lack of clinical domain knowledge and experience, lack of preparation (PR1-2)*

**Implementing the resolutions**

* *Redefining the job responsibilities and standardising the entire consultation process to reduce the workload among supporting staffs at the interorganisational level and centre level (PR2-1)*
* *Optimising the appointment schedule and meeting room allocation for the supporting staffs so that each supporting staff has consistent workloads and optimised workload variations (PR2-2)*
* *Establishing a 360-evaluation mechanism to ensure users’ performance (PR2-3)*

**Reinforcing virtuous circle**

* *Providing the essential clinical (on-job) training to doctors to improve the accuracy of diagnostic decision-making (PR3-1)*
* *Establish training programs and hold annual events (PR3-2)*

Vicious cycle

Virtuous Cycle

Phase 1

Phase 2

Phase 3

Supporting actors in fostering cycle shifts

National level

Regional and local level

P-HC and P-AS PD-TCSP, IT vendors, P-ITS, P-AS PD-TCSP, P-ITS,

P-HC

RL-D, RL-AS RL-D, RL-AS, RL-ITS RL-AS, RL-ITS

RL-ITS

Figure 13. A model of latent structure misfit (role) resolution

Table 14. A model of latent structure misfit (role) resolution

|  |  |
| --- | --- |
| Code | Latent structure misfit resolution practices (focusing on role misfit) |
| PR1-1 | * P-ITS Doctors and support staff from primary care hospitals who applied for telemedicine were asked to fill out the questionnaire. The questionnaire was about the quality of expert and support staff accompanying services and areas for improvement. * Interviews were conducted with a random selection of relevant personnel in the sub-centre by phone calls. * The interviews focused on the use of telemedicine systems, the quality of services provided by telemedicine systems, and the challenges faced by telemedicine systems at the sub-centre. There are two types of communication between the Centre Director and the support team: group meetings and one-on-ones. |
| PR1-2 | * RL-D fails to possess the experience/skills needed to properly describe patients’ symptoms or explain examination results in complex cases. |
| PR2-1 | Through TCSP upgrade to redefine job responsibilities /allocate workload   * Teleconsultations can be adjusted in bulk. Consultation rooms, for instance, schedule a number of consultations. As a result, the room will not function properly on the day of the consultation, and it needs to be moved to another consultation as soon as possible. Previously, support staff had to transfer consultations one by one from this room to the new room. Bulk selection and transfer to another consultation room are now possible with the upgraded system. * A mobile-based telemedicine system is available. Mobile phones can be used for scheduling and consultations. |
| PS2-2 | * The scheduling of consultations is limited to only one support staff at a time, which is locked after scheduling, so that duplicative work is not performed by other support staff. |
| PS2-3 | * The 360-evaluation method, a performance management approach is developed without evaluating the leader in order to reduce pressure on the head of the centre. Under these indicators are also detailed secondary indicators, and an evaluation approach based on measurable KPIs is used. |
| PR3-1 | * An intensive one-week training program for supporting staffs and technicians of municipal sub-centres was carried out in partnership with Huawei, and those who passed the examination received a certificate of completion. This training laid the foundation for municipal telemedicine centres to use the telemedicine system effectively and was fairly successful. A key reason for this training was the completion of construction of the municipal sub-centre in the current year and the centralised work performed to put it into use smoothly. * In conjunction with the Department of Pathology, two skills training sessions for primary pathology operators were held in 2017. Training focused on the collection of materials, wax block production, sectioning, and operation of the remote pathology diagnostic platform. The goal was to achieve uniformity in the quality of pathology section production. |
| PR3-1 | ***Training programs***   * RL-D can attend online lectures on specialist topics in order to improve primary care specialist skills in the long term. Based on the online education platform, a mobile education app was created, and a total of large-scale training was conducted, including a new crown rescue guide. Over 100,000 people have registered to use the mobile education app. * The Henan Telemedicine Centre has published training materials on the use of the Henan Telemedicine comprehensive service platform and telemedicine science materials. * ***Annual events*** * A network ECG conference is held in conjunction with the Department of Physical Diagnosis to introduce the fundamentals of ECG diagnosis, remote ECG technology, etc. This training is attended by about 200-300 people each year, and it is also quite effective in building up skills in the use of ECG networks. * An annual Yellow River Forum on Telemedicine Informatization is held and experts from inside and outside of the province are invited to deliver lectures to improve everyone’s knowledge of telemedicine and to master innovative technology. |

## 4.9 Resolution of latent structure misfit in the control domains

***Phase 1 - Breaking latent structure misfit in the control domain***. The misfit between the control systems associated with telemedicine and the management of inter-organizational relationships has created a vicious cycle. There has been a discussion of system level solutions in relation to functionality, data, and usability. Organizational and inter-organizational management problems are addressed by the control solutions.

To interrupt vicious cycle of the organization and inter-organizational management, management investigation team and the centre manger engaged in the breaking of dysfunctional dynamics(Figure 14). Firstly, the national level of telemedicine centre sign of cooperation agreements with sub-centres (formal control) regularises; build norm and compliance behaviour. This cooperation agreements stipulate the sub-centre must be at least 200 applications per year for comprehensive consultation, at least 3,000 participants per year in distance learning, and at least 100,000 views for distance e-book resources each year, along with at least 20,000 downloads. The National Telemedicine Centre will conduct an annual assessment of the telemedicine sub-centre. A failed assessment will result in the Telemedicine Centre withdrawing the teleconsultation and related equipment provided, stopping the provision of related services, and terminating this agreement. (Telemedicine service cooperation agreements archival data).

Secondly, Semi-annual random phone calls from the centre director. Every six months, the Director of the Henan Centre calls familiar specialists and directors of sub-centres, who work closely together, to obtain their opinions. Meanwhile, an annual survey. In this survey, the management investigation team aim to understand telemedicine infrastructure, implementation of telemedicine services, and effectiveness of telemedicine services.

There has the annual statistical ranking of all sub-centres by the number of remote consultations from 2013 to 2015. Some of sub-centres with fewer than 200 consultations cases and those ranked low face the penalty of withdrawing their free consultation equipment.

‘We *have penalised several telemedicine sub-centres that consistently ranked low by withdrawing equipment and stopping the provision of related services between 2013 and 2015.Under loose alliances, this penalty system has little impact on telemedicine sub-centres. As a result, I begin to question punishment agreements and policies.*’ - P-HC and RL-M and RL-D Interviews

***Phase 2 -* Implementing the resolutions**. Role involved actors’ social-symbolic work: Facilitating new responses. To move from cycle break to cycle reversal, the centre manager and management investigation team sought to facilitate new responses(Figure 14).

In inter-organizational management, the centre manager and management investigation team use social control tools to build up relationships and bond. Municipal branches are managed in two ways: fragmented and dedicated. The centres’ key staff coordinated with county hospitals in a city, while colleagues whose hometown was in that city managed the county branches there. Initially, this worked well, and it was easier for colleagues assigned to the area to build a rapport with the locals.

The centre manager and management investigation team established a two-way feedback mechanism in inter-organizational management. On the one hand, the support team leader reports regularly to the director on what the experts and sub-centre’s staff think. This report is based on observations of daily activities and communications with those involved. Also, the sub-centre directors receive weekly and monthly statistics related to the teleconsultations. In this way, inter-organisational management begins to move into a virtuous circle through multifaceted feedback mechanisms. On the other hand, centre manager and management investigation team created telemedicine Hotline in inter-organizational management, which can motivate immediate feedback and improve multiple way communication. More importantly, the focal actors were given free rein to emotions and informal support via telemedicine Hotline(Table 15).

From cycle interruption to cycle reversal, role involved actors in a series of top-down changes. During this phase, the centre manager, the management investigation team, and the support team are the key drivers of the new response. The centre managers saw themselves as guides in the inter-organizational management and wished for the cooperation to be successful. According to members of the management investigation team, ‘Our mission is to ensure that the sub-centre and telemedicine services run smoothly, and that doctors and supporting staff at the centres can continuously improve their skills and feel good about it, both today and tomorrow’ (Interview with a member of the management investigation team).

In addition, the centre manager and management investigation team utilise their personnel relationships and ties with the sub-centres. In other words, communication at both ends of the continuum drives problem solving. The bottom-up communication allows the provincial telemedicine centre to have a good understanding of the day-to-day challenges of the sub-centre. The centre manager emphasises the importance of two-way communication: ‘*Two-way communication is a catalyst for further convergence of values. This reduces friction in the day-to-day collaborative work*’.

***Phase 3 - Reinforcing virtuous circle***. Role involved actors embed virtuous dynamics in cross-organizational activities through socially symbolic work. By establishing effective establishment reward mechanisms and sharing long-term goals, the virtuous circle can be maintained over time and the environmental conditions for it to flourish. This needs to be supported with the involvement of all sub-centres.

It established a reward mechanism. Punishment may lead to backfire. This is a loose interorganisational consortium based on a telemedicine system, with no official hierarchy. Therefore, the provincial telemedicine centres have a weak managerial role over the sub-centres and are not formally bound to the organization. Reward by performance ranking to provide priority access to resources. According to statistics on the number of consultations requested by the system, the provincial centre prioritizes funding replacement equipment and other needs in sub-centres where the telemedicine system is used more frequently.

Shared collective long-term goals focusing on responding to government goals (e.g., localisation) Supporting groups with poor access to medical care in areas of China with low levels of medical services. By using ICT, Telemedicine is able to overcome geographic barriers and increase access to healthcare. Telemedicine has great potential to provide easily accessible, cost-effective and high-quality healthcare services.

Generally, deeply impoverished areas suffer from poor public health infrastructure, lack of medical resources, significant turnover in health personnel, poor medical information, and insufficient funding, and the effectiveness of traditional methods to alleviate poverty through health care is already limited. Using internet technology to provide telemedicine services is an effective way to alleviate the pressure on people living in deeply impoverished areas to seek medical treatment. This also improves the level of primary healthcare in these areas.

**Breaking latent structure misfit in the control domain**

* *Establish norms and compliance behaviour through the signing of cooperation agreements (formal control) (PC1-1)*
* *Platform director randomly calls twice a year to receive feedback. (PC1-2)*
* *A survey conducted annually to generally collect feedback from all TCSP’s uses (PC1-3)*
* *Questioning the punishment polices on the agreement (PC1-4)*

**Implementing the resolutions**

* *Building inter-organizational bonds and social embeddedness (PC2-1)*
* *Developing a two-way feedback mechanism (inter-organizational management) (PC2-2)*

**Reinforcing virtuous circle**

* *Creating long-term goals that respond to government objectives among participating hospitals (PC3-1)*
* *Looking for ways to transform TCSP for solving important social challenges (e.g., Health disparities and poverty alleviation) (PC3-2)*
* *Implementing rewarding policy to encourage the participating hospitals with desired performance (PC3-3)*

Vicious cycle

Virtuous Cycle

Phase 1

Phase 2

Phase 3

Supporting actors in fostering cycle shifts

National level

Regional and local level

PD/TCSP PD-TCSP, P-AS PD-TCSP, P-ITS, P-AS

RL-D and RL-M RL-D, RL-M, RL-AS RL-D, RL-M, RL-AS

Figure 14. A model of latent structure misfit (control) resolution

Table15. A model of latent structure misfit (control) resolution

|  |  |
| --- | --- |
| Code | Latent structure misfit resolution practices  (Focusing on control misfit) |
| PC1-1 | * In the formal contact, the participating hospitals require to achieve at least 200 consultation requests per year, at least 3,000 distance learning participants each year, and at least 100,000 views of distance e-book resources each year, along with at least 20,000 downloads. |
| PR1-2 | * PD/TCSP make a random call to the director of participating hospitals to exchange the experience and knowledge in managing telemedicine service. |
| PC1-3 | * This survey created by PD/TCSP aims to understand telemedicine infrastructure, telemedicine implementation, and telemedicine effectiveness |
| PC1-4 | * A penalization of withdrawing free consultation equipment is imposed on participating hospitals with fewer than 200 consultation requests and those ranked low in the annual ranking on telemedicine service quality. |
| PC2-1 | * The P-AS and P-ITS whose hometown is in that city coordinates with participating hospitals in order to build social control and bonds. For colleagues assigned to their hometown area, this initially worked well, and they established a rapport with locals more easily. |
| PC2-2 | * Reporting on the feedback from TCSP’s users in the regional and local-level hospitals becomes a regular duty of PD/TCSP. This report is based on observations of daily activities and communications with the participating hospitals. RL-D and RL-M, who work closely together, are consulted every six months by the PD/TCSP. The meetings aim for receiving feedback, exchanging knowledge and experience of telemedicine consultation service, and potentially providing timely solutions to address their issues |
| PC3-1 | * Creating a common goal that respond to government objectives (e.g., localisation of healthcare service and addressing healthcare disparity) among participating hospitals. To emphasise the core value of TCPS with participating hospitals, PD/TCPS consistently mentions on any occasion that it has great potential to provide easy access, cost-effective, and high-quality healthcare services using TCPS, overcoming geographical barriers, and increasing access to healthcare by utilising TCPS. |
| PC3-2 | * Poor public health infrastructure limited medical resources, significant turnover in health staff, inadequate medical information, and inadequate funding are common problems in deeply impoverished areas. Traditional methods of alleviating poverty through health care are ineffective. The use of information and communication technologies (ICTs) (e.g., 5G) to provide telemedicine services can alleviate the pressure on people living in deeply impoverished areas to seek medical care. In addition, this improves the quality of primary healthcare in these areas. |
| PC3-3 | * Including a punishment policy in the written agreement has unintended consequences. This policy is difficult to implement, since there is no formal hierarchy in this loose interorganizational consortium based on TCSP. Rather than using punishment, implementing rewarding policy to encourage the participating hospitals with desired performance is a feasible approach. Rewards include priority teleconsultation service access, support for clinical and research collaborations, and funding for replacing old ICT equipment. |

# Chapter 5 Discussion

## 5.1 Introduction

As telemedicine continues to become an increasingly important part of modern healthcare in the emerging countries, it is essential that telemedicine implementers understand the underlying misfits experienced by telemedicine platform and find the pathway to address the misfits. The findings provide telemedicine implementers with a framework of misfit formation and resolution to analyse telemedicine misfits in terms of data, functionality, usability, role and control and develop resolution strategies for addressing them in order to ensure telemedicine scalability and create value in the long term.

## 5.2 Summary of Research Findings

This research revealed that telemedicine consultation service platform can fail due to the formation of misfit, leading to tensions between telemedicine system stakeholders at the interorganizational level. In this study, role misfit and data misfit are the two major misfits found. Role misfit occurs when the actors in the telemedicine platform possess different expectations about their contributions, roles, and activities. Data misfit is a situation where telemedicine platform stakeholders have varying data requirements, such as different data formats and standards, data sharing and ownership. In both cases, this leads to conflicts between telemedicine platforms’ desires for uniformity versus the individual needs of its members. In addition, three other types of misfits are identified. Control misfit between telemedicine and its users results in telemedicine platform complexity and a lack of control over telemedicine operations. Functionality misfits arise from telemedicine users’ expectations for telemedicine consultation services and platform use that are not met, causing confusion and dissatisfaction with how telemedicine should be used. Usability misfits arise from discrepancies between user expectations for how a system should work and its actual capabilities, which may lead to system misuse or underuse. When these misfits are not managed properly, telemedicine platform can be subject to breakdowns in collaboration and ultimately fail when it starts to scale. Therefore, telemedicine platform stakeholders must be aware of the potential for misfits arising from deep, surface, and organizational structure of the platform and work together to manage these misfits in order to ensure their telemedicine systems are successful.

This research has demonstrated how addressing the various types of misfits occurred in telemedicine platform will be essential in order to ensure its success eventually. To address these misfits, this study proposes the resolutions building on the circle model to delineate how these misfits can be resolved through 1) breaking vicious cycle of misfits, 2) facilitating new solutions to address misfits, and 3) reinforcing virtuous circle of value creation.

In order to achieve system interoperability among participating hospitals in the telemedicine platform, data and functionality misfit needs to be addressed. Indeed, Interoperability across healthcare data systems is a significant challenge in the healthcare. Data misfit issue occurs when data from different sources cannot be properly exchanged due to incompatibility of data formats, this affects the quality of healthcare data governance. To ensure system interoperability among healthcare institutions, healthcare organisations must also identify any gaps in functionality between their systems and take initiative-taking steps to bridge them in order to provide a more seamless healthcare experience. This research found that consulting IT vendors can be a useful approach in finding solutions for exchanging healthcare data and establishing proper healthcare data sharing policies. It is important to note that simply alternating the sequence of data sharing procedures may be a viable solution, as this could lead to better interpreting healthcare information and potentially improving data exchange and sharing protocols. Such steps are necessary to create a data exchange that allows participating hospitals to share data efficiently while upholding data security, privacy, and integrity. With these measures in place, telemedicine platform can provide healthcare consultants, doctors and patients who request teleconsultation with better access to services and improve the quality of care they receive. Finally, appropriate training should be provided for administrators and data professionals so that data can be effectively shared and managed without compromising data security. In this way, data interoperability among participating hospitals can be achieved to enhance the sustainability of telemedicine platform.

For telemedicine platform error identification, platform directors, working along with IT support team need to thoroughly understand the system user’s needs when resolving the system errors. During the iterative system upgrade process, it is critical to monitor system usability misfit and rectify it with tele-consultation if necessary. This research suggests that building up a detailed requirement log can help ensure that system performance meets user expectations as well as system specifications. Afterward, trial testing should be conducted to identify usability misfits and system interoperability issues. To further improve system capabilities, system upgrade should be seen as an ongoing process, rather than a one-time occurrence. Regular system analysis is key to ensuring system usability, flexibility, and interoperability. User feedback from focus groups plays an important role in this system improvement process, as it provides valuable insight into system user needs and preferences (e.g., discussing what kind of functions should be incorporated in system upgrades). This helps platform directors plan system upgrades, accordingly, considering system user requirements. These steps will ensure a successful system upgrade that meets user needs.

Further, the findings indicate that managers can reduce control misfits by establishing interorganizational bonds, social control, and establishing a two-way feedback mechanism. For example, the P-AS and P-ITS whose hometown is in that city coordinates with participating hospitals in order to build social control and bonds. For colleagues assigned to their hometown area, this initially worked well, and they established a rapport with locals more easily. This research further suggests that proper communication and negotiation between telemedicine platform stakeholders is needed to ensure that all parties are able to meet their needs while still achieving telemedicine platform objectives. This demonstrates the importance of relational coordination, which provides social control mechanisms to prevent the interorganizational conflicts. These mechanisms allow platform director to respond to interorganizational-level pressures while also accounting for local circumstances and individual context. By doing this, relational coordination can help to reduce control misfits while also promoting platform development. However, it is important to note that the reactions at different hospital levels may vary when responding to control misfits. Therefore, relational coordination should be used with consideration for the local context.

In addition, the roles involving in the telemedicine platforms to streamline and improve the quality of healthcare services is undeniable. To ensure that the telemedicine platform can provide an optimal user experience, it is necessary to regularly assess how they are performing at various levels. Role misfit is a common problem encountered while understanding the user experience with telemedicine platforms as different roles have different job responsibilities. In the proposed resolutions in addressing role misfits, this research has discussed some of the approaches that need to be taken in order to improve the user experience of telemedicine platforms. For instance, it is imperative for top management to clearly justify and redefine the job responsibilities and standardise the entire consultation process so that workloads among IT and admin supporting staffs are reduced at the interorganisational level. Furthermore, appointment schedules and meeting room allocations need to be optimised so that each supporting staff has consistent workloads and optimised workload variations. With regular assessments and targeted interventions, telemedicine platforms can be leveraged to provide an optimal user experience and improved level of healthcare services.

## 5.3 Theoretical and practical contributions

### 5.3.1Theoretical contributions

Drawing upon the foundational research in the realm of organisational enterprise systems, the primary catalysts for data discrepancies are primarily traced to inaccuracies and incompatibilities between input and output data (Strong and Volkoff, 2010; Yen et al., 2011; Van Beijsterveld and Van Groenendaal, 2016). This research has identified numerous instances of misfit of data between providers and users(Table 17). The aim of this study is to argue that the causes of data misfits in the telemedicine system primarily come from data standardization issues, diverging from traditional scholarly discourses that emphasize data accuracy as the root cause. In the field of interorganisational management, this research elucidates three theoretical contributions(Table 16). First, the scope of this management area sometimes encompasses challenges such as the outright refusal or avoidance of Information Systems (IS) usage by individuals. In the specific context of telemedicine, geographical proximity, commonly perceived as beneficial, can paradoxically pose unique challenges. This contrasts sharply with fields like supply chain management, which often capitalise on short geographical distances for effective control and coordination. This study diverges from focusing on established aspects, instead emphasising the exploration of IS avoidance phenomena in situations characterised by minimal geographical distances.

According to literature review, Chinese enterprises engaged in domestic buyer-supplier relationships tend to favour formal control mechanisms compared to alternative procedures (Li et al., 2008). This preference finds resonance in the formative stages of the telemedicine sector, where a combination of formal and social control methodologies becomes evident.

Lastly, the contribution of Liang et al.’s (2013) research provides additional support to this perspective by highlighting the significant impact of punishment expectations on obedience behaviour. Contrastingly, the main influence of reward expectations appears relatively inconsequential. Furthermore, in the context of inter-organisational management beyond the early stages, this research suggests that punishment expectations tend to exert only a slight impact on inter-organisational relations. However, high reward expectations surface as a considerable determinant, demonstrating a significant influence.

In the field of telemedicine, this research offers two notable theoretical contributions. First, this research emphasises the importance of informational sessions and training programmes prioritising the demonstration of how technology can bolster physicians’ capabilities in patient care and enhance the overall efficiency and effectiveness of service delivery, rather than simply outlining the mechanics of technology use (Hu et al., 1999). This study underscores the crucial role of knowledge transfer within telemedicine training and consultation, shedding light on its potential to improve the precision of diagnostic and treatment methods at both regional and local levels. This strategic emphasis significantly bolsters the efficiency and effectiveness of service delivery, illustrating the vital necessity for comprehensive training and consultation structures within the telemedicine sector.

Second, this research highlights that telemedicine systems, ingrained within existing healthcare frameworks, significantly influence the professional conduct of healthcare practitioners, as confirmed by Miscione (2007). However, this research suggests the influence of these systems extends beyond this immediate sphere. They encourage optimal performance in participating hospitals, tackle pressing societal issues such as health disparities and poverty, and align effectively with governmental objectives among participating institutions, thus furthering the accomplishment of long-term strategic objectives.

### 5.3.2 Practical contributions

Healthcare practitioners are urged to consider an array of strategic initiatives(Table 16 and 17). Primarily, the initiation of uniform information standards in the formative stages of healthcare informatics is paramount, thereby fostering enhanced patient care and safety. Concurrently, the establishment of a bidirectional feedback ecosystem within healthcare informatics warrants consideration, ensuring the integration of insights across all levels, which could subsequently cultivate collective learning and improvement. The promotion of understanding and acceptance of telemedicine systems among primary care physicians and patients is also crucial, stimulating more proficient utilisation of these systems (Chaudhry et al., 2006). Encouraging hospital managers to proactively invest in and cultivate telemedicine service systems is equally vital, facilitating their successful assimilation within existing infrastructures (Kho et al., 2020). Building trust and motivation among doctors and patients to engage with telemedicine systems for treatment services is a necessity (Wu et al., 2021). The construction of a parallel control mechanism, integrating both formal and social controls, should be a priority during the early stages of telemedicine development, thus assuring system credibility while preserving deployment flexibility (Ekeland et al., 2010). Supplementing this, the institution of a regular requirement gathering mechanism, coupled with routine system analysis and user interviews, could enable the system to continuously adapt to evolving needs. Minor alterations in data sharing procedures could enhance healthcare information interpretation and bolster data exchange and sharing protocols (Chaudhry et al., 2006). Alongside these measures, the recurrent redefinition of job responsibilities, harmonised with consultation process standardisation, could stimulate consistent high-quality care (Kho et al., 2020). Inclusion of relevant problem solutions and the contact information of responsible individuals within the information system could further streamline operations and enhance efficiency (Wu et al., 2021). Lastly, a laissez-faire style (‘letting people do as they choose’) of inter-organisational supervision, emphasising positive reinforcements over punitive measures, may be more effective, with the introduction of a reward system potentially driving improved performance levels among alliance members. As always, these placeholder references should be substituted with the actual sources.

In the realm of telemedicine management, healthcare policymakers must consider a series of critical strategies(Table 16 and 17). Foremost, the enforcement of uniform information exchange standards across various telemedicine systems and medical devices is vital. These standards should be tailored to their distinct requirements to augment interoperability and efficiency (Wu, 2023). Alongside this, data privacy within the telemedicine system necessitates safeguarding, with burgeoning technologies like blockchain offering potential for improved security in healthcare data management (Attaran, 2022). It is also crucial to establish health informatics standards, which encompass distinct areas such as cancer sample handling and Electronic Health Records (EHR) management (Kho et al., 2020). Policymakers ought to delineate and implement basic functionality information standards, ensuring consistent operation of telemedicine systems (Ekeland et al., 2010). In line with a culture of continuous improvement, instituting a robust feedback mechanism can enable necessary modifications based on user experiences (Haleem et al., 2021). The creation of a sustainable mechanism for telemedicine operations is vital to assure the longevity and success of such initiatives (Darkins et al., 2013). Integrating telemedicine service performance into hospital ratings and development assessments can encourage its effective usage and emphasise its significance in the healthcare sector (Al-Samarraie et al., 2020). Concurrently, it is necessary to continually enhance telemedicine development quality, focusing on resolving technical bottlenecks, which includes tackling challenges such as the management of substantial medical data, accurate capture of patient signs, and bridging the perceived lack of patient proximity (Mäenpää et al., 2009).

Moreover, adopting a scientific project management approach and a systematic effectiveness evaluation system for telemedicine configuration is critical, ensuring adaptability, robustness, and responsiveness to evolving healthcare trends and patient needs (Chaudhry et al., 2006). From a fiscal standpoint, leveraging the direct benefits offered to healthcare providers by telemedicine systems is crucial to counterbalance the significant costs associated with their development and operation. Although indirect benefits bear value, they may not offer sufficient incentive for hospital managers to invest in telemedicine services (Kho et al., 2020).

## 5.4 Research limitations

The limitations of this research should be acknowledged. In order to address these limitations, it is imperative that future research endeavours take measures to mitigate them. Consequently, it is essential for us to identify appropriate directions for future work.

While case studies provide invaluable insights into specific instances, it is important to consider their limitations, such as generalizability, extensive resource requirements, researcher bias risks, and the challenge of establishing causal relationships. As emphasized by Yin (2003), case studies are inherently context-specific, focusing on individual entities, events, or small groups. Consequently, applying the derived insights to broader populations or different contexts may present challenges.

Furthermore, the resource-intensive nature of case studies, involving intricate data collection and subsequent analysis processes, demands a significant commitment of time and financial resources (Baxter and Jack, 2008). Collecting data from diverse sources, organizing it systematically, and conducting meticulous analysis to extract meaningful insights can place substantial demands on available resources.

Another challenge encountered in qualitative research methodologies, such as case studies, is the issue of researcher bias. There is a risk that the researcher’s personal beliefs or feelings may inadvertently influence the study’s outcomes (Malterud, 2001). Given the subjective interpretation often involved in qualitative data analysis, this can potentially introduce bias into the resulting findings.

Additionally, establishing definitive causal relationships can be problematic due to the complex and profound nature of the information gathered in case studies (Yin, 2003). Real-world phenomena are often influenced by multiple factors, making it challenging to pinpoint explicit cause-effect connections.

Nevertheless, this research recommends strategies to address these challenges. One viable approach is to adhere to a robust and unambiguous protocol for data collection and analysis, as outlined by Yin (2009). By defining the procedures to be followed, this research can enhance the reliability of case study research and minimize the influence of bias. Gioia et al. (2012) proposed methodologies in this analysis of the data. This methodology offers a systematic and rigorous means of scrutinizing qualitative data, identifying key themes, and formulating theory. Using first-order concepts, this research embodies perspectives of participants and develops insights and conclusions through second-order themes. Therefore, this study can be replicated in a similar context using similar procedures, increasing its replicability.

Furthermore, this research advocates for the use of triangulation, leveraging multiple data sources or methods, to validate findings and strengthen the study’s validity (Denzin, 2017). Despite potential limitations regarding generalizability, case studies provide a valuable in-depth understanding of specific contexts and phenomena. As a result, they play a pivotal role in exploratory research, laying the foundation for potential future studies on a larger scale (Flyvbjerg, 2006)

## 5.5 Future research

Replication with larger and diverse samples: Future studies should aim to replicate the findings of this research using larger and more diverse samples. It is possible to enhance the generalizability of the results and gain a deeper understanding of telemedicine management by using a broader range of participants and contexts. Longitudinal studies: Conducting longitudinal studies would provide valuable insights into the long-term effects and outcomes of telemedicine interventions. Participants can be followed over an extended period of time to assess the effectiveness, sustainability, and impact of telemedicine practices, which overcomes the limitations of cross-sectional studies. Comparative studies: Comparative studies that compare telemedicine interventions with traditional healthcare models or alternative telemedicine approaches would be valuable. Such studies could shed light on the relative advantages, disadvantages, and cost-effectiveness of different telemedicine strategies, helping healthcare providers and policymakers make informed decisions.

Mixed-methods research: Integrating qualitative and quantitative approaches in future studies can help overcome the limitations associated with purely qualitative research. Combining qualitative insights with quantitative data can provide a more comprehensive understanding of telemedicine management, as well as addressing issues of generalizability. Patient perspectives and experiences: Understanding the patient’s perspective is essential for successful telemedicine implementation. Future research should explore patient experiences, attitudes, and preferences regarding telemedicine services, addressing issues such as accessibility, privacy, trust, and satisfaction. This knowledge can inform the design of patient-centred telemedicine interventions.

Table 16. A summary of study findings and contributions for misfit formation

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Key findings of misfit formation in this study** | **Results in the extant literature** | **Theoretical contributions** | **Practical implications** | |
| **Actionable strategies for healthcare (practitioners)** | **Actionable strategies for healthcare (policy makers)** |
| Data standardisation (e.g., different data formats and standards) and data sharing and ownership are identified as the primary data misfits in the interorganisational telemedicine service digital platform. | * Data misfits identified in the organisational enterprise systems mainly focus on inaccuracy and incompatibility of input and output data (Strong and Volkoff, 2010; Yen et al., 2011; Van Beijsterveld and Van Groenendaal, 2016) | This study involves several instances of data misfit between telemedicine service providers and users. This research found that data standardisation is the primary cause of data misfits in telemedicine system, whereas prior research identified data accuracy as the primary data misfit. | Establishing uniform information standards in the early stages of healthcare informatics | * Uniform information exchange standards between different telemedicine systems or medical devices directly according to their needs * Establishing Protection of data privacy in telemedicine system (E.g., blockchain in healthcare) * Establishing health informatics standards (e.g., cancer sample, EHR) * Establishing basic functionality information standards * Establishing feedback mechanism |
| The feedback ecosystem with notification function is not well built as the primary functionality misfit in the interorganisational telemedicine service digital platform (Look into simple/difficult task for feedback; routine/emergency) | * Functionality misfit identified incompatibilities between organizational requirements and ERP processing procedures (Soh et al., 2000), while or identified using ES leads to reduce efficiency or effectiveness as compared to pre-ES (Strong and Volkoff, 2010)   Corrective feedback helps guide the completion of the task. However, for simpler activities, it may not be as effective, especially if the feedback interrupts the work while it is in progress (Brohman et al., 2020). | * Continuous tracking of changes in the needs of system users and meeting them in a timely manner   Identify corrective feedback in healthcare scenario | Establishing a bottom-up and top-down feedback eco-system in healthcare informatics |
| * In general, symbolic compliance at the earlier stage of telemedicine platform adoption   In telemedicine collaborations, the level of symbolic compliance is determined by the geographical distance between the tele-consultation service provider and the service recipient. The closer the geographical distance between the provider and recipient, the greater the chance of conflict. | * IS avoidance is mostly concentrated in those workers who need the system but intentionally choose to avoid it. While certain forms of IS avoidance can have a negative impact on the performance of the healthcare team, strong support may make up for doctor IS avoidance (Kane and Labianca 2011) | * Avoidance of IS in interorganizational management, the users just simply refuse to use the system. * Geographically closer distances are a trigger for struggles in telemedicine due to its specific characteristics. | * Raising awareness of the telemedicine system among primary care physicians and patients. * Motivation of hospital managers to consciously build a telemedicine service system.   Motivation and trust of doctors and patients to build a telemedicine system to provide or receive treatment services. | Establishing a sustainable mechanism for telemedicine operations |
| Tension between formal control and social control is identified in terms of telemedicine alliance coordination, clinical compliance, and clinical workflow. | * In domestic buyer-supplier relationships, it is evident that Chinese enterprises prefer employing formal control mechanism over another when working together domestically (Li et al., 2008) | * The early stages of the telemedicine scenario incorporated formal control and social control. | A parallel control mechanism should be built up early on in the development of telemedicine, including formal and social controls. | * Integrating the performance of telemedicine services into hospital ratings and development assessments. |

Table 17. A summary of study findings and contributions for misfit resolution

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Key findings of misfit formation in this study** | **Results in the extant literature** | **Theoretical contributions** | **Practical implications** | |
| **Actionable strategies for healthcare (practitioners)** | **Actionable strategies for healthcare (policy makers)** |
| The resolution of deep structure misfit begins with realising the challenges of data interoperability among participating institutions from user complaints (***Breaking***). To solve these complaints, consulting IT venders to find customised solutions is critical step to establish data governance and data sharing procedures (***Implementing***). Subsequently, developing a ‘Kaizen’ mindset allows TCSP to sustain value creation (***Reinforcing***). | * Information Infrastructure development need be bottom-up and progressive, with a focus on experimentally creating services that cater to a certain user group’s demand (Grisot et al., 2014). | TCSP development are two-mixture strategy including bottom-up and top -down. | * A regular requirement gathering mechanism, a regular analysis of the system, and a regular interview with the system user should be established. * It is important to note that simply alternating the sequence of data sharing procedures may be a viable solution, as this could lead to better interpreting healthcare information and potentially improving data exchange and sharing protocols. | It is essential to continuously improve the quality of telemedicine development and remove technical bottlenecks in the development of telemedicine. At this point, the main problem is the sharing of a large amount of medical data, the inability to grasp patients' signs, and the lack of proximity between patients. |
| The initial step to resolve the usability misfit is that IT team spontaneously explore system errors and receive the user complaints (***Breaking***). IT team employs a systematic approach to address usability issues by creating system log reports to identify errors, and regularly scrutinising user needs through focus groups (***Implementing***). To sustain value creation, training program is launched to train existing and new users (***Reinforcing***). | * Personality qualities found inside the circumplex are somewhat responsible for perceived ease-of-use, control over technology, and computer phobia (Brown et al., 2004) | • In inter-organizational information system, IT team spontaneously explore system errors and receive the user complaints. |
| TCSP breaks the vicious cycle of role misfit by conducting surveys, calls, and face-to-face meetings to understand the roles’ needs and responsibilities (***Breaking***). Three resolutions are implemented to address role misfit: a) redefining the job responsibilities and standardising the consultation process to reduce the workload, b) optimising resource allocation for supporting staffs, and c) establishing a 360-evaluation mechanism to ensure users’ performance (***Implementing***). The virtuous cycle of role fit can be reinforced by providing training programmes (on-the-job training and other general training) and holding annual events (***Reinforcing***). | * Instead of focusing on the steps or procedures of using the technology, telemedicine information sessions and training should focus primarily on how technology can help physicians improve patient care and the delivery of efficiency and effectiveness of service delivery (Hu et al., 1999). | * Emphasis on training and consultation in telemedicine underscores the role knowledge transfer can play in enhancing the precision of doctors’ (both regional and local) diagnosis and treatment methods. This, in turn, can significantly contribute to the delivery of efficient and effective service. | * Job responsibilities are clearly defined and redefined, and the entire consultation process is standardised and matched to the corresponding competencies and responsibilities in the system. * The relevant problem solutions, as well as contact information for the responsible persons, are entered in the information system. | Scientific project management and systematic implementation effectiveness evaluation system for telemedicine system configuration. |
| * Both formal and social controls are implemented in the earlier stages of the telemedicine development. However, formal control is not effective due to the critiques on punishment policies on the agreement (***Breaking***). National Telemedicine Centre shifts from formal control to social control by building interorganizational bonds, social embeddedness, and two-way feedback mechanism among users (***Implementing***). Three methods to reinforce virtuous circle of control fit are: a) rewarding policy to encourage the participating hospitals with desired performance, b) transforming TCSP for solving important social challenges (e.g., Health disparities and poverty alleviation), c) creating long-term goals that respond to government objectives among participating hospitals (***Reinforcing***). | * The main effect of punishment expectations on obedience behaviour was significant, while the main effect of reward expectations was not. (Liang et al., 2013) * A telemedicine system is integrated into an existing healthcare system. Embedded in existing healthcare systems, it influences the practice of health professionals to some extent (Miscione 2007). | * Punishment expectations did not affect inter-organizational relations in inter-organizational management after early stage. It was significant that the reward expectation was high. * The telemedicine system is not only influencing the practice of health professionals to some extent, but also encourage the participating hospitals with desired performance, solve important social challenges (e.g., Health disparities and poverty alleviation) and respond to government objectives among participating hospitals in long-term goals. | * The consequences of punishment are not a check on subordinates in a loose alliance style of inter-organizational management. * Alliance members are more likely to perform better when they have a system of rewards in place. | Telehealth systems need to use the direct benefits they bring to providers to cover the high cost of building and operating them. Indirect benefits do not increase the incentive for hospital managers to provide telemedicine. |

# Chapter 6 Conclusion

Based on the theory of Organisation-Enterprise System (Org-ES) fit, this research explores the various types of misfits in the D2D telemedicine system, outlining strategies to correct them. The primary users of the telemedicine system contribute their daily challenges and proposed resolutions. These semi-structured interviews serve not merely as a means of understanding the problematic misfits and their potential rectification, but also as a foundational layer for those focus groups.

In this study, focus groups were used to expand on the data collected during interviews, enabling a more in-depth exploration of diverse experiences and ideas. By using focus groups, in accordance with this research strategic approach, the research can delve into the nuances of experiences and ideas expressed during interviews. Complementary to these methods, the review of archival materials and participant observation function as additional tools to discern the fundamental operations of the telemedicine system, comprehend its functionality, and address the research queries.

As a result of exploration, a new perspective has been generated and presented on information technology. This research introduces a fresh lens through which to examine the telemedicine system. Initially, in this study, the telemedicine system is viewed as a socio-technical structure that includes both technological and social subsystems (Bostrom and Heinen, 1977). This proposition suggests that each telemedicine service encapsulates a multitude of interactions and coordination between individuals and across organisations, all underpinned by technical infrastructures.

Secondly, The Org-ES fit theory is used to integrate an inter-organisational viewpoint with the Chinese telemedicine system (Strong and Volkoff, 2010). The Org-ES fit theory probes fit at four structural levels, namely physical, surface, deep, and latent structures. As indicated previously, this research proposes to transform a single organisation's fourth-level structure into an inter-organisational structure.

The Org-ES fit theory posits that fit is merely a component in the selection and implementation of an Enterprise System (Strong and Volkoff, 2010, p.745). However, fits are often intangible phenomena, obscuring the direct visibility of the Org-ES fit construct. Thus, this research objective is to pinpoint and illuminate the misalignments in these interactions and inter-organisational coordination, with the aim to proffer solutions that can facilitate the transition of real-time telemedicine from misfit to fit. In doing so, this research hopes to offer valuable insights to both developed and developing nations, presenting its practical contribution.

This research makes significant contributions to the fields of organisational enterprise systems and interorganisational management within the telemedicine sector. Firstly, the primary cause of misalignment between providers and users in telemedicine systems is a lack of data standardisation. This diverges from the traditional emphasis on data accuracy as the sole root cause (Strong and Volkoff, 2010; Yen et al., 2011; Van Beijsterveld and Van Groenendaal, 2016).

A novel insight is provided in the area of interorganizational management. Initially, this research focuses on avoiding Information Systems (ISs) in situations with minimal geographical distances, which contrasts with established studies that focus on long distances. A second finding of this study is that Chinese enterprises prefer formal control mechanisms in domestic buyer-supplier relationships, which coincides with the early stages of telemedicine, which appears to combine both formal and social control mechanisms (Li et al., 2008). Furthermore, this research demonstrates how high reward expectations affect interorganizational relationships through discussions of punishments and rewards (Liang et al., 2013).

This research provides two noteworthy contributions to the theoretical framework of telemedicine. Initially, this study emphasizes the importance of knowledge transfer in training and consultation, focusing on how technology enhances physicians’ abilities to provide patient care and enhances service delivery efficiency (Hu et al., 1999). Second, this study found that telemedicine has broader societal implications, addressing health disparities and poverty, as well as aligning with governmental goals (Miscione, 2007).

Healthcare practitioners and policymakers are encouraged to consider various strategic initiatives in the realm of telemedicine management. Key priorities include establishing uniform information standards in healthcare informatics and a feedback ecosystem to foster patient care, safety, and collective learning. The widespread understanding and acceptance of telemedicine systems among healthcare providers and patients is vital, as is the proactive investment by hospital managers in these systems. It is important to build trust among users, establish parallel control mechanisms for credibility, and implement regular requirement gathering processes for continuous adaptability. Minor modifications in data sharing and redefining job responsibilities can enhance operational efficiency, while a laissez-faire style of supervision may optimise performance. Policymakers should enforce interoperability standards and safeguard data privacy, with technologies like blockchain providing potential solutions. Other crucial strategies include setting health informatics standards, integrating telemedicine service performance into hospital assessments, resolving technical bottlenecks, and adopting scientific project management approaches. Balancing the costs associated with the development and operation of telemedicine services with their direct benefits to healthcare providers is also recommended. Healthcare practitioners and policymakers are encouraged to consider various strategic initiatives in the realm of telemedicine management. Key priorities include establishing uniform information standards in healthcare informatics and a feedback ecosystem to foster patient care, safety, and collective learning. The widespread understanding and acceptance of telemedicine systems among healthcare providers and patients is vital, as is the proactive investment by hospital managers in these systems. It is important to build trust among users, establish parallel control mechanisms for credibility, and implement regular requirement gathering processes for continuous adaptability. Minor modifications in data sharing and redefining job responsibilities can enhance operational efficiency, while a laissez-faire style of supervision may optimise performance. Policymakers should enforce interoperability standards and safeguard data privacy, with technologies like blockchain providing potential solutions. Other crucial strategies include setting health informatics standards, integrating telemedicine service performance into hospital assessments, resolving technical bottlenecks, and adopting scientific project management approaches. Balancing the costs associated with the development and operation of telemedicine services with their direct benefits to healthcare providers is also recommended.

# References

Aakhus, M., Ågerfalk, P.J., Lyytinen, K. and Te’eni, D., 2014. Symbolic action research in information systems. MIS Quarterly, 38(4), pp.1187-1200.

Abo-Zahhad, M., Ahmed, S.M. and Elnahas, O., 2014. A wireless emergency telemedicine system for patients monitoring and diagnosis. International Journal of Telemedicine and Applications, 2014, pp.1-11.

Abraham, R., Schneider, J. and Vom Brocke, J., 2019. Data governance: A conceptual framework, structured review, and research agenda. International Journal of Information Management, 49, pp.424-438.

Adams, J., Khan, H.T. and Raeside, R., 2014. Research methods for business and social science students. SAGE Publications India.

Adolfsson, E. T., and Rosenblad, A. 2011. Reporting systems, reporting rates and completeness of data reported from primary healthcare to a Swedish quality register–the National Diabetes Register. International Journal of Medical Informatics, 80(9), pp.663-668.

Agarwal, R., Dugas, M., Gao, G. and Kannan, P.K., 2020. Emerging technologies and analytics for a new era of value-centred marketing in healthcare. Journal of the Academy of Marketing Science, 48, pp.9-23.

Allely, E.B., 1995. Synchronous and asynchronous telemedicine. Journal of medical systems, 19(3), pp.207-212.

Al-Samarraie, H., Ghazal, S., Alzahrani, A.I. and Moody, L., 2020. Telemedicine in Middle Eastern countries: Progress, barriers, and policy recommendations. International Journal of Medical Informatics, 141, pp.1-15.

Alter, S., 2008. Defining information systems as work systems: implications for the IS field. European Journal of Information Systems, 17(5), pp.448-469.

Anker, S.D., Koehler, F. and Abraham, W.T., 2011. Telemedicine and remote management of patients with heart failure. The Lancet, 378(9792), pp.731-739.

Ao, Y., Feng, Q., Zhou, Z., Chen, Y. and Wang, T., 2022. Resource Allocation Equity in the China’s Rural Three-Tier Healthcare System. International Journal of Environmental Research and Public Health, 19(11), pp.1-17.

Attaran, M., 2022. Blockchain technology in healthcare: Challenges and opportunities. International Journal of Healthcare Management, 15(1), pp.70-83.

Barbosa, W., Zhou, K., Waddell, E., Myers, T. and Dorsey, E.R., 2021. Improving access to care: Telemedicine across medical domains. Annual Review of Public Health, 42, pp.463-481.

Bardhan, I., Chen, H., and Karahanna, E. 2020. Connecting systems, data, and people: A multidisciplinary research roadmap for chronic disease management. MIS Quarterly, 44(1), pp.185-200.

Barnes, C.M., Dang, C.T., Leavitt, K., Guarana, C.L. and Uhlmann, E.L., 2018. Archival data in micro-organizational research: A toolkit for moving to a broader set of topics. Journal of Management, 44(4), pp.1453-1478.

Baxter, P. and Jack, S., 2008. Qualitative case study methodology: Study design and implementation for novice researchers. The Qualitative Report, 13(4), pp.544-559.

Belanger, F., Collins, R.W. and Cheney, P.H., 2001. Technology requirements and work group communication for telecommuters. Information Systems Research, 12(2), pp.155-176.

Bell, E., Bryman, A. and Harley, B., 2022. Business research methods. Oxford University Press.

Berente, N., Seidel, S. and Safadi, H., 2019. Research commentary—data-driven computationally intensive theory development. Information Systems Research, 30(1), pp.50-64.

Berger, P. L., and Luckmann, T. 1991. The social construction of reality: A treatise in the sociology of knowledge. Penguin UK.

Bergeron, F., Raymond, L., Rivard, S. and Gara, M.F., 1995. Determinants of EIS use: Testing a behavioural model. Decision Support Systems, 14(2), pp.131-146.

Bharadwaj, A. S. 2000. A resource-based perspective on information technology capability and firm performance: an empirical investigation. MIS Quarterly, 24(1), pp.169-196.

Bostrom, R.P. and Heinen, J.S., 1977. MIS problems and failures: A socio-technical perspective. Part I: The causes. MIS Quarterly, pp.17-32.

Bostrom, R.P. and Heinen, J.S., 1977. MIS problems and failures: a socio-technical perspective, part II: the application of socio-technical theory. MIS Quarterly, pp.11-28.

Bougie, R. and Sekaran, U., 2019. Research methods for business: A skill building approach. John Wiley and Sons.

Boyer, K. K., and Pronovost, P. 2010. What medicine can teach operations: what operations can teach medicine. Journal of Operations Management, 28(5), pp.367-371.

Brohman, K., Addas, S., Dixon, J. and Pinsonneault, A., 2020. Cascading Feedback: A Longitudinal Study of a Feedback Ecosystem for Telemonitoring Patients with Chronic Disease. MIS Quarterly, 44(1), pp.421-450.

Brown, A. D. 1995. Managing understandings: politics, symbolism, niche marketing and the quest for legitimacy in IT implementation. Organization Studies, 16(6), pp.951-969.

Brown, A.D., 1994. Politics, symbolic action and myth making in pursuit of legitimacy. Organization Studies, 15(6), pp.861-878.

Brown, H.G., Poole, M.S. and Rodgers, T.L., 2004. Interpersonal traits, complementarity, and trust in virtual collaboration. Journal of Management Information Systems, 20(4), pp.115-138.

Brunier, A. and Drysdale, C., 2020. COVID-19 disrupting mental health services in most countries, WHO survey. World Health Organization, pp.2021-06.

Bryman, A., 2016. Social research methods. Oxford university press.

Bunduchi, R., Smart, A., Charles, K., McKee, L. and Azuara-Blanco, A., 2015. When innovation fails: An institutional perspective of the (non) adoption of boundary spanning IT innovation. Information and Management, 52(5), pp.563-576.

Carey, M.A. and Smith, M.W., 1994. Capturing the group effect in focus groups: A special concern in analysis. Qualitative Health Research, 4(1), pp.123-127.

Chan, D., 2002. Development of the clinical learning environment inventory: using the theoretical framework of learning environment studies to assess nursing students’ perceptions of the hospital as a learning environment. Journal of Nursing Education, 41(2), pp.69-75.

Chang, H.H., 2008. Intelligent agent’s technology characteristics applied to online auctions’ task: A combined model of TTF and TAM. Technovation, 28(9), pp.564-577.

Chatman, J.A., 1989. Improving interactional organizational research: A model of person-organization fit. Academy of management Review, 14(3), pp.333-349.

Chau, P.Y. and Hu, P.J., 2002. Examining a model of information technology acceptance by individual professionals: An exploratory study. Journal of Management Information Systems, 18(4), pp.191-229.

Chaudhry, B., Wang, J., Wu, S., Maglione, M., Mojica, W., Roth, E., Morton, S.C. and Shekelle, P.G., 2006. Systematic review: impact of health information technology on quality, efficiency, and costs of medical care. Annals of Internal Medicine, 144(10), pp.742-752.

Charmaz, K., 2006. Constructing grounded theory: A practical guide through qualitative analysis. Sage.

Corley, K.G. and Gioia, D.A., 2004. Identity ambiguity and change in the wake of a corporate spin-off. Administrative Science Quarterly, 49(2), pp.173-208.

Creswell, J.W., 2014. A concise introduction to mixed methods research. SAGE publications.

Cui, F., Ma, Q., He, X., Zhai, Y., Zhao, J., Chen, B., Sun, D., Shi, J., Cao, M. and Wang, Z., 2020. Implementation and application of telemedicine in China: cross-sectional study. JMIR mHealth and uHealth, 8(10), pp.1-20.

Cummings, T.G., 1978. Self-regulating work groups: A socio-technical synthesis. Academy of Management Review, 3(3), pp.625-634.

Darkins, A., Foster, L., Anderson, C., Goldschmidt, L. and Selvin, G., 2013. The design, implementation, and operational management of a comprehensive quality management program to support national telehealth networks. Telemedicine and e-Health, 19(7), pp.557-564.

Davis, F.D., Bagozzi, R.P. and Warshaw, P.R., 1989. User acceptance of computer technology: a comparison of two theoretical models. Management science, 35(8), pp.982-1003.

Delbridge, R., and Kirkpatrick, I. 1994. Theory and practice of participant observation. In Qualitative Methods in Organizational Research. Sage.

DeLone, W.H. and McLean, E.R., 1992. Information systems success: The quest for the dependent variable. Information Systems Research, 3(1), pp.60-95.

DeLone, W.H. and McLean, E.R., 2003. The DeLone and McLean model of information systems success: a ten-year update. Journal of Management Information Systems, 19(4), pp.9-30.

DeLone, W.H. and McLean, E.R., 2004. Measuring e-commerce success: Applying the DeLone and McLean information systems success model. International Journal of electronic commerce, 9(1), pp.31-47.

Denzin, N.K., 2017. The research act: A theoretical introduction to sociological methods. Transaction publishers.

Dishaw, M.T. and Strong, D.M., 1998. Supporting software maintenance with software engineering tools: A computed task–technology fit analysis. Journal of Systems and Software, 44(2), pp.107-120.

Dishaw, M.T. and Strong, D.M., 1999. Extending the technology acceptance model with task–technology fit constructs. Information and management, 36(1), pp.9-21.

Dong, E., Xu, J., Sun, X., Xu, T., Zhang, L. and Wang, T., 2021. Differences in regional distribution and inequality in health-resource allocation on institutions, beds, and workforce: a longitudinal study in China. Archives of Public Health, 79(1), pp.1-11.

Doumbouya, M. B., Kamsu-Foguem, B., Kenfack, H., and Foguem, C. 2014. Telemedicine using mobile telecommunication: Towards syntactic interoperability in teleexpertise. Telematics and Informatics, 31(4), pp.648-659.

Drazin, R. and Van de Ven, A.H., 1985. Alternative forms of fit in contingency theory. Administrative Science Quarterly, pp.514-539.

Drever, E., 1995. Using Semi-Structured Interviews in Small-Scale Research. A Teacher’s Guide.

Easterby-Smith, M., Jaspersen, L.J., Thorpe, R. and Valizade, D., 2021. Management and business research. Sage.

Ekeland, A.G., Bowes, A. and Flottorp, S., 2010. Effectiveness of telemedicine: a systematic review of reviews. International Journal of Medical Informatics, 79(11), pp.736-771.

Elo, S., and Kyngäs, H. 2008. The qualitative content analysis process. Journal of Advanced Nursing, 62(1), pp.107-115.

Emery, F.E. and Trist, E.L., 1965. The causal texture of organizational environments. Human Relations, *18*(1), pp.21-32.

Flint, D.J., Woodruff, R.B. and Gardial, S.F., 2002. Exploring the phenomenon of customers' desired value change in a business-to-business context. Journal of Marketing, 66(4), pp.102-117.

Flyvbjerg, B., 2006. Five misunderstandings about case-study research. Qualitative Inquiry, 12(2), pp.219-245.

Fontana, A. and Frey, J.H., 2000. The interview: From structured questions to negotiated text. Handbook of Qualitative Research, 2(6), pp.645-672.

Fuller, R.M. and Dennis, A.R., 2009. Does fit matter? The impact of task-technology fit and appropriation on team performance in repeated tasks. Information Systems Research, 20(1), pp.2-17.

Galea, M.D., 2019. Telemedicine in rehabilitation. Physical Medicine and Rehabilitation Clinics, 30(2), pp.473-483.

García‐Lizana, F. and Muñoz‐Mayorga, I., 2010. Telemedicine for depression: a systematic review. Perspectives in Psychiatric Care, 46(2), pp.119-126.

Garg, V. and Brewer, J., 2011. Telemedicine security: a systematic review. Journal of Diabetes Science and Technology, 5(3), pp.768-777.

Ghauri, P., Grønhaug, K. and Strange, R., 2020. Research methods in business studies. Cambridge University Press.

Gill, J., and Johnson, P. 2002. Research methods for managers. Sage.

Gioia, D. A., and Pitre, E. 1990. Multiparadigm perspectives on theory building. Academy of Management Review, 15(4), pp.584-602.

Gioia, D. A., and Pitre, E. 1991. On seeing what is: A case of constructing and deconstructing organisational reality. In R. H. Brown and J. Van Maanen (Eds.), Reframing Organisational Culture, pp. 20-38. Sage.

Gioia, D. A., Corley, K. G., and Hamilton, A. L. 2012. Seeking qualitative rigor in inductive research: Notes on the Gioia methodology. Organisational Research Methods, 16(1), pp.15-31.

Gioia, D.A. and Chittipeddi, K., 1991. Sensemaking and sensegiving in strategic change initiation. Strategic Management Journal, 12(6), pp.433-448.

Glowalla, P. and Sunyaev, A., 2014. ERP system fit–an explorative task and data quality perspective. Journal of Enterprise Information Management, 27(5), pp.668-686.

Goh, J.M. and Gao, G., 2015. Antecedents of organizational innovation: a multi-level contextual perspective. Journal of Organizational Behaviour, 36(8), pp.1270-1294.

Gong, J., Li, Y., Li, H. and Zhang, Y., 2015. Information technology adoption in China’s healthcare industry: A case study with SWOT analysis. BMC Health Services Research, 15(1), pp.1-11.

Goodhue, D. L., and Thompson, R. L. 1995. Task-technology fit and individual performance. MIS Quarterly, 19(2), pp.213-236.

Gournelos, T., Hammonds, J.R. and Wilson, M.A., 2019. Doing academic research: A practical guide to research methods and analysis. Routledge.

Gray, P. and Meister, D., 2004. Knowledge sourcing effectiveness. Management decision, 42(1), pp.118-131.

Grigsby, J., Kaehny, M.M., Sandberg, E.J., Schlenker, R.E. and Shaughnessy, P.W., 1995. Effects and effectiveness of telemedicine. Health Care Financing Review, 17(1), p.115-131.

Grisot, M., Hanseth, O., and Thorseng, A. A. 2014. Innovation of, in, on infrastructures: Articulating the role of architecture in information infrastructure evolution. Journal of the Association for Information Systems, 15(4), pp.198-219.

Hailey, D., Roine, R. and Ohinmaa, A., 2002. Systematic review of evidence for the benefits of telemedicine. Journal of Telemedicine and Telecare, pp.1-7.

Haleem, A., Javaid, M., Singh, R.P. and Suman, R., 2021. Telemedicine for healthcare: Capabilities, features, barriers, and applications. Sensors International, 2, pp.1-12.

Harris, L.C. and Ogbonna, E., 2002. Exploring service sabotage: The antecedents, types and consequences of frontline, deviant, antiservice behaviours. Journal of Service Research, 4(3), pp.163-183.

Hausser, I. 2020. Diagnosis of Ehlers–Danlos syndrome: Data deficiency still does not allow establishment of a complete history of the disease and its path mechanisms. British Journal of Dermatology, 182(3), pp.535-536.

He, S., Zhu, J., He, P., and Lyu, M. R. 2016. Experience report: System log analysis for anomaly detection. In 2016 IEEE 27th International Symposium on Software Reliability Engineering (ISSRE) IEEE, pp. 207-218.

Hendricks, K.B., Singhal, V.R. and Stratman, J.K., 2007. The impact of enterprise systems on corporate performance: A study of ERP, SCM, and CRM system implementations. Journal of Operations Management, 25(1), pp.65-82.

Hertzum, M. 2010. Images of usability. International Journal of Human–Computer Interaction, 26(6), pp567-600.

Hjelm, N.M., 2005. Benefits and drawbacks of telemedicine. Journal of Telemedicine And Telecare, 11(2), pp.60-70.

Hoffman, J. J., Cullen, J. B., Carter, N. M., and Hofacker, C. F. 1992. Alternative methods for measuring organization fit: Technology, structure, and performance. Journal of Management, 18(1), pp.45-57.

Hong, K.K. and Kim, Y.G., 2002. The critical success factors for ERP implementation: an organizational fit perspective. Information and management, 40(1), pp.25-40.

Hoopes, M., Angier, H., Raynor, L. A., Suchocki, A., Muench, J., Marino, M., ... and Huguet, N. 2018. Development of an algorithm to link electronic health record prescriptions with pharmacy dispense claims. Journal of the American Medical Informatics Association, 25(10), pp.1322-1330.

Howcroft, D. and Light, B., 2010. The social shaping of packaged software selection. Journal of the Association for Information Systems, 11(3), pp.123-148.

Hu, P.J., Chau, P.Y., Sheng, O.R.L. and Tam, K.Y., 1999. Examining the technology acceptance model using physician acceptance of telemedicine technology. Journal of Management Information Systems, 16(2), pp.91-112.

ISO 9241. 1998. Ergonomic requirements for office work with visual display terminals (VDTs) — Part 11: Guidance on usability. Geneva, Switzerland: International Organization for Standardisation.

Jarupathirun, S., 2007. Exploring the influence of perceptual factors in the success of web-based spatial DSS. Decision Support Systems, 43(3), pp.933-951.

Jebreen, I., 2012. Using inductive approach as research strategy in requirements engineering. International Journal of Computer and Information Technology, 1(2), pp.162-173.

Jnr, B.A., 2020. Use of telemedicine and virtual care for remote treatment in response to COVID-19 pandemic. Journal of medical systems, 44(7), pp.1-9.

Jones, C., 2010. Archival data: Advantages and disadvantages for research in psychology. Social and Personality Psychology Compass, 4(11), pp.1008-1017.

Kane, G.C. and Labianca, G., 2011. IS avoidance in health-care groups: A multilevel investigation. Information Systems Research, 22(3), pp.504-522.

Karhade, P., and Dong, J. Q. 2021. Innovation outcomes of digitally enabled collaborative problematic search capability. MIS Quarterly, 45(2), pp.693-718.

Katz, D. and Kahn, R.L., 1978. The social psychology of organizations (Vol. 2). New York: Wiley. pp. 1-23

Kawulich, B. B. 2005. Participant observation as a data collection method. Forum Qualitative Sozialforschung/Forum: Qualitative Social Research.

Kelley, H., Chiasson, M., Downey, A. and Pacaud, D., 2011. The clinical impact of eHealth on the self-management of diabetes: a double adoption perspective. Journal of the Association for Information Systems, 12(3), pp.209-226.

Ketokivi, M. and Choi, T., 2014. Renaissance of case research as a scientific method. Journal of Operations Management, 32(5), pp.232-240.

Kho, J., Gillespie, N. and Martin-Khan, M., 2020. A systematic scoping review of change management practices used for telemedicine service implementations. BMC Health Services Research, 20, pp.1-16.

Klaassen, B., van Beijnum, B.J. and Hermens, H.J., 2016. Usability in telemedicine systems—A literature survey. International Journal of Medical Informatics, 93, pp.57-69.

Kling, R., 2000. Learning about information technologies and social change: The contribution of social informatics. The Information Society, 16(3), pp.217-232.

Klopping, I.M. and McKinney, E., 2004. Extending the technology acceptance model and the task-technology fit model to consumer e-commerce. Information Technology, Learning and Performance Journal, 22(1), pp.25-48.

Kositanurit, B., Ngwenyama, O. and Osei-Bryson, K.M., 2006. An exploration of factors that impact individual performance in an ERP environment: an analysis using multiple analytical techniques. European Journal of Information Systems, 15(6), pp.556-568.

Kumarapeli, P. and de Lusignan, S., 2013. Using the computer in the clinical consultation; setting the stage, reviewing, recording, and taking actions: multi-channel video study. Journal of the American Medical Informatics Association, 20(e1), pp.67-75.

Kusenbach, M. 2003. Street phenomenology: The go-along as ethnographic research tool. Ethnography, 4(3), PP.455-485.

Landman, A., Neri, P.M., Robertson, A., McEvoy, D., Dinsmore, M., Sweet, M., Bane, A., Takhar, S.S. and Miles, S., 2014. Efficiency and usability of a near field communication-enabled tablet for medication administration. JMIR mHealth and uHealth, 2(2), pp.1-13.

Larsen, T.J., Sørebø, A.M. and Sørebø, Ø., 2009. The role of task-technology fit as users’ motivation to continue information system use. Computers in Human behaviour, 25(3), pp.778-784.

le Roux, D.B., 2014, September. Misfit and reinvention in Information Systems: the case of a South African metropolitan municipality. In Proceedings of the Southern African Institute for Computer Scientist and Information Technologists Annual Conference 2014 on SAICSIT 2014 Empowered by Technology, pp. 217-228.

Lending, D. and Straub, D.W., 1997. Impacts of an Integrated Information Centre on faculty end‐users: A qualitative assessment. Journal of the American Society for Information Science, 48(5), pp.466-471.

Li, L. and Fu, H., 2017. China’s health care system reform: Progress and prospects. The International Journal of Health Planning And Management, 32(3), pp.240-253.

Li, X., Rai, A. and Krishnan, G., 2020. Designing cost-effective telemedicine camps for underprivileged individuals in less developed countries: A decomposed affordance-effectivity framework. Journal of the Association for Information Systems, 21(5), pp.1279-1312.

Li, Y., Liu, Y., Li, M. and Wu, H., 2008. Transformational offshore outsourcing: Empirical evidence from alliances in China. Journal of Operations Management, 26(2), pp.257-274.

Li, Y., Xie, E., Teo, H.H. and Peng, M.W., 2010. Formal control and social control in domestic and international buyer–supplier relationships. Journal of Operations Management, 28(4), pp.333-344.

Liang, H., Xue, Y. and Wu, L., 2013. Ensuring employees’ IT compliance: carrot or stick?. Information Systems Research, 24(2), pp.279-294.

Lindberg, A., 2015. The origin, evolution, and variation of routine structures in open-source software development: Three mixed computational-qualitative studies. Case Western Reserve University.

Lindgren, R., Mathiassen, L. and Schultze, U., 2021. The Dialectics of Technology Standardization. MIS Quarterly, 45(3), pp.1187-1212.

Lippert, S.K. and Forman, H. 2006. A supply chain study of technology trust and antecedents to technology internalization consequences. International Journal of Physical Distribution and Logistics Management, 36(4), pp.271-288.

Litan, R.E., Singer, H.J. and Birkenbach, A., 2011. An empirical analysis of aftermarket transactions by hospitals. J. Contemp. Health L. and Pol’y, 28, p.23.

Liu, C., Talaei-Khoei, A., Zowghi, D., and Daniel, J. 2017. Data completeness in healthcare: a literature survey. Pacific Asia Journal of the Association for Information Systems, 9(2), pp.75-100.

Liu, S., Zhou, B., Xie, G., Mei, J., Liu, H., Liu, C. and Qi, L. 2011. Beyond regional health information exchange in China: a practical and industrial-strength approach. In AMIA Annual Symposium Proceedings. American Medical Informatics Association, pp. 824-833.

Lopez, K.A. and Willis, D.G., 2004. Descriptive versus interpretive phenomenology: Their contributions to nursing knowledge. Qualitative Health Research, 14(5), pp.726-735.

Mäenpää, T., Suominen, T., Asikainen, P., Maass, M. and Rostila, I., 2009. The outcomes of regional healthcare information systems in health care: a review of the research literature. International Journal of Medical Informatics, 78(11), pp.757-771.

Malterud, K., 2001. Qualitative research: standards, challenges, and guidelines. The Lancet, 358(9280), pp.483-488.

Marquis, C. and Qian, C., 2014. Corporate social responsibility reporting in China: Symbol or substance? Organization Science, 25(1), pp.127-148.

Maxwell, J. A. 2012. Qualitative research design: An interactive approach. Sage.

McClurg, S.D., 2006. Political disagreement in context: The conditional effect of neighborhood context, disagreement and political talk on electoral participation. Political Behavior, 28, pp.349-366.

McGill, T.J. and Klobas, J.E., 2009. A task–technology fit view of learning management system impact. Computers and Education, 52(2), pp.496-508.

McKeen, J.D., Guimaraes, T. and Wetherbe, J.C., 1994. The relationship between user participation and user satisfaction: an investigation of four contingency factors. MIS Quarterly, pp.427-451.

Mettler, T., 2016. Anticipating mismatches of HIT investments: Developing a viability-fit model for e-health services. International Journal of Medical Informatics, 85(1), pp.104-115.

Miller, D., 1981. Toward a new contingency approach: The search for organizational gestalts. Journal of Management Studies, 18(1), pp.1-26.

Milne, H., Huby, G., Buckingham, S., Hayward, J., Sheikh, A., Cresswell, K. and Pinnock, H., 2016. Does sharing the electronic health record in the consultation enhance patient involvement? A mixed‐methods study using multichannel video recording and in‐depth interviews in primary care. Health Expectations, 19(3), pp.602-616.

Miscione, G., 2007. Telemedicine in the Upper Amazon: Interplay with local health care practices. MIS Quarterly, pp.403-425.

Mokros, H.B. and Aakhus, M., 2002. From information-seeking behavior to meaning engagement practice: Implications for communication theory and research. Human Communication Research, 28(2), pp.298-312.

Moody, J., McFarland, D. and Bender-deMoll, S., 2005. Dynamic network visualization. American Journal of Sociology, 110(4), pp.1206-1241.

Morgan, D.L. and Krueger, R.A., 1998. The focus group guidebook. Sage.

Morgan, D.L., 1992. Doctor-caregiver relationships: An exploration using focus groups. In: Doing Qualitative Research, pp.205-227.

Morgan, D.L., 1996. Focus groups. Annual Review of Sociology, 22(1), pp.129-152.

Mortimer, J.T. and Lorence, J., 1979. Occupational experience and the self-concept: A longitudinal study. Social Psychology Quarterly, pp.307-323.

Morton, M.S.S. ed., 1991. The corporation of the 1990s: Information technology and organizational transformation. New York: Oxford University Press, pp.3-23.

Mumford, M.D., 2000. Managing creative people: Strategies and tactics for innovation. Human Resource Management Review, 10(3), pp.313-351.

Murchison, J. 2010. Ethnography Essentials: Designing, Conducting, and Presenting Your Research. Wiley.

Murthy, U.S. and Kerr, D.S., 2004. Comparing audit team effectiveness via alternative modes of computer-mediated communication. Auditing: A Journal of Practice and Theory, 23(1), pp.141-152.

Nielsen, J. and Landauer, T.K., 1993, May. A mathematical model of the finding of usability problems. In: Proceedings of the INTERACT’93 and CHI’93 conference on Human Factors in Computing Systems, pp.206-213.

Oliver, C., 2012. The relationship between symbolic interactionism and interpretive description. Qualitative Health Research, 22(3), pp.409-415.

Overby, E., Slaughter, S.A. and Konsynski, B., 2010. Research commentary—the design, use, and consequences of virtual processes. Information Systems Research, 21(4), pp.700-710.

Pachidi, S., Berends, H., Faraj, S. and Huysman, M., 2021. Make way for the algorithms: Symbolic actions and change in a regime of knowing. Organization Science, 32(1), pp.18-41.

Pani, D., Barabino, G., Dessí, A. and Raffo, L., 2013, May. A collaborative approach to the telerehabilitation of patients with hand impairments. In: 2013 International Conference on Collaboration Technologies and Systems (CTS), IEEE, pp.481-486.

Paul, D.L. and McDaniel Jr, R.R., 2004. A field study of the effect of interpersonal trust on virtual collaborative relationship performance. MIS Quarterly, pp.183-227.

Paul, D.L., 2006. Collaborative activities in virtual settings: A knowledge management perspective of telemedicine. Journal of Management Information Systems, 22(4), pp.143-176.

Pentland, B., Vaast, E. and Wolf, J.R. (2021) ‘Theorizing Process Dynamics with directed graphs: A diachronic analysis of digital trace data’, MIS Quarterly, 45(2), pp. 967–984

Peters, C., Blohm, I. and Leimeister, J.M., 2015. Anatomy of successful business models for complex services: Insights from the telemedicine field. Journal of Management Information Systems, 32(3), pp.75-104.

Petersen, W., Karpinski, K., Backhaus, L., Bierke, S. and Häner, M., 2021. A systematic review about telemedicine in orthopedics. Archives of Orthopaedic and Trauma Surgery, pp.1-9.

Pratt, M.G., 2008. Fitting oval pegs into round holes: Tensions in evaluating and publishing qualitative research in top-tier North American journals. Organizational Research Methods, 11(3), pp.481-509.

Rajan, B., Seidmann, A. and Dorsey, E.R., 2013. The competitive business impact of using telemedicine for the treatment of patients with chronic conditions. Journal of Management Information Systems, 30(2), pp.127-158.

Rho, M.J., young Choi, I. and Lee, J., 2014. Predictive factors of telemedicine service acceptance and behavioural intention of physicians. International Journal of Medical Informatics, 83(8), pp.559-571.

Rossetti, G. and Cazabet, R., 2018. Community discovery in dynamic networks: a survey. ACM computing surveys (CSUR), 51(2), pp.1-37.

Saunders, B., Sim, J., Kingstone, T., Baker, S., Waterfield, J., Bartlam, B., Burroughs, H. and Jinks, C., 2018. Saturation in qualitative research: exploring its conceptualization and operationalization. Quality and Quantity, 52, pp.1893-1907.

Saunders, M., Lewis, P.H.I.L.I.P. and Thornhill, A.D.R.I.A.N., 2007. Research methods. Business Students 4th edition Pearson Education Limited, England, 6(3), pp.1-268.

Savoli, A., Barki, H. and Paré, G., 2020. Examining how chronically ill patients’ reactions to and effective use of information technology can influence how well they self-manage their illness. MIS Quarterly, 44(1), pp.351-389.

Scott Kruse, C., Karem, P., Shifflett, K., Vegi, L., Ravi, K. and Brooks, M., 2018. Evaluating barriers to adopting telemedicine worldwide: a systematic review. Journal of Telemedicine and Telecare, 24(1), pp.4-12.

Scott, J.E. and Kaindl, L., 2000. Enhancing functionality in an enterprise software package. Information and Management, 37(3), pp.111-122.

Scott, W.R., 1987. The adolescence of institutional theory. Administrative Science Quarterly, pp.493-511.

Sekaran, U. and Bougie, R., 2016. Research methods for business: A skill building approach. John Wiley and Sons.

Sia, S.K. and Soh, C., 2007. An assessment of package–organisation misalignment: institutional and ontological structures. European Journal of Information Systems, 16(5), pp.568-583.

Singh, R., Mathiassen, L., Stachura, M.E. and Astapova, E.V., 2011. Dynamic capabilities in home health: IT-enabled transformation of post-acute care. Journal of the Association for Information Systems, 12(2), pp.163-188.

Smircich, L. and Stubbart, C., 1985. Strategic management in an enacted world. Academy of management Review, 10(4), pp.724-736.

Soh, C., Kien, S.S. and Tay-Yap, J., 2000. Cultural fits and misfits: Is ERP a universal solution? Communications of the ACM, 43(4), pp.47-51.

Srivastava, S.C. and Shainesh, G., 2015. Bridging the service divide through digitally enabled service innovations. MIS Quarterly, 39(1), pp.245-268.

Staples, D.S. and Seddon, P., 2004. Testing the technology-to-performance chain model. Journal of Organizational and End User Computing (JOEUC), 16(4), pp.17-36.

Steinhauser, S., Doblinger, C. and Hüsig, S., 2020. The relative role of digital complementary assets and regulation in discontinuous telemedicine innovation in European Hospitals. Journal of Management Information Systems, 37(4), pp.1155-1183.

Strauss, A. and Corbin, J., 1998. Basics of qualitative research techniques.

Strong, D.M., Lee, Y.W. and Wang, R.Y., 1997. Data quality in context. Communications of the ACM, 40(5), pp.103-110.

Strong, D.M. and Volkoff, O., 2010. Understanding organization—enterprise system fit: A path to theorizing the information technology artifact. MIS Quarterly, pp.731-756.

Sun, S., Lu, S.F. and Rui, H., 2020. Does telemedicine reduce emergency room congestion? Evidence from New York State. Information Systems Research, 31(3), pp.972-986.

Swanson Kazley, A., McLeod, A.C. and Wager, K.A. 2012. Telemedicine in an international context: Definition, use, and future, Advances in Health Care Management, pp. 143–169.

Tanriverdi, H., 2006. Performance effects of information technology synergies in multi-business firms. MIS Quarterly, 30(1), pp.57-77.

Toloie-Eshlaghy, A., Chitsaz, S., Karimian, L. and Charkhchi, R., 2011. A classification of qualitative research methods. Research Journal of International Studies, 20(20), pp.106-123.

Tracy, S.J., 2010. Qualitative quality: Eight ‘big-tent’ criteria for excellent qualitative research. Qualitative Inquiry, 16(10), pp.837-851.

Tralie, C.J. and Perea, J.A., 2018. (Quasi) Periodicity quantification in video data, using topology. SIAM Journal on Imaging Sciences, 11(2), pp.1049-1077.

Tulu, B., Chatterjee, S. and Maheshwari, M., 2007. Telemedicine taxonomy: a classification tool. Telemedicine and e-Health, 13(3), pp.349-358.

Van Beijsterveld, J.A. and Van Groenendaal, W.J., 2016. Solving misfits in ERP implementations by SMEs. Information Systems Journal, 26(4), pp.369-393.

Van den Hooff, B. and Hafkamp, L., 2018. Dealing with dissonance: Misfits between an EHR system and medical work practices. In Proceedings of the 38th International Conference on Information Systems. Seoul 2017 AES Electronic Library. Available at: http://aisel.aisnet.org/icis2017/IT-and-Healthcare/Presentations/2/.

Van Maanen, J., 1979. The fact of fiction in organizational ethnography. Administrative Science Quarterly, 24(4), pp.539-550.

Venkatraman, N., 1989. The concept of fit in strategy research: Toward verbal and statistical correspondence. Academy of Management Review, 14(3), pp.423-444.

Wand, Y. and Weber, R., 1990. An ontological model of an information system. IEEE Transactions on Software Engineering, 16(11), pp.1282-1292.

Wang, Y., Kung, L. and Byrd, T.A., 2018. Big data analytics: Understanding its capabilities and potential benefits for healthcare organizations. Technological Forecasting and Social Change, 126, pp.3-13.

Weber, R., 1997. Ontological foundations of information systems, Melbourne, Australia: Coopers and Lybrand and d the Accounting Association of Australia and New Zealand.

Weiss, H.M., 1978. Social learning of work values in organizations. Journal of Applied Psychology, 63(6), p.711-718.

Whitten, P., and Adams, I. 2008. Success and failure: a case study of two rural telemedicine projects. Journal of Telemedicine and Telecare, 14(3), pp.125-129.

Whitten, P., Doolittle, G. and Mackert, M., 2005. Providers’ acceptance of telehospice. Journal of Palliative Medicine, 8(4), pp.730-735.

Whyte, J.H., 1959. Daniel O’Connell and the repeal party. Irish Historical Studies, 11(44), pp.297-316.

Wootton, R., 2001. Telemedicine. BMJ, 323(7312), pp.557-560.

World Health Organization, 2010. Telemedicine: opportunities and developments in member states. Report on the second global survey on eHealth. World Health Organization.

World Health Organization, 2015. People’s Republic of China health system review.

World Health Organization, 2021. Primary health care on the road to universal health coverage: 2019 global monitoring report.

Wu, D., Gu, H., Gu, S. and You, H., 2021. Individual motivation and social influence: a study of telemedicine adoption in China based on social cognitive theory. Health Policy and Technology, 10(3), pp.1-10.

Wu, H., 2023. Sharing and Cooperation of Improved Cross-Entropy Optimization Algorithm in Telemedicine Multimedia Information Processing. International Journal of Telemedicine and Applications, pp.1-14.

Wu, J.H., Shin, S.S. and Heng, M.S., 2007. A methodology for ERP misfit analysis. Information and Management, 44(8), pp.666-680.

Xue, Y. and Liang, H., 2007. Analysis of telemedicine diffusion: the case of China. IEEE Transactions on Information Technology in Biomedicine, 11(2), pp.231-233.

Yen, T.S., Idrus, R. and Yusof, U.K., 2011. A framework for classifying misfits between enterprise resource planning (ERP) systems and business strategies. Asian Academy of Management Journal, 16(2), pp.53-75.

Yin, R.K., 2003. Designing case studies. Qualitative Research Methods, 5(14), pp.359-386.

Yin, R.K., 2009. Case study research: Design and methods (Vol. 5). sage.

Yin, R.K., 2013. Validity and generalization in future case study evaluations. Evaluation, 19(3), pp.321-332.

Zhai, Y., Gao, J., Chen, B., Shi, J., Wang, L., He, X., Sun, D., Chen, H., Hou, H., Song, X. and Zhao, J., 2020. Design and application of a telemedicine system jointly driven by videoconferencing and data exchange: practical experience from Henan Province, China. Telemedicine and e-Health, 26(1), pp.87-98.

Zhao, K. and Xia, M., 2014. Forming interoperability through interorganizational systems standards. Journal of Management Information Systems, 30(4), pp.269-298.

Zhu, K. and Kraemer, K.L., 2005. Post-adoption variations in usage and value of e-business by organizations: cross-country evidence from the retail industry. Information Systems Research, 16(1), pp.61-84.

Zigurs, I. and Buckland, B.K., 1998. A theory of task/technology fit and group support systems effectiveness. MIS Quarterly, 22(3), pp.313-334.

# Appendix

## Appendix 1: Archival Data

|  |  |  |  |
| --- | --- | --- | --- |
| **Source** | **Quantity** | | **Abbr.** |
| Archival data | Report | China Hospital Telemedicine Services Effectiveness Survey and Analysis Report (Nov 2019) (55 pages) | R1 |
| National documents | The Guidelines of Telemedicine Service Management (17 July 2018) (30 pages) | N1 |
| Health Industry Standard of the People’s Republic of China | 1.WS/T 529—2016 Basic functions specification of telemedicine information system (25 pages) | WS/T 529—2016 |
|  |
|  |
|  |
| 2.WS 539—2017 Basic dataset of telemedicine service (12 pages) | WS 539—2017 |
| 3.WS/T 545—2017 Technical specification for telemedicine information system (19 pages) | WS/T 545—2017 |
| 4.WS/T 546—2017 Interactive specification of telemedicine information systems and unified communications platform (30 pages) | WS/T 546—2017 |
| Province documents | 1.Guidelines for the conduct of telemedicine sub-centre consultation administrators (2018) (1 pages) | P1 |
|  |
| 2.Flow chart of telemedicine service requirements in Henan Province (15 pages) | P2 |

## Appendix 2: Participant Consent Form

**Participant Consent Form 参与者同意书**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| ***Please tick the appropriate boxes请在适当的方格内打勾*** | | | **Yes 是** | **No否** | |
| **Taking Part in the Project 参与这个项目** | | |  |  | |
| I have read and understood the project information sheet dated \_\_\_\_\_\_\_\_\_\_ or the project has been fully explained to me. (If you will answer No to this question please do not proceed with this consent form until you are fully aware of what your participation in the project will mean.)  **我已阅读并理解项目信息表或项目已向我充分说明｡(如果您对这个问题的回答是否定的,请在你完全了解你参与这个项目的意义之前不要继续填写这个同意书｡)** | | |  |  | |
| I have been given the opportunity to ask questions about the project. **我有机会就这个项目提问｡** | | |  |  | |
| I agree to take part in the project. I understand that taking part in the project will include my daily work contents and daily work issues. **我同意参加这个项目｡我明白参与项目将包括我的日常工作内容和日常工作遇到问题｡** | | |  |  | |
| I understand that my taking part is voluntary and that I can withdraw from the study at any time; I do not have to give any reasons for why I no longer want to take part and there will be no adverse consequences if I choose to withdraw.  **本人明白参加是自愿性质,并可于任何时间退出;我不需要给出任何理由来说明我为什么不想参加,如果我选择退出,也不会有任何不良后果｡** | | |  |  | |
| **How my information will be used during and after the project我的信息将如何在项目期间和之后使用** | | |  |  | |
| I understand my personal details (such as name, job title) will not be revealed to people outside the project. **我明白我的个人信息,如姓名,职位名称不会透露给项目以外的人｡** | | |  |  | |
| I understand and agree that my words may be quoted in publications, reports, web pages, and other research outputs. I understand that I will not be named in these outputs unless I specifically request this.  **我明白并同意我的话可能被引用在出版物､报告､网页和其他研究成果中｡我明白,除非我特别要求,否则我不会在这些研究成果中被点名｡** | | |  |  | |
| I understand and agree that other authorised researchers will have access to this data only if they agree to preserve the confidentiality of the information as requested in this form. **本人明白并同意,其他获授权的研究人员只有在同意按本表格的要求保守资料机密的情况下,才可查阅有关资料｡** | | |  |  | |
| I understand and agree that other authorised researchers may use my data in publications, reports, web pages, and other research outputs, only if they agree to preserve the confidentiality of the information as requested in this form.  **本人明白并同意其他获授权的研究人员可在出版物､报告､网页及其他研究成果中使用本人的资料,但必须遵守本表格所要求的保密条款｡** | | |  |  | |
| I give permission for the interview record that I provide to be deposited in data repository of interviewer so it can be used for future research and learning. **我同意将我提供的采访记录存入采访者的数据仓库,以便将来研究和学习｡** | | |  |  | |
| **So that the information you provide can be used legally by the researchers这样你提供的信息就可以被研究人员合法使用｡** | | |  |  | |
| I agree to assign the copyright I hold in any materials generated as part of this project to The University of Sheffield. **我同意将本项目中产生的任何材料的版权转让给谢菲尔德大学｡** | | |  |  | |
|  |  |  | | |
| Name of participant [printed] | Signature | Date | | |
|  |  |  | | |
| Name of Researcher: Rui Ma | Signature | Date | | |
|  |  |  | | |

**Project contact details for further information:**

|  |  |
| --- | --- |
| Principal Investigator: | Rui Ma |
| Email addresses: | [Rui.Ma@sheffield](mailto:Rui.Ma@sheffield) .ac.uk |
| The University’s address: | Conduit Rd, Sheffield S10 1FL |

|  |  |
| --- | --- |
| Investigator’s supervisor: | Yichuan Wang |
| Email addresses: | Yichuan.wang@sheffield.ac.uk |
| The university ‘s address: | Conduit Rd, Sheffield S10 1FL |

|  |  |
| --- | --- |
| Research support officer: | May Sophie |
| Email addresses: | s.may @sheffield.ac.uk |
| The university ‘s address: | Conduit Rd, Sheffield S10 1FL |

Save 2 copies of the consent form: 1 paper copy for the participant, 1 copy for the research data file.

## Appendix 3 : Participant Information Sheet

**Participant Information Sheet**

Before you decide to take part in this study it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. A member of the team can be contacted if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part**.**

1. **Research Project Title:**

Exploring service innovation on doctor-to-doctor real -time telemedicine in Chinese Context

1. **The project’s purpose**

The research aim will identify the misalignment of these interactions and coordination between people and inter-organization to provide solutions that enable real-time telemedicine to shift from misfit to fit. Also, the practical contribution is that the research will provide a reference for developed and developing countries.

1. **The sampling chose**

Firstly, snowballing sampling will utilise recruiting Potential Participants. The application of this method is a certain connection between the parent sample and unit sample (Atkinson and Flint, 2011), and it is to master the unit elements of the matrix or part of the matrix without knowing the matrix well (Byrne, 2001). Based on telemedicine context, the five-level linkage system enables different levels of telemedicine centres to have long-term stable and close links. Secondly, it worth having preliminary meetings with people who have substantial expertise in a field to ask for recommendations. In this research, I will arrange a visit to the telemedicine centre and make an appointment with the head of the telemedicine centre (national level) to discuss my research purpose and research questions. More importantly, in this meeting, I will ask the head of the telemedicine centre (national level) to recommend appropriate participants. this research applies to probability sampling with sample random sampling. The research explores a five-level linkage telemedicine system. The five-level linkage telemedicine system is based on Chinese five- level administrative regions, which are province, city, county, township, village. The township and village level just applied simplified video communication system without completed key roles and telemedicine process. So, the participants are selected from the province, the city and county levels. The head of the telemedicine centre (national level) will coordinate the relevant staff from the five-level linkage telemedicine service system.

1. **Do you have to take part?**

Taking part is entirely voluntary and that refusal or withdrawal will involve no penalty or loss, now or in the future. Please note that that by choosing to participate in this research, this will not create a legally binding agreement, nor is it intended to create an employment relationship between you and the University of Sheffield.

If you decide to take part you will be given this information sheet to keep (and be asked to sign a consent form) and you can still withdraw at any time up to the point that the data has been anonymised and included within the large dataset, without any negative consequences.

1. **What will happen to me if you take part? What do you have to do?**

All the interviews will be conducted a range between 40 minutes and 1 hour. All the interviews will be conducted in the telemedicine centres. The content of interviews will make by digitally recorded and field notes simultaneously. The recordings will be transcribed to facilitate analysis.

The interview questions are about your work experiences and how to solve specific matters in your daily work. The common complaints may include the type of misfits in the telemedicine system.

1. **What are the possible disadvantages and risks of taking part?**

The interview is a non-invasive research method following the adequate procedure in this research. The potential for distress is no greater than might be experienced in everyday life.

1. **What are the possible benefits of taking part?**

Whilst there are no immediate benefits for participating in the project, it is hoped that the research findings will take some feedback for daily works of telemedicine service.

1. **Will my taking part in this project be kept confidential?**

All the information that we collect about you during the course of the research will be kept strictly confidential and will only be accessible to members of the research team. You will not be able to be identified in any reports or publications unless you have given your explicit consent for this. If you agree to us sharing the information you provide with other researchers (e.g. by making it available in a data archive) then your personal details will not be included unless you explicitly request this.

1. **What will happen to the data collected, and the results of the research project?**

The interview questions will not ask any personal details, such as name, gender, home address or personal contact number. In addition, the job titles and the name of hospital will be only associated with an arbitrary code. Moreover, the audio transcriptions will have the same arbitrary code and have an arbitrary code that is shared with my supervisors. Finally, the audio data will be stored on my personal computer. I will transcribe the audio into text then translate it into English for analysis. The transcriptions, translation and audio data will be used for my PhD thesis. If there is information specifically related to personal data and privacy or that cannot be fully translated into English this will be noted. Any sensitive information will be given an alternative code to represent the sensitivity.

Once the PhD is completed the data will be erased. The results of this research will not be shared with the telemedicine service centre. The data will be stored securely on my personal computer and will be password protected.

1. **The organising and funding the research**

This research is the PhD student thesis.

1. **The Data Controller**

The University of Sheffield will act as the Data Controller for this study. This means that the University is responsible for looking after your information and using it properly. This research is being carried out as a task in the public interest.

1. **The ethically reviewed the project**

This project has been ethically approved via the University of Sheffield’s Ethics Review Procedure, as administered by Management school.

1. **What if something goes wrong and you wish to complain about the research?**

If you wish to make a complaint you should inform us directly using the contact details provided. If you feel that your complaint has not been handled to your satisfaction you can contact the investigator’s supervisor– Yichuan.wang@sheffield.ac.uk. If you remain unsatisfied, you have the right to lodge a formal complaint with the UK Information Commissioner’s Office (ICO). Full details may be accessed on the complaints section of the ICO’s website.

1. **Contact for further information**

|  |  |
| --- | --- |
| Principal Investigator: | Rui Ma |
| Email addresses: | [Rui.Ma@sheffield](mailto:Rui.Ma@sheffield) .ac.uk |
| The University’s address: | Conduit Rd, Sheffield S10 1FL |

|  |  |
| --- | --- |
| Investigator’s supervisor: | Yichuan Wang |
| Email addresses: | Yichuan.wang@sheffield.ac.uk |
| The university ‘s address: | Conduit Rd, Sheffield S10 1FL |

## Appendix 4: Transcription of Interview

**1. The data management of telemedicine consulting system has been optimized several times since 2013. What are the main optimization contents? Why did you decide to optimize (specific event, time)? What triggered the optimization? What is the objective to be achieved in each optimization?**

The first edition of the provincial telemedicine integrated management platform (only a consultation management system) was put into operation at the end of 2013, but only the registration of consultation information could be completed, the support to save consultation data on provincial platform and to consult consultation patient information on a larger scale by experts is not enough.

Around 2014, attempts were made to retrofit the interface of county-level hospitals, which is the mainstream technology route of the platform, and is still the case today. At that time, the provincial centre selected 35 county hospitals for front-end configuration, but only about half of the hospitals completed the interface modification and access to the platform, but these access to the provincial platform of front-end machine operation quality is poor, about a year later, the front-end was almost all turned off by county hospitals. On the whole, the project was a failure. The main reasons for this include:

The interface of the system based on interface is difficult to operate on the actual work, while the HIS and related information system of the grass-roots hospital are upgraded, the interface needs to be reformed again, and the remote consultation is only the auxiliary service of the grass-roots hospital, the business volume is very small and does not affect its mainstream business, and the initiative of grass-roots hospitals is not high. Secondly, the interface transformation involves costs. At that time, the interface transformation of a business system may cost 100,000 yuan, the docking of telemedicine platform needs the transformation of many business systems, and the cost is high. The grass-roots hospitals are not willing to pay the cost Third, the convenience of the telemedicine platform based on data exchange is not as good as the experience of the system based on video conference. Doctors at both ends are more used to and more willing to use the video system. It is simple and does not need much operation. From this point of view, doctors at both ends do not actually carry out the interface transformation and platform construction of the inherent needs. Our so-called demand is more platform operators that is the demand of our centre, and low demand for housing. Fourthly, at that time, the informatization construction of many county-level hospitals was relatively backward, and the basic conditions and consciousness were not strong. Hospital leaders built telemedicine systems more for showing their political achievements than for business needs, more people, money, etc. are not realistic.

Some minor improvements around 2014 include the full entry of paper-based consultation notes. By inputting the record sheet of expert consultation, Consultation Inquiry and consultation statistics are formed preliminarily, which lays a foundation for further data management.

Between 2016 and 2017, more than 10 members of Huawei’s big data team moved into the centre to conduct research on medical big data, and to carry out comprehensive work on Big Data Infrastructure, data collection, data annotation, text analysis, and other aspects, trying to get ahead of the curve in the country, this was an industrial experiment by a Huawei Company and the centre’s first systematic attempt at big data on health care. But because of the complexity of health data, the collaboration was large-scale, large-scale and long-lasting, but in-depth specialized data, due to insufficient cooperation with specialized doctors, work into a dead end, failed to achieve the goals of both sides. This practice also shows that medical big data and smart medicine need to first solve the problem of data collection and labelling, which is an infrastructure that requires national financial investment and is difficult to achieve by relying on us or other single units. But there has been little progress.

An attempt was also made in 2017 to annotate and collate digital pathology data, and a one-week high-throughput scan was carried out with digital pathology scanner manufacturers, but the manual work required for the latter data annotation was too large, it failed to get off the ground.

During the period 2016-2018, the provincial platform did not make many attempts on data management, but the provincial ping centre has not given up the idea of building a data-driven-cantered integrated service platform, has been with the domestic mainstream information technology manufacturers to demonstrate, almost the top domestic HIT enterprises to the Provincial Centre for Technology Exchange, but also did not propose a breakthrough value of the program. During the period, a large-scale bid for the technical cooperation development of the data management platform was also conducted, but after listening to the proposal of the bidding enterprise and on-site assessment, no suitable technical partner was found and the bid failed. At that time, the concept of data lake and micro-service became popular. The Provincial Centre finally implemented the system transformation based on the data lake jointly with Kyushu Tong Company according to the requirements of the leaders in charge, the company affiliated to the centre and Kyushu Tong (Holographic Yuntong Health Science and technology (Beijing) Co. , Ltd.) also invested a lot of manpower in the pre-research and development, and carried out a unified allocation of the data centre, to purchase a batch of hardware, customizing and developing software to build a data exchange platform based on micro-services, but due to technical difficulties, the final approach is actually an interface, plus some other unspoken reasons, after more than one year, the cooperation has come to nothing. Now the official website of the centre is the product of this transformation.

In 2019, in the face of a series of national policies on Internet Hospital Construction, the centre invited micro-medical, Dalian Xinyi, Hangzhou pioneering and other companies to conduct in-depth talks, but also did not select the right partner. At this stage, the centre-led thinking has deviated from the mainstream of social thinking, the centre of the pursuit of a comprehensive, one-stop solution leads to find the right partner.

In the second half of 2019, the centre launched another round of cooperation with Huawei Companies and Shanghai Le Jiu Company. Huawei wants to use the latest technology to drive big data cleansing and modelling in healthcare, but the bottleneck of heavy data tagging and the need for a large number of clinicians has yet to be overcome and the collaboration has yet to end. Later, the centre and Shanghai Le Jiu Cooperation, the computer room storage of the first affiliated hospital of Zhengzhou 4 years of data preliminary management, some results, the basic completion of the data standardization management, but the ideal of big data is still a long way off.

A new round of platform upgrading and transformation will be implemented in the second half of 2020, the centre still uses the standard of the centre to distribute data, the centre provides the front-end server free of charge, the centre even provides the partial interface transformation expense for the county hospital, the grass-roots hospital coordinates the manufacturer to connect the way, the aim is to improve the original platform in the operational convenience, data collection, and other aspects of the lack of national science and technology projects undertaken, but so far the effect is very general. The reasons are: non-demand-driven transformation is difficult to cooperate with, can only be lively for a period of time; medical information awareness and the general environment has not fundamentally changed, large-scale transformation is difficult to adapt to the situation; communication is not in place, a lot of leading work is overlooked.

In general, there is no efficient way to link medical data, and it is difficult to have a very targeted policy, which may be related to the excessive marketing behavior of hospitals. It can be said that the centre has done a great deal of work in this area over the years, but the results have not been very good, and it is difficult to see how this work can be substantially promoted in the years to come if the general environment for health services does not change.

**2. The system function of telemedicine consultation system has been optimized several times since 2015. What are the main optimization contents? Why did you decide to optimize (specific event, time) (what triggered the optimization) ? What is the objective to be achieved in each optimization?**

All along, the provincial platform has been mainly based on remote consultation, and little adjustment has been made since the system went online in 2013, small optimizations such as some field improvements occur (there is no way to recall this, the technical person has changed a few, but is responsible for the block, they are also difficult to give you a detailed optimization process). A big optimization may be the launch of the Consultation Management APP in 2015. This is mainly for the convenience of experts, leaders, and grassroots workers to consult consultation information; however, it is a pity that the mobile remote consultation system is not included in the APP, which only realizes the business management function, but not the business function. Since then, the consultation system is not much improvement. Until this time the system is completely reformed. But this transformation, did not change the traditional architecture, although the old system has a certain amount of rich, but the system functions in the recent trial run also quite a lot of problems, is improving.

Overall, the remote consultation system deployed in 2013 was relatively successful, its business process carding and so on are relatively standardized, the system has also become a model of remote consultation systems in various hospitals, and later, many provinces, cities, hospitals of the remote consultation system has not achieved a major breakthrough. Including this time around, the technical requirements were not the mainstream. There were more non-technical considerations and were not caused by the requirements. Therefore, upgrading and upgrading could not achieve an essential upgrade.

**3. In the remote medical consultation system docking 3000 hospital electronic medical record system, interconnection is how to progress step by step? (According to the information I have, the first step you and your team took was to use the 2021 technology to implement real-time connectivity in the context of no government-mandated document connectivity and no extra funds for interface modification. Since then, 150 high-frequency remote consultation units have been selected for interface modification.) Please describe in detail how you and your team did this? What was achieved with each step?**

Firstly, at present, there are no 3000 hospitals capable of direct docking. This includes indirect docking via other provincial telemedicine platforms. About 600 hospitals are directly connected to each other.

Secondly, connectivity is a very broad concept, its essence is business and data connectivity. In telemedicine, intercommunication generally includes face-to-face effect and data exchange. Video conference ensures face-to-face effect, but data exchange cannot. The auxiliary stream cannot realize the interconnection, but only realizes the face-to-face communication. But the effect of secondary flow is getting better and better, can achieve the sharing of electronic medical records browsing, but there is no way to save the other end just. In particular, the epidemic has led to the rapid development of online conferencing technology, which is also being used in telemedicine, internet diagnosis and treatment.

Thirdly, the first round of roughly in 2016-2017 appearance, we implemented the first round of interface transformation, the front has answered, 35, but the effect is not good.

Fourthly, 2021 implementation of a new round of interface transformation and 2016 is the same principle, only parameters adjustment, but from now on, the number of really completed transformation of the hospital and quality is not optimistic. The reason is the same as before. Moreover, there are several more reasons for the lack of willingness of grass-roots hospitals. First, the internet medical platform, represented by provincial doctors, the first affiliated hospital of Traditional Chinese medicine, and other institutions, has become a regular operation, the internet medical platform has been able to solve some of the data docking problems, and can meet clinical needs. There are more consultation objects in grass-roots hospitals, even if do not do interface transformation will not have too much negative impact on the basic-level hospital remote consultation. Second, the cost of system conversion is very high, including the cost of time, grass-roots hospitals are not willing to learn to use the new platform again, and the new platform design, although the underlying architecture has been optimized, but the operation has not been able to achieve a large increase in usability, business system transformation at the beginning of a common platform switching tired, of course, this will continue to improve in the later. Third, the reform was pushed in the name of ‘ Covid-19 pneumonia prevention and control’ , with policy and political requirements attached. It was originally thought that grass-roots hospitals would ‘ Obey orders’ , but in fact this was not the case, it bothers some hospitals.

From the perspective of the provincial centre, the fundamental reasons of all the interface modifications are for data retention and value mining of late big data, but they are faced with uncertainty and do not take into account the real needs of users, and are not driven by needs, there is a supply-side drive, and the gap is clear.

**4.What are the government’s guidelines on connectivity (information sharing)? Why Can't we enforce interconnectivity? Please explain.**

There are a lot of documents requiring interoperability, especially in the areas of electronic medical record rating, hospital interoperability assessment, and declaration of regional medical centres, but the actual operation will be at all levels of hospital cleverly resolved, focus on ‘ Interconnectivity’ rather than ‘ Interconnectivity’ , even if ‘ Interconnectivity’ is also temporary interconnectivity, may be cut off at any time, in fact, it is.

The interconnection of business systems, including telemedicine, is not well done. The fundamental reason is that the needs of grassroots and upper-level hospitals have not been stimulated. The needs of both sides for the interconnection are not essential.

In the administrative system, connectivity is still possible, the hospital on time to submit regulatory data is relatively punctual, this is mainly administrative directives, involving hospital resources. This is only a provincial or national platform, but inter-hospital access to information is far from being achieved.

As a business system, telemedicine does not have a rising administrative level, but more business level. Moreover, the proportion of telemedicine in the whole medical service system is too weak, and the right of speech is insufficient, the final interconnection or to lower-level hospitals to realize the important value of telemedicine. Classification (administrative data and medical business data) is very necessary to manage the interworking of medical information.

As for whether there is a way to force forward, of course there is, as other data can be required, to grasp the essential needs of the hospital. For example, the health insurance system docking, docking is very good, this is because all levels and all types of hospitals have a strong demand for the health insurance system, not docking cannot get medical insurance costs. However, if the telemedicine business system to do so, I am afraid it will suddenly die. Therefore, it is not possible to have telemedicine connectivity without coercion, even if it is too much coercion. In the end, we still need to get both sides to recognize the value of telemedicine. This requires a lot of detailed promotion work and strong research results, let more medical institutions truly realize the value of telemedicine, this work is seen as simple, in fact, a long way to go. Including our theoretical research, but also the need for theoretical breakthroughs and credible results.

**5. How Do you push forward the consultation management assessment at all levels (provincial, municipal and county levels)? What obstacles have been encountered in the course of propulsion? Please explain in detail.**

We only consider the performance appraisal of provincial-level platform staff, did not consider the assessment of grass-roots hospitals, because they have their own personnel and salary relations, we do not need to regulate.

In the provincial centre, I have repeatedly developed a performance management approach, also carried out a colleague opinion collection, also reported to the leadership, but all in vain. The performance evaluation mainly includes daily attendance, business volume, business quality, peer evaluation, expert evaluation, grass-roots evaluation, etc. The basic principle is the 360 evaluation method, but in order to reduce the pressure of centre leaders, not included in the leader’s assessment. In these indicators there are detailed secondary indicators, to take a measurable KPI-based approach to comprehensive evaluation. But after many rounds of tossing also failed to implement.

The main reasons are: first, the centre’s employees are basically the children and family members of the hospital’s older workers. Many people come to the centre for easy work rather than hard work, and some have second careers, performance management will be strictly standardized, a variety of channels to say no to the implementation of performance management many; second, internal staff themselves also opposed, that is, their own torture themselves, doing well and doing more does not necessarily increase income, nor does it necessarily have a good prospects for development, opinions are very big, looking for related leaders everywhere to complain; third, the leadership in charge is in a sensitive period of development, do not want to offend the hospital staff because of this matter, affecting the unity and stability of the hospital.

**6. What training has been provided to all levels of consulting physicians and consulting managers since 2015? What are the reasons that trigger these trainings? What are the objectives of these trainings? After the training? Example: this year’s telemedicine knowledge contest.**

Professional and technical training for primary consultation doctors in provincial centres includes: The Department of Pathology has held two training sessions for basic pathology operators, probably in 2017. At that time, the provincial centre deployed around 100 pathology scanning equipment in the whole province, a network of remote pathological consultation in Henan province was set up, and two stages of professional training were carried out in order to achieve the unification of the quality of pathological section making, the main content of the training was the application and operation of the related technology and remote pathological diagnosis platform, such as taking materials, making wax blocks and slices. The training worked well.

Jointly with the physical diagnosis division, the department held an annual network ECG conference to introduce the basic principles of ECG diagnosis, remote ECG network technology and other content. About 200-300 participants attended the conference every year, and the training results were quite good, the skill of using ECG network is established preliminarily.

Of course, the specialized lectures that are being given every day, I understand, should not be in the scope of your question. This kind of training is done almost every day, mainly by clinical experts to expand their influence, build links, and improve the skills of specialists at the grass-roots level. So far, the results have been good, with a large (but not as large as desired) audience, it has also developed an education APP, with more than 100,000 registered users. Based on the education platform, it has conducted large-scale training including the new Crown Treatment Guide.

Training for managers includes:

First, in 2016, special training for managers and technical personnel of municipal sub-centres was carried out in conjunction with Huawei. The training lasted for one week and was long and rich in courses, the training, which established the ability to use the leading telemedicine system at the municipal level, was a relatively successful one, with the examinees receiving certificates of completion from both the provincial centre and the Huawei Company. This training is because of the municipal sub-centre completed that year capital, in order to make its smooth use of the concentrated work.

The Yellow River Forum on telemedicine Informalization was held once a year, and a telemedicine competition was held at the forum for two consecutive years, in the form of a knowledge contest, a speech, a quick answer and other forms, and was welcomed by the grass-roots level, close the relationship between the provincial centre and the grass-roots level. However, because the leadership in charge thought it was of little significance, it was discontinued. However, the annual Yellow River Forum on telemedicine informalization has persisted, inviting experts from within and outside the province to give lectures to improve everyone is understanding of telemedicine and master cutting-edge technology and knowledge. It has not been held so far this year.

Last year, the first telemedicine skills competition in Henan province was held, which rose to the level of professional skills competition in Henan province. The first competition had a greater impact. Although there were many problems and conditions were continuous, the overall effect was better, played a role in improving basic-level hospital skills.

The application training materials of Henan province telemedicine integrated service platform and the teaching materials of telemedicine popular science were compiled and distributed to the whole province for self-study.

In conclusion, there are very few powerful means to link up the loose inter-hospital cooperation of telemedicine, but in the end, it is necessary to form a close relationship and benefit-driven mechanism.

**7. How many times has the consultation process been optimized since 2015? What is it about? What is the reason for triggering the optimization? What is the goal of optimization?**

This question is so trivial that I cannot remember it clearly. It might go something like this: First, in order to keep the consultation records and urge the consultation service staff to work seriously, the on-site consultation records were started, requiring the accompanying staff to record the whole process, and then gradually becoming electronic, on-site record electronic log-in platform, and arrange a full-time staff audit consultation records.

The second is the scheduling adjustment of consultation room and consultation service personnel, is for each staff workload is basically the same, reduce workload differences, urge the weak responsibility to strengthen the work of personnel. Later in the implementation of the effect is getting worse and worse.

Third, perhaps you think of online platform optimization, such small optimization occurs constantly, the number and specific motivation is not easy to recall, but the root cause is to facilitate consultation.

**8. What efforts have you and your team made since 2015 to familiarize the grassroots with business processes? What and when?**

After 2015, we have done very little to familiarize the grass-roots with business processes, since most of this work is done by 2015. So, I’m not sure I understand what you mean by familiarity with business processes? Mass training? After this point in time is no longer, more in the business application to familiarize with the business process. For the provincial centres, in fact, since 2015, the centre’s main energy, especially mine, has shifted to declaring scientific research projects and publishing scientific research papers. Of course, this is in accordance with the requirements of the leadership in charge, then go to the grass-roots contacts to strengthen the emotional and business docking of the few things. From this stage, the centre began to pay less attention to the remote consultation business.

**9. Since 2015, with the gradual increase of telemedicine member units, the formation of cross-organizational collaborative work, Henan Telemedicine Centre is how to manage cross-organizational work? How to conduct feedback and evaluation of cross-organizational collaboration?**

I’ve been thinking a lot about how to strengthen cross-organizational management, and I can’t find a place to summarize it. As mentioned above, telemedicine is a kind of cooperative network. There is no question of who leads whom among the nodes. Therefore, my principle is to ask the staff to respect the lower-level hospitals as much as possible, adhere to the concept of serving the grassroots, service experts, in the actual work is also required.

During this period, the implementation of a fragmented management and municipal branch management of two specific practices. Let the Main Staff of the centre be responsible for the contact of a county-level hospital in a city. Basically, there are colleagues from their hometown who manage the county-level branch office in the city. The effect of doing so is relatively good in the initial stage, it was easier for the pack’s colleagues to form an emotional bond with the local community, but the more they did, the less important they became. In addition, one comrade was specially designated to be in charge of the contact of the 17 municipal sub-centres. This workload was quite heavy, but the situation of the municipal hospital was special, and it was a typical sandwich cake with an extremely unstable mentality. Therefore, special personnel were assigned to be in charge, however, due to the person in charge of responsibility, working methods and other issues related to quality can only be said fair.

In addition, I have also strengthened ties by involving the heads of municipal sub-centres in scientific research projects, participating in conferences, and assisting in running private affairs, and to increase the grass-roots Network Hospital meeting, project demonstration and other aspects of support, hope to emotionally establish inter-provincial, municipal work and personal contact.

When it comes to standardized management across organizations, it’s hard for me to find a solid approach. Our Centre is an informal organization, a lot of behaviour requires the leadership to agree to do, and the formal organization is different, a lot of work is actually impossible to do.

As for the assessment of inter-organizational collaboration, this is not done, nor is it intended to be done.

## Appendix 5: The Relevant Telemedicine Management Specification

远程会诊管理规范

**Remote Consultation Management specification**

1. 医疗机构具备与所开展远程医疗服务相适应的诊疗科目及相应的人员､技术､设备､设施条件,符合远程医疗相关卫生信息标准和信息安全的规定,满足开展远程医疗服务的需要｡

The medical institution shall have the diagnosis and treatment subjects and the corresponding conditions of personnel, technology, equipment and facilities that are suitable for the telemedicine services it carries out and shall meet the requirements of the health information standards and information security related to telemedicine, to meet the needs of developing telemedicine services.

1. 签订合作协议｡医疗机构之间开展远程医疗服务的,要签订远程医疗合作协议,约定合作目的､合作条件､合作内容､远程医疗流程､双方权利义务､医疗损害风险和责任分担等事项｡

Sign a cooperation agreement. Those who carry out telemedicine services between medical institutions shall sign a telemedicine cooperation agreement, agreement on the purpose of cooperation, cooperation conditions, cooperation content, telemedicine process, rights and obligations of both sides, medical damage risk and liability sharing and other matters.

1. 远程会诊中心应指定专门人员负责远程会诊设备､设施､系统的定期检测､登记､维护､改造､升级,确保正常运行,若管理人员工作调动,应办理交接手续｡

The teleconsultation centre shall appoint special personnel to be responsible for the periodic examination, registration, maintenance, transformation and upgrading of the teleconsultation equipment, facilities and systems to ensure the normal operation, should go through the handover procedures.

1. 远程会诊医师应具备以下条件:取得执业医师资格并注册;具有副主任医师及以上专业技术职务;会诊､咨询内容与本人执业范围､专业技术相一致｡

A teleconsultation physician should be qualified and registered as a medical practitioner, hold the post of deputy chief physician or above, and the content of consultation and consultation should be consistent with the scope and skill of his practice.

1. 远程会诊医师纳入’ 会诊医师专家库’ 统一管理,会诊中心负责专家库的建设､维护与更新｡

The teleconsultation doctors are under the unified management of the expert database of the consulting doctors, and the consulting centre is responsible for the construction, maintenance and update of the expert database.

1. 远程会诊患者基本要求｡

Basic requirements for remote consultation of patients.

1. 病例应为重症或疑难杂症患者,在分中心门诊或住院病历,已亡或出院病历不得申请会诊｡

The case should be severe or complicated disease patients, in the sub-centre outpatient or in-patient medical records, dead or discharged medical records cannot apply for consultation.

1. 病历及相关材料已经全部完善的患者｡

Case history and related materials have been completed in all patients.

1. 经科内讨论后,仍未能确诊的患者｡

After internal discussion, the patient still cannot confirm the diagnosis.

1. 远程会诊申请方发出会诊申请前,须征得患者及其亲属知情同意,并签署患者知情同意书｡会诊后应将会诊结果记入病程记录,并向患者或其亲属通报远程医疗会诊结果｡

The applicant for Teleconsultation shall obtain the informed consent of the patient and his/her relatives and sign the informed consent form of the patient before issuing the application for teleconsultation. The results of the consultation should be recorded in the course of the disease and the patient or his relatives should be informed of the results of the telemedicine consultation.

1. 远程会诊包括普通预约会诊和紧急会诊｡在突发情况､紧急情况下,针对危机重症患者,可以申请远程紧急会诊｡普通会诊一般在24小时内做出会诊安排,2个工作日内完成会诊;紧急会诊一般在2小时内做出会诊安排,4小时内完成会诊｡

Remote consultation includes general appointment consultation and emergency consultation. In the emergency, emergency, for the critical patients, you can apply for remote emergency consultation. General consultation is scheduled within 24 hours and completed within 2 working days; emergency consultation is scheduled within 2 hours and completed within 4 hours.

1. 远程会诊现场汇报病例期间,患者及家属可以在现场完善病情及病史;病例讨论期间,患者及家属需要离场回避｡

The patient and his/her family can improve the patient’s condition and medical history on the spot during the report of the case through remote consultation, and the patient and his/her family need to leave the scene during the discussion of the case.

1. 会诊结束后,远程会诊分中心应做好远程会诊病例信息的登记工作｡出具会诊报告单(主要包括:专家诊断意见､治疗建议等),并根据需要打印或保存,最后做会诊数据整理､保存工作｡门诊患者应交由患者本人留存｡对会诊患者应定期进行疗效回访｡

After the consultation, the teleconsultation sub-centre should register the case information of teleconsultation. Issue consultation report sheet (mainly including expert diagnosis opinion, treatment suggestion, etc.) , print or save according to need, and finally do consultation data collation, preservation. Outpatients should be handed over to the patients themselves for retention. To consult the patient should carry on the curative effect to return to visit regularly.

1. 开展远程会诊的医疗机构和医务人员应当依法保护患者的隐私和个人资料,维护患者和会诊医师的合法权益｡

Medical institutions and medical personnel conducting teleconsultation shall protect patients’ privacy and personal data in accordance with the law and safeguard the legitimate rights and interests of patients and consulting physicians.

1. 远程会诊医师与申请会诊医师属于医学咨询关系,申请会诊医师与患者属于法律意义上的医患关系｡

The telemedicine consultant and the applicant consultant belong to the medical consultation relationship, and the applicant consultant and the patient belong to the doctor-patient relationship in the legal sense.

1. 在远程医疗服务过程中发生医疗争议时,远程会诊双方应按照相关法律､法规和达成的协议进行处理,并承担相应的责任｡医疗机构和医务人员在开展远程医疗服务过程中,有违反《执业医师法》､《医疗机构管理条例》､《医疗事故处理条例》和《护士条例》等法律､法规行为的,由卫生计生行政部门按照有关法律､法规规定处理｡

When a medical dispute occurs in the course of telemedicine service, both parties should handle it according to relevant laws, regulations and agreements, and bear corresponding responsibilities. In the course of developing telemedicine services, medical institutions and medical personnel, those who have violated laws and regulations such as the law on medical practitioners, the regulations on the management of medical institutions, the regulations on the handling of medical accidents and the regulations on nurses, the administrative department for Health and family planning shall handle the matter in accordance with relevant laws and regulations.

远程会诊基本流程

Basic process of remote consultation

提交会诊申请 -->病例资料上传(准备)-->会诊预约 -->材料接收 -->材料审核 -->会诊安排 -->启动设备 -->申请医师汇报病例病情病史 -->专家诊断 -->会诊病例讨论 -->形成诊断方案/治疗方案 -->会诊结束(材料整理备案)｡

Submission of consultation application-> case data upload (preparation)-> consultation appointment-> material receipt-> Material Review-> consultation arrangement-> initiating equipment-> application for physician’s report of case history-> expert diagnosis-> consultation case discussion-> Formation of diagnostic/treatment protocols-> end of consultation (material preparation) .

紧急会诊处理可以不采用会诊的基本流程｡我中心会根据实际情况直接协调安排进入正式会诊环节,所需会诊资料由请求会诊医院现场补充传送｡

Emergency consultation can be handled without the basic process of consultation. My Centre will be based on the actual situation of direct coordination arrangements into the formal consultation link, the required consultation information by the request consultation hospital site supplementary transmission.

已约会诊不得无故换诊､缺诊,若有特殊情况,请提前2小时致电我中心重新安排调度,否则,产生的一切后果由分中心负责｡

Appointments cannot be without reason for change, absence of diagnosis, if there are special circumstances, please call my centre 2 hours in advance to re-schedule, otherwise, all the consequences by the sub-centre responsible.

**各级远程医学分中心会诊管理员行为规范**

The behaviour standard of consultation administrator in all levels telemedicine sub-centre

各级远程医学分中心设立至少1名专职会诊管理员,负责远程会诊的申请､现场保障､会诊后记录､本院会诊医师沟通等工作｡

At least one full-time consultation administrator shall be set up in each telemedicine sub-centre to be responsible for the application, on-site support, post-consultation record, and communication with the doctors in the hospital.

严格审核每例远程会诊申请单,做到申请表规范填写,会诊病人病历信息完善,初步诊断及会诊目的和申请科室相符｡出院､转院及死亡病例不能申请远程会诊｡

Strictly examine the application form of each remote consultation, fill in the application form, complete the information of the patient’s medical record, and the purpose of the preliminary diagnosis and consultation is consistent with the application department. Discharge, transfer and death cases can not apply for remote consultation.

发出会诊申请后,及时登录’ 河南省远程医学中心区域医疗协同平台’ ,查看会诊安排情况,会诊时间以平台信息为准｡

After issuing the consultation application, log on the’ Regional medical cooperation platform of Henan telemedicine centre’ in time to see the consultation arrangement. The consultation time shall be based on the platform information.

会诊时间确定后,提前告知远程会诊申请医师,并在会诊当天再次电话或短信通知远程会诊申请医师,做好会诊前准备工作｡

After the consultation time is confirmed, inform the applicant physician in advance, and inform the applicant physician again by phone or text message on the day of the consultation.

会诊安排后,分中心不得无故换诊､缺诊,若由于某些不可抗力无法如期会诊,请提前2小时致电省中心更改会诊时间或撤诊｡每周无故缺诊三次及以上,停止该分中心申请远程会诊三天｡

After the consultation arrangement, there will be no unjustified change or absence of consultation. If some force majeure can not attend the consultation as scheduled, please call the centre 2 hours in advance to change the consultation time or withdraw the consultation. No more than three unexcused absences per week. Stop applying for remote consultation for three days.

提前十五分钟测试设备是否畅通,将患者病历及相关电子资料打开,提前告知申请医师会诊时间安排,做好会诊准备｡

Test if the equipment is clear 15 minutes in advance. Open the patient’s medical record and related electronic data, inform the applicant in advance of the schedule of the consultation, and prepare for the consultation.

会诊期间,分中心会诊管理员不得擅自离场,并保证会诊网络､会诊中心电话畅通｡负责主持会场､维护会诊室环境,杜绝喧哗,要求所有与会人员手机静音､着装整洁､态度严肃认真｡

During the consultation, the sub-centre consultation manager shall not leave the venue without authorization, and ensure consultation network, consultation centre telephone unblocked. Be responsible for chairing the meeting place, maintaining the environment of the consultation room, eliminating noise, requiring all participants to mute their mobile phones, dress neatly and seriously.

告知申请医师,会诊过程中除紧急病例外不得私自与会诊医师商议添加会诊｡

Inform the applicant physician that in the consultation process, consultation with the consultant is not allowed except for emergency cases.

会诊过程中,未经许可,会诊患者及家属不得在场,禁止在会诊过程中拍照､录音､录像｡

During the consultation process, without permission, the consultation patients and their family members shall not be present, and it is prohibited to take photos, record audio and video in the consultation process.

会诊过程中,会诊室不得同时进行其他工作影响会诊正常进行｡

During the consultation process, the consultation room shall not carry out other work at the same time to affect the normal consultation.

分中心会诊管理员变更或联系方式变更,应及时电话告知省中心,以保障远程业务顺利进行｡

Sub-centre consultation manager changes or changes in contact, should be timely phone to inform the provincial centre, to ensure the smooth implementation of remote business.

工作时间:周一至周五(8:00-12:00,14:30-17:30),周六(8:00-12:00)

Working Hours: Monday to Friday (8:00-12:00,14:30-17:30) , Saturday (8:00-12:00)

分诊电话:0371-67966212/67966509

Triage Contact: 0371-67966212/67966509

会诊电话:0371-67966217

Consultation telephone: 0371-67966217

**远程教育中心管理制度**

**Management System of distance education centre**

远程教育中心是开展远程教育的场所,配备有精密贵重设备,为保证教学质量和设备正确使用,制定本管理制度｡

Distance Education Centre is a place for distance education, equipped with precision and valuable equipment, in order to ensure the quality of teaching and correct use of equipment, the development of the management system.

非录播室工作人员未经允许不得随意进入录播间｡

Non-studio staff shall not enter the studio without permission.

在导播间的操作台､所有机器设备上严禁摆放任何液体｡室内禁止吸烟,杜绝火种,配备灭火器,管理员应会使用灭火器｡

It is strictly forbidden to place any liquid on the operating table and all machinery and equipment in the guide booth. No smoking in the room, no fire, equipped with fire extinguishers, managers should be able to use fire extinguishers.

录播室管理人员要经常对机器设备进行检查､维护､保养,发现问题及时处理,保证机器设备的安全､可靠,始终让机器处于良好状态｡

The manager of the studio should check, maintain and deal with the problems in time to ensure the safety and reliability of the machine and keep the machine in good condition.

爱护录播室设备和设施,未经管理人员同意,任何人不得擅自使用､搬动和拿走｡不得擅自把录制的有关资料对外借阅和复制｡

Care recording studio equipment and facilities, without the consent of the management staff, no one may use, move and take away. The recorded materials shall not be lent or copied without authorization.

录播室内的所有设备应由演播室管理人员操作,操作人员必须严格按照使用说明和操作规程进行｡

All equipment in the recording studio shall be operated by the studio manager, who shall strictly follow the instructions and operating procedures.

做好安全防范工作｡室内禁止使用明火和违规用电,下班离开前一定要关灯､关电,关好门窗,做好防火､防盗｡

Do a good job of security precautions. It is forbidden to use open fire and illegal electricity in the room. You must turn off the lights and power before leaving work. Close the doors and windows and prevent fire and theft.

教师进行远程教学时,需遵守我中心授课管理制度,具体内容如下:

Teachers are required to comply with the teaching management system of our centre when conducting distance learning. The details are as follows:

教学目标明确｡上课时应做到目标明确,内容适度,重点突出｡

Clear teaching objectives. Class should be a clear goal, moderate content, focus.

教学内容准确无误｡授课教师应保证所讲授知识准确无误,对概念､定义的表述,乃至上课引用的事例,都应是确切无疑｡

The teaching content was accurate. The teacher should ensure the accuracy of the knowledge taught, the presentation of concepts, definitions, and even cited examples in class should be accurate.

授课教师要认真提前做好课前的准备工作,提前15分钟到场｡

The teacher should do a good job in advance of the pre-class preparation, 15 minutes in advance to arrive.

授课时,授课教师要重视仪表形象,衣着整洁,授课时要用普通话进行教学,不得使用地方俗语｡

When teaching, teachers should pay attention to appearance, clean clothes, teaching to use Mandarin teaching, not the use of local idioms.

教师要严格遵守教学时间,按时上课,不擅离职守,不漏课,不停课,不找他人代课;因故(事或病)不能如期上课,需提前3天通知我中心,并履行相关停调课手续｡

Teachers should strictly observe the teaching time, attend classes on time, do not leave their posts without permission, do not miss classes, do not suspend classes, do not ask others to substitute for classes; due to an accident (or illness) cannot attend classes on time, need to inform my centre 3 days in advance, and perform the relevant procedures for class suspension.

## Appendix 6: TCSP Development History

The regional disparity in healthcare resources in China, specifically in Henan Province, is a significant issue. Most of the high-quality healthcare resources and skilled practitioners are concentrated in larger cities and medical institutions, leaving remote and rural areas underserved.

Henan Province, despite being the third most populous province in China, suffers from an imbalanced distribution of healthcare resources. However, the advent of telemedicine presents a unique opportunity to address this problem. The Henan Telemedicine Centre, established in 1996, has been a pioneering institution in leveraging technology to extend medical services to remote regions.

Currently, the Henan Telemedicine Centre is connected to over 300 hospitals, handling a significant volume of multidisciplinary consultations daily and offering continuing education to hundreds of thousands of primary healthcare workers every year. This not only improves the accessibility of healthcare services but also elevates the quality of healthcare in remote regions through continuous professional development for healthcare workers.

With the construction of 19 regional-level sub-centres, the coverage of telemedicine services in Henan Province is set to increase further. The aim is to create a telemedicine service system that covers every level, from the provincial city to the county to the village (or community), thereby ensuring comprehensive medical and health services for everyone in the province.

The telemedicine platform uses advanced technology including a 1080P/60-frame Smart Truth system, optical fibre, satellite, 3G, microwave, etc., to provide various services such as communication, emergency command, remote consultation, image data transmission, video conferencing, appointment booking, two-way referrals, health management, remote training, and sharing of digital resources.

The goal is to create a new model of telemedicine service, primarily driven by data exchange between hospitals, complemented by video communication. This innovative approach aims to bridge the urban-rural divide in healthcare services, making quality healthcare more accessible to people in Henan Province and other remote regions.

This development is indeed promising, suggesting that telemedicine has the potential to dramatically improve the delivery of healthcare services in China, particularly in regions where access to medical services has been traditionally limited. Over time, this could lead to a significant improvement in health outcomes for people living in these areas.

Telemedicine not only revolutionizes patient care but also transforms professional development for healthcare providers, particularly in regional and local hospitals where educational resources might be constrained due to budgetary limits.

The cost and logistical challenges associated with sending regional and local doctors for further training can be substantial. Not only does it incur direct expenses related to travel, accommodation, and tuition, but it also creates an indirect cost through the absence of these doctors from their regular work, which may impact the delivery of healthcare services.

However, telemedicine consultation services provide an innovative solution to this dilemma. Starting in 2014, regional doctors could utilize telemedicine platforms for remote consultations with specialists in tertiary hospitals, improving the quality of care they deliver while simultaneously enabling them to receive ongoing education. This practice eliminates the need for doctors to leave their jobs for training, significantly lowering the associated costs and minimizing disruption to regular services. Following the success of this approach at the regional level, the model was expanded in 2017 to include local-level doctors. This moves further democratized access to high-quality medical education and expert consultation, raising the standard of medical service at local-level hospitals. This use of telemedicine for continuing education demonstrates the broad potential of digital technologies in healthcare, extending beyond direct patient care to encompass professional development for healthcare providers. Eventually, this can contribute to a more robust and resilient healthcare system by enhancing the knowledge and skills of medical professionals, particularly in regional and local hospitals where access to advanced training has traditionally been limited.

Table 18. Timeline for TCSP (Resource: Author)

|  |  |
| --- | --- |
| Year | Key system events and organizational events |
| 1995-2007 | * It was one of the first telemedicine centres in China to open and is still in operation. * There were 30 members of the virtual alliance in 2007. * An early prototype of a telemedicine system based on telephony and IM technology. |
| 2010 | * Henan Provincial Department of Health approved the construction of Henan telemedicine centre relying on The First Affiliated Hospital of Zhengzhou University. |
| 2011 | * Telemedicine centre officially opened. |
| 2012 | * Build up the hospital alliance of telemedicine services. |
| 2013 | * Build the four-stage linkage telemedicine service. |
| 2014 | * Extend 19 remote medical centres in the regional level. * It was the first time that the telemedicine platform was linked to telemedicine outside of the province and offered telemedicine consultations through the telemedicine system in the Xinjiang Region. A heterogeneous system outside of the province can be interconnected with the telemedicine service platform. * China's first provincial telemedicine academic organization, the Telemedicine Informatization Professional Committee of Henan Provincial Health Information Society, was established in Henan Telemedicine Centre. |
| 2015 | * Henan Province telemedicine integrated Service Cloud platform was officially put into use. * Telemedicine construction stage. * The first version of cloud -based connected health platform. * Telemedicine Data Centre established in Henan Province. |
| 2016 | * Build the five-level linkage telemedicine service system. * Consultation with a pathologist via remote diagnostics started. * Providing online training in ECG. * Training in the preparation of pathological specimens and specimens for the production of paraffin tissues. * It has been announced that a remote diagnosis service will be available online. * Built up healthcare data Hadoop system. |
| 2017 | * A Local-level network of telemedicine centres is being demonstrated in Henan Province as part of a demonstration project. * Two telemedicine information technology industry standards were drafted by the Centre (WST546-2017 and WST545-2017), which were formally approved by the National Health and Family Planning Commission of China. |
| 2018 | * Chinese first 5G medical experimental network. * The newly upgraded national telemedicine collaborative service platform. * Integrating telemedicine resources and platforms. Six provincial hospitals offer telemedicine consultation services to the local and regional health care consultant via the telemedicine consultation service platform. |
| 2019 | * Six provincial-level hospitals in Henan province began to offer remote consultation services. * A new Internet-based supervision platform for medical services has been launched in Henan Province. |
| 2020 | * New telemedicine access points have been added Henan Provincial Health Commission and Covid-19 Designated treatment hospitals, which will be connected to the telemedicine system of Henan Province through special lines. * Requirements collection for telemedicine consultation system upgrade. |
| 2021 | * Telemedicine consultation service platform upgrade. * Telemedicine consultation service platform upgrade online training. |

## Appendix 7: Telemedicine Literature Review Table

Table 19. Type of misfit and Definition (Soh et al., 2000, p.49 and Strong and Volkoff, 2010)

|  |  |  |
| --- | --- | --- |
| Type | Definition (Soh et al., 2000) | Definition (Strong and Volkoff 2010) |
| Data | ‘Data misfits arise from incompatibilities between organizational requirements and ERP package in terms of data format or the relationships among entities as represented in the underlying data model.’ | ‘Data misfits occur when data or data characteristics stored in or needed by the ES leads to data quality issues such as inaccuracy, inconsistent representations, inaccessibility, lack of timeliness, or inappropriateness for users' contexts.’ |
| Functional | ‘Functional misfits arise from incompatibilities between organizational requirements and ERP packages in terms of the  processing procedures required.   1. Control misfits arise from missing validation procedures or checking routines. The missing procedures do not affect day-to-day operation but relate directly to the management’s risk tolerance level. 2. Operational misfits occur when normal.   operational steps are missing or inappropriate, often due to the incompatibility of the embedded business.’ | ‘Functionality misfits occur when the way processes are executed using the ES leads to reduced efficiency or effectiveness as compared to pre-ES outcomes.’ |
| Output | ‘ Output misfits arise from incompatibilities between organizational requirements and the ERP package in terms of the presentation format and the information content of the output.’ |  |
| Usability |  | ‘Usability misfits occur when the interactions with the ES required for task execution are cumbersome or confusing, i.e., requiring extra steps that add no value, or introduce difficulty in entering or extracting information.’ |
| Role |  | ‘Role misfits occur when the controls embedded in the ES provide too much control, inhibiting productivity, or too little control, leading to the inability to assess or monitor performance appropriately.’ |
| Control |  | ‘Control misfits occur when the controls embedded in the ES provide too much control, inhibiting productivity, or too little control, leading to the inability to assess or monitor performance appropriately.’ |
| Organizational culture |  | ‘Organizational culture misfits occur when the ES requires ways of operating that contravene organizational norms.’ |

Table 20. Telemedicine literature review

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Author  (Year) | Journal | Research objectives | Theoretical base/model | Research Method  (Method/dataset) | Variable outcome | Key findings |
| Hu et al., (1999) | JMIS | This research aims to determine if the Technology Acceptance Model (TAM) may be used to explain why doctors choose to employ telemedicine in medical contexts. | TAM | * Quantitative (survey) * 421 valid responses from physicians were collected. | * Telemedicine technology management * Technology acceptance | * The physician’s usage of telehealth technology was adequately explained by TAM. More than perceived ease of use, perceived usefulness had an impact on attitudes and intentions. * Physicians often concentrate on the technology's own utility. Since doctors tend to perceive technology as a tool that can only be embraced if its intended usefulness is proved in their practise, it is crucial to show that telemedicine technology can suit the demands of specific doctors in order for it to be accepted by physicians. In this sense, it is crucial to provide suitable user training in order to direct and solidify doctors’ impressions of the technology’s use. * Instead of focusing on the steps or procedures of using the technology, telemedicine information sessions and training should focus primarily on how technology can help physicians improve patient care and the delivery of efficiency and effectiveness of service delivery. |
| Chau and Hu (2002) | JMIS | The intention of each physician to employ telemedicine technology is the main subject of this study. Using physicians’ acceptance of telemedicine technology examine intention of physicians. | TAM (Individual level) | * Exploratory Study(questionnaire) * 408 physicians from the 3 public tertiary hospitals | * Telemedicine technology management * Technology acceptance | * Physicians seem to make acceptance decisions based primarily on the usefulness of the technology rather than its ease of use. * Technology acceptance decisions were dominated by concerns about compatibility with the doctor’s practice, less emphasis on controlling the technology’s operation, and less weight given to peer opinions. * The hierarchical three-tiered structure was proposed for technology acceptance by individual professionals, in which the personal context is at the core, the implementation context is at the outermost level, and the technology context is in the middle. |
| Brown et al., (2004) | JMIS | This paper proposes the Interpersonal Circumstance Model (ICM) as a theoretical framework for understanding the role of personal traits in virtual environments. | Interpersonal circumplex model (ICM): individuals’ personality traits | * Qualitative (interviews) * 350 geographically and culturally diverse students from across the globe. | * Technology acceptance * virtual collaboration | * This paper proposes that interpersonal traits, particularly personality types defined by context, influence individuals’ propensity to trust, perceived trustworthiness, communication, and thus willingness to collaborate and collaborative sustainability and productivity. * The model allows us to unlock the black box concepts of trust propensity, trust in others and trust stance that are currently included in trust theory in information systems. This theory can also explain the dynamics of trust at the binary and group levels. * We hypothesise that individual traits and binary complementarity are mediators of interpersonal trust and willingness to use new technologies, and significantly influence the onset, duration and productivity of computer-mediated collaboration time and productivity. |
| Paul (2006) | JMIS | This study intends to give a better understanding of how various parties are able to achieve their objectives via collaborative activities by investigating collaborative activities in virtual environments from a knowledge management perspective. | Knowledge Management Perspective | * Qualitative (Case study, semi-Interview) * 55 Clinicians, 19 administrators, and   21IT professionals | * Virtual Collaborative | * The main collaborative activity of distance learning and distance consultancy projects must be the discovery or creation of knowledge. * Effective knowledge transfer is also hindered by the social environment, which does not facilitate effective collaboration. In a virtual environment, the social context facilitates open interaction and trust development. * Applied tacit knowledge as well as exogenous knowledge is necessary to make telemedicine projects successful. |
| Rajan et al.,  (2013) | JMIS | In this paper, we examine how telemedicine technology affects the market share of specialist hospitals that use the technology and the market share of competing hospitals in the same region that use the technology. | Modelling Patients’ Choice and Its Influence on Market Share | * Quantitative (Randomized controlled clinical trial) * 27peopleinscheduled telemedicine visits and 33 people in scheduled in-person visits | * Telemedicine Chronic treatment * Parkinson’s Disease | * Contrary to early expectations, telemedicine’s value does not necessarily increase with distance from the hospital, compared with on-site visits. * Telemedicine care may not be popular with patients far from specialist hospitals because of this result. It is shown that telemedicine is not a ‘ winner-takes-all’ application like many other forms of e-commerce. * In our study, we found that the advent of telemedicine has changed the competitive balance between specialist hospitals and community hospitals. Instead of continuing to compete with each other, both types of hospitals will benefit greatly from providing complementary care to patients with chronic conditions. |
| Peter et al.,  (2015) | JMIS | The paper proposes a specific business model framework and identifies three type of business model models for the telemedicine industry. | CompBizMod  framework |  | * Telemedicine Business Models | * The CompBizMod framework has been developed and evaluated. It contains a morphological structure that can be used to (1) analyse, describe and classify telehealth business models, (2) identify white spots for future business opportunities, and (3) identify models for creating successful business models. * This paper proposes three business model models for the telehealth industry based on a specific framework. 1) Enablement 2) Support 3) Empowerment |
| Steinhauser  et al., (2020) | JMIS | We examine the relative roles of digital complementary assets and regulation in driving discontinuous innovation adoption based on research on IT innovation adoption. | Conceptual research model | * Quantitative (multiple secondary data) * 30 European countries * 1,753 acute care hospitals | * Telemedicine Innovation | * Examining the factors that influence the adoption of discontinuous digital innovations is a contribution to IS research on digital transformation. Discontinuous digital advances provide new problems for established organisations, necessitating reorganisation of current procedures and perhaps even alterations to current business structures. Users like to employ digital technology to gradually expand or change already-existing processes. * By quantifying the relative importance of organisational and regulatory factors, as well as the role of digital complementary assets in overcoming the inertia of existing businesses, the study of the factors that influence existing firms’ adoption of discontinuous digital innovation now includes the influence of regulatory frameworks. implying that discontinuous digital advances may succeed when they can get beyond stringent control. |
| Singh et al., (2011) | JAIS | In the United States, health care payment and regulation changes have challenged home health care providers' business models. The paper discusses ways to address this challenge by combining adaptive organizational principles with information technology. | Dynamic capability and sense-and-respond approach | * Qualitative (Longitudinal case study, semi-interview) * Managers, doctors, nurses, patients (22 in person) | * Post-acute care * Home health care | * This change has enhanced nursing practise by using the dynamic capacities present in the organisation. * Collaboration between doctors, nurses, office personnel, and patients is used to carry it through. Through the integration of information systems and health services literature, our research looks at how providers develop IT support for adaptive care delivery capabilities, identifies target processes for transformation, and shows how transformation leads to improved clinical and financial outcomes. * Additionally, we offer fresh perspectives on the micro-foundations of dynamic capabilities, distinguishing between transactional-level and transformational-level capabilities, and elaborating on how home healthcare providers adapt their capabilities to various forms of IT support in order to adapt to environmental changes. |
| Kelley et al., (2011) | JAIS | How to assist eHealth systems in reducing the challenges that doctors and patients have while coordinating self-care. | * Health promotion theory * Theories of IT Adoption * The Precede-Proceed Model | • Qualitative (face-to-face assessment session, observations, face-to-face eHealth system training)   * 29 patients:12 was male and 15 were females.39 to 89 years of age. * 95 observations | * Self-Management of Diabetes | To maximise the use of e-health learning, patients, particularly those who have just received a diagnosis, must communicate with physicians’ online. This sort of IT usage has an impact on the dispositional and enabling variables that encourage the adoption of chronic self-care behaviours. |
| Grisot et al., (2014) | JAIS | Which conditions enable successful information infrastructure innovation?’ | Base Cultivation | * Qualitative (case study) * semi-structured interviews, observation and document review * 22 MyRec team members | * Innovation | * First and foremost, infrastructure development must be bottom-up and progressive, with a focus on experimentally creating services that cater to a certain user group’s demand. The infrastructure that has to be built as well as the organisation responsible for development must meet a number of requirements. Both must be straightforward and adaptable, which also implies that they are loosely tied in contrast to other infrastructures and development organisations. * The three categories of innovation—infrastructure innovation, internal innovation, and infrastructure innovation—need to be addressed for infrastructure innovation to be effective. The first is necessary for the latter two forms of innovation (i.e., the architecture of the entire infrastructure will limit or support innovation related to existing infrastructure or components on top of infrastructure). elements of the current infrastructure). |
| Li et al., (2020) | JAIS | The purpose of this research was to comprehend the efficiency of doctor-patient communication in telemedicine clinics, which comprise the following specific characteristics: Poor rural patients, far-flung medical professionals, and inexpensive telemedicine technology | Affordance-effectivity framework | * Mix method * 216telecamp participants * 46 sessions of teleconsultation video archives | Cost-effective | * The difficulty of the illness diagnosis and the extent to which the patient's medical demands are met both have an impact on patient satisfaction with teleconsultation. * The field operator plays numerous functions and serves as a ‘compensator for user efficiency,’ enabling patients and doctors to communicate verbally and nonverbally while appropriating technology. There are practical ramifications for increasing access to healthcare for underprivileged people in developing nations and, more broadly, for accomplishing technology supply in multi-actor usage scenarios |
| Overby and Konsynski (2010) | ISR | This paper's goal is to provide a research agenda for creating high-level theories and frameworks that explain the phenomena of process virtualization in general. By creating these theories and frameworks, current knowledge will be synthesised, and a theoretical base will be formed upon which new information may be added as it is produced. | Research Commentary | Research Commentary | Virtual processes | * Virtualisation of processes does not eliminate physical interactions, as virtual processes often involve participants interacting with computers, phones, etc. * The effectiveness of telemedicine in comparison to traditional care processes. In meta-analyses, telemedicine has been shown to produce better outcomes than physical care processes, especially when it comes to conditions like diabetes, heart disease, and mental health issues. * Technology is used in many telemedicine applications to provide healthcare in remote areas and developing countries, enabling doctors with specialist knowledge to serve more patients. |
| Kane and Labianca (2011) | ISR | * This study looked at whether and how performance is impacted by post-adoption resistance. There is a specific kind of post-adoption resistance known as IS avoidance, which identifies circumstances in which people avoid working with adopted IS in spite of the need and opportunity. * How IS avoidance affects the effectiveness and quality of service provided by healthcare organisations? | * Beyond Simple Lack of Use * A Multilevel View of IS Avoidance * IS | * Mix method * 2,000–2,500 patients * 4–6 doctors * 8–12clinical administrative support Staff. | IS avoidance | * After the system is put into place, resistance might still exist in the form of avoidance, which could have an impact on how much IS influences performance. The link between IS avoidance and performance is essentially different. * While some users may have good justifications for not utilising a certain system (e.g., they typically do not need it for their organisational function), IS avoidance is mostly concentrated in those workers who need the system but intentionally choose to avoid it. While certain forms of IS avoidance can have a negative impact on the performance of the healthcare team, strong support may make up for doctor IS avoidance. |
| Sun et al., (2020) | ISR | Can telemedicine reduce overcrowding in ER departments? | standard DID  regression | * Quantitative (secondary data) * HIMSS database * American Hospital Association database | health information technology | * In ERs, telemedicine applications can significantly reduce patients’ average length of stay. * Telemedicine gains efficiency without compromising quality or increasing healthcare expenditures. The benefits of telemedicine do not come at the cost of a lower quality of care or a higher cost of healthcare. * A flexible resource allocation can also be achieved through telemedicine, in addition to more efficient information exchange. Especially when demand and supply fluctuate, the provision of care is greatly improved. |
| Paul and McDaniel (2004) | MISQ | This article examines the relationship between interpersonal trust and virtual collaborative relationship (VCR) performance. | Facet theory | * Qualitative(interview) * 74 clinicians administrators, and information technology professionals | * Virtual collaboration | * The functions that various forms of trust may fulfil. Integrated interpersonal trust has a favourable relationship with VCR performance. * If VCRs are to perform strongly positively, appraisals of all three categories of trust must be good. |
| Miscione  (2007) | MISQ | How do telemedicine and local healing practices influence each other? | New institutional theory | * Qualitative (Semi-structured interview; Focus group; Shadowing) * health care staff, patients and traditional healers * 8 clinics | * Developing countries | * Organizational learning can help developing countries reorient their information system designs and implementations. * There are different kinds of learning that occur in different contexts. Learning is more than just transferring knowledge; it occurs through participation in practice. * A telemedicine system is integrated into an existing healthcare system. Embedded in existing healthcare systems, it influences the practice of health professionals to some extent. |
| Srivastava and Shainesh (2015) | MISQ | How to plan such service innovation initiatives. Two Indian businesses that have created viable telemedicine healthcare service delivery models for the rural population in India are specifically explored using a process approach. | Service-dominant logic | * Qualitative (interview and secondary data) * Directors, Managers Administrators, technicians and patients | * Service innovation | * Three value-generating processes were identified: resource exploitation, resource combination, and value reinforcement. * It has shown that efficient service solutions come from creative mashups of many resources, including knowledge, technology, and institutions. * After filtering and integrating the enabling themes that initially emerged from the interpretation of the data, we identified four broad enabling factors for service innovation based on an iterative and reconciliation process: excessive customer empathy, trust in ICT’s transformative power, continuous recursive learning, and effective network coordination. |
| Savoli et al.,  (2020) | MISQ | The impact of causal attributions on the self-management success or failure of patients with chronic illnesses was examined in terms of cognitive perception, emotional responses, and use of the IT SM system. Cognitive perceptions, emotional responses, and use of the ITSM system in chronic illness patients are influenced by outcome attributions. | Attribution theory and learned helplessness theory | mixed-method research | * Chronic disease self-management | * It appears that some patients benefit more from these systems than others and use them more effectively than others. Patients who receive SM interventions are generally required to follow a certain structure in their illness, such as reporting symptoms, taking medication, and exercising regularly. Portals follow a similar structure of discipline and supervision. They are encouraged to comply with the prescribed regimen by the monitoring structure of the portal. Health care systems have long struggled to ensure patient adherence to medications and physical activity, and nonadherence can have both serious and expensive consequences. The study contributes to past research on this topic by demonstrating that IT-based SM systems can be beneficial to both participating and dependent patients by assisting them with adhering to treatment regimens. * This study suggests that patients with chronic illnesses can benefit from efficient use of the SM system since they will have a positive SM. The use of IT-based SM can increase the patient’s awareness of his/her condition and help him/her to be more aware. A patient may also be able to relate his/her symptoms to SM behaviours, thus helping him/her learn how to better manage his/her condition. SM systems based on IT can therefore go beyond traditional knowledge-based patient education by incorporating reflective behaviour. |

1. Instead of directly quoting interviewees, we have paraphrased them for clarity and neatness of the quotes. [↑](#footnote-ref-1)