Modeling Process and Information Systems: leveraging technology to improve service operations

by

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Abstract

This thesis considers the relationship between service quality, operational flow and technological integration through process modeling methodologies. Mixed methods research is presented in a series of process improvement case studies which incorporate Lean and Total Quality Management (TQM) principles. The studies are in context of clinical and administrative departments within a single organization; each department has undergone change to adopt a new information system. Data was collected using semi-structured interviews, focus groups and observations. We apply user-centric process modeling methodologies, Patient Journey Modeling Architecture (PaJMA) or Customer-Centric Process Improvement Methodology (CCPIM), and incorporate Electronic Health Record (EHR) access data to develop and validate process models which reflect the patient care journey or business service operations. Our aim was to identify opportunities for quality improvement of services and technological integration. The second aim was to provide a common language for process improvement across the organization. We conclude with a combination of case study results to provide overall process improvement and change management recommendations to senior management of the organization.

Keywords: process modeling, process improvement, Patient Journey Modeling Architecture (PaJMA), Customer-Centric Process Improvement Methodology (CCPIM), quality, Lean, Total Quality Management, Business Process Modeling Notation (BPMN), service operations, information systems, technology integration

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List of Abbreviations

BMJ: British Medical Journal

BPMN: Business Process Modeling Notation

CCPIM: Customer-centric Process Modeling Methodology

CINHAL: Cumulative Index of Nursing and Allied Health Literature

CMCC: Canadian Memorial Chiropractic College

EHR: Electronic Health Record

HIT: Health Information Technologies

ICT: Information Communication Technologies

ID: Identifiers

IDEF0: Integrated Definition for Function Modeling

IT: Information Technology

MEDLINE: Medical Literature Analysis and Retrieval System Online

NICU: Neonatal Intensive Care Unit

OSCAR: Open Source Clinical Application Resource

PaJMA: Patient Journey Modeling Architecture

PDSA: Plan-Do-Study-Act

PHIPA: Personal Health Information Protection Act

PIPEDA: Personal Information Protection and Electronics Data Act

REB: Research Ethics Board

SADT: Structured Analysis and Design Technique

TQM: Total Quality Management

UML: Unified Modeling Language

UOIT: University of Ontario Institute of Technology

VSM: Value Stream Mapping

Chapter 1. Introduction

Canada is heavily investing in technological innovation in healthcare. Since 2001, the Canadian government has invested approximately $2.1 billion in digital health technologies, and produced over $16 billion in quantifiable gains between 2007-2015 (Gherorghiu & Hagens, 2017; "Investment Programs- Canada Health Infoway", 2017). Moreover, the federal government has recently, allocated $500 million from the 2017 budget to advancing digital health technologies ("Investment Programs- Canada Health Infoway", 2017).

A key component of digital health technologies is the electronic health record (EHR). The EHR provides a comprehensive representation of patient health information from all types of health care providers. The information is in a digital format which is easily stored, transferred and received ("EHRs Explained - eHealth Ontario", 2017). The federal government established the Canadian Health Infoway in 2001 to accelerate the adoption of EHRs across all provinces and territories ("Investment Programs- Canada Health Infoway", 2017). By 2016, a reported 139 000 healthcare professionals were active EHR users; this was a noted increase from 91 000 active users in 2015 (Canada Health Infoway, 2016). The Canadian Health Infoway (2015) identified that adopting the EHR remains a key strategy to improve the quality of healthcare services and management. There is a need to leverage technological integration and use data-driven approaches to attain full benefits of the new technologies (Canada Health Infoway, 2015). This includes ensuring timely, efficient communication and information exchange between stakeholders, and improvement of the patient healthcare experience (Canada Health Infoway, 2015). Rapidly increasing adoption of EHRs has led Canada Health Infoway to expand the scope of their key strategic objectives; there is clear interest to incorporate informatics support, specifically considering system implementation approaches, information management best practices, and change management (Canadian Health Infoway, 2016).

Implementation of a new information system within an organization is a mutually transformative relationship among the adopted new technology, overarching system, and the organization (Berg, 2001). In this sense, the new technology affects information flows and content of tasks. It also affects the relationships between service providers, support staff, and customers. For example, modifications due to adopting the EHR would suggest changes in information custodial practices based on which roles have access to, or responsibility of health information (Berg, 2001). The idea of a transformative relationship between technological adoption, the organization, and system also applies to strategic alignment (Luftman & Brier, 1999). Sustaining alignment between the organization's strategy, operations, and information technology is imperative to allow for companies to harness the full potential of new information technologies, including potential long term benefits (Luftman & Brier, 1999). A common component of strategic alignment theory involves understanding, and subsequently leveraging, an organization's operational processes and flow to support technological innovation (Luftman & Brier, 1999; Zacharia, Preston, Autry & Lamb, 2009).

This thesis considers the linkage between service quality, operational flow and technological innovation through the use of process modeling techniques. The research is within context of a private healthcare college, and it's clinical and administrative offices. Considering the transformative relationship between technological innovation and an organization's processes, this project examines means to direct, manage, and sustain positive change. Additionally, service quality and information management related efficiencies of operational processes are determined; we use a Total Quality Management (TQM) approach to process improvement based on Lean principles.

Section 1.1. Definitions & Context of Common Terms

This section describes common terms used in this thesis to provide clarity and context to the reader. In this thesis, the words *patient*, *user*, and *customer* hold similar meaning. *Patient*, *user*, and *customer* are the roles receiving service, or the roles that the output or purpose of process, serves. In a clinical context, *patient-centric*, *customer-centric*, and *user-centric* are used synonymously; *patient-centered approach* and *customer-centred approach* are also used synonymously. However, in a business management or administrative context, rather than *patient*, the words *customer* or *user* are used to refer to the role receiving the service, or whom the service is provided to. In a business or administrative context, *customer-centric*, *user-centric*, *customer-centred* and *user-centric* are used interchangeably. The terms *patient journey* and *careflow* are synonymous, and refer to the entire process of care provision; this begins when the patient arrives and enters a system, and ends when the patient leaves or exits the system.

Subprocess refers to individual process activities, or a subset of processes. *Subprocesses* combine to form a process. In addition, the terms *model*, *flowchart*, and *diagram* are used interchangeably. *Process Modeling* or *modeling processes*, and *process mapping* or *mapping processes* are used as verbs to refer to the actions of developing the process models. *Methodologies*, *approaches* and *techniques* are synonymous and refer to a systematic tactic. Mentions of *outcomes, quality, service* and *practices* are in an informatics or operational context, rather than medically focused.

Section 1.2. Research Questions

Primary Research Question: *Can modeling processes enhance process improvement and technology integration across all areas of a clinical organization following adoption of new information technologies?*

This thesis examines clinical and administrative processes, and the application of process modeling methodologies, in the context of an educational-based clinical organization. This thesis presents a series of case studies with similar methodology. To maintain clarity and focus of the topic, the primary research question has been broken down into sub- questions.

We aim to address the following sub-questions in the individual case studies by identifying potential overarching themes and results:

a) Can process modeling provide a basis for in-depth simulation scenario analysis for strategic planning?

b) Can strengths and weaknesses of process modeling approaches for technology enabled processes be identified through comparison of methodologies?

c) Will process modeling enhance consistency of operational practices and service quality across multiple clinical locations?

d) Will process modeling improve communication, operational efficiency, and technological adoption within administrative units?

Section 1.3. Case Study Overviews

To address the research sub-questions, we have divided the research into three distinct case studies set at the Canadian Memorial Chiropractic College (CMCC). Each case- specific research method uses a process modeling and analysis technique to examine process attributes in specified contextual settings. Each case study combines Lean principles with process modeling and analysis. Conclusions are formulated based on the results. The premise of including multiple case studies stemming from alternating settings was to demonstrate TQM, and the use of process modeling to support a common language of process improvement across the organization. In particular, we examine processes within the clinical and business administration units. The following section provides an introduction to each case study.

Section 1.3.1. Case Study #1: CMCC Campus Clinic

The first case study presents current and future state analysis of chiropractic-based careflow using a patient-centric method for process mapping. Our research aims to demonstrate the significance of this specialized method in a healthcare setting. We examine patient-centric process modeling as a method to improve health information management practices and the careflow process, following adoption of an EHR. Current and future state analysis is conducted pre- and post- adoption of the EHR at CMCC's main campus clinic site. Analysis aims to examine patient care flow and determine areas of quality control and compliance. Use of process modeling methods to support change management and technological integration is investigated as part of this research case. Results are combined with EHR data to demonstrate potential suitability for simulation development, in addition to identification of data logging concerns for verification of the models.

Section 1.3.2. Case Study #2: Process Modeling & Clinic Site Comparison

The second case study presents a comparison of the patient journey between two clinical sites of a single organization following adoption of an EHR. This case study addresses characteristics of compliance, quality control, information flow, and communication, related to the patient journey and service provision. These characteristics are key indicators of health services quality and health information management standards. The indicators are essential to support technology integration, and for educational purposes, considering the academic nature of CMCC. Process models are developed and analyzed to determine levels of process variability between clinical settings. It is hypothesized that the study will distinguish the significance of establishing relevant guidelines and policies to ensure high standards of health services and information management practices across the facilities. A second aim is to compare process modeling techniques that demonstrate patient careflow. Comparison is based on process modeling tool constructs of Patient Journey Modeling Architecture (PaJMA) and Business Process Modeling Notation (BPMN). We use construct examination to gain greater understanding of varying process modeling tools, while formulating an evidenced-based inference of the more applicable tool.

Section 1.3.3. Case Study #3: Integrating Technology across the Organization

The final case focuses on business process management that incorporates Lean principles to examine functional processes of administrative units within CMCC. The study is motivated by the aim of establishing a common platform for quality improvement across the organization. Scientific investigation was conducted following the adoption of new information management systems in each department. A customer-centric process modeling technique is applied to identify areas of process inconsistencies and determine opportunities for improvement based on analysis. The analysis addresses implications of quality control and compliance, flexibility, and technological integration. Change management is discussed in conclusion of the case study. Although this case study focuses primarily on the Human Resources Department, work with similar scope and research design was conducted by UOIT Faculty of Business Capstone students in other CMCC administrative departments. The additional departments included Finance & Accounting and Information Technology Services. The Business Capstone students' project produced similar results to our own. The students' work show our research study can be replicated in multiple departments at CMCC.

Section 1.4. Significance of the Study & Research Outcomes

Outcomes of this research have an impact on healthcare, academia, and the participating client organization. Our investigation emphasizes efficiency, customer-centred value and process improvement. The study impacts the healthcare industry through identification of opportunities for service improvement, and customer or patient benefits. This study examines methods to streamline workflows, and reduce expenditure and cost by identifying opportunities for process efficiencies. In addition, we use scientific reasoning and methods to deduce ideas and conclusions based on innovative frameworks and techniques. We apply user-centric methodologies, on an immense project scale, encompassing hierarchies of an entire organization. The scale of this research and novel methodology are significant to academia. The modeling techniques provide a mechanism and common language for process improvement throughout the organization. This is significant considering everyone from clinicians, students and clerical staff to senior management and IT staff can easily engage in the process improvement and change efforts.

In addition to industry and academia, outcomes of this research impact the participating client organization, CMCC. Upon completion of this study, participating departments receive specialized process flow maps to contribute to their own quality improvement and management initiatives. Provision of results in the form of graphical process models offers improved visualization of the various inputs and outputs of each process. Visualization aids comprehension of various interactions and interdependencies of each task and role in a process. Stakeholders are able to evaluate their performances', provide comparative assessments, and identify best practices. This is especially significant in CMCC's clinical settings considering external clinic sites can be compared against the main campus clinic. Moreover, we apply process modeling as a means to improve service quality and information management processes. We conduct process analysis to identify constraints, redundancies, and bottlenecks of current states. We link theories to the analysis to recommend methods to minimize operational inefficiencies and avoid poor information management practices. Stakeholders can use the final process models and user-centric change theories to implement and sustain the recommended process changes. Implementation and sustainability methods for the CMCC is discussed Chapter 7 (*Section 7.2*).

Section 1.5. Consultation and Ethics Approval

This multi-centered study was approved by the UOIT Research Ethics Board REB FILE # 13-001 (Appendix I. *Research Ethics Board Approval UOIT*). This study was also approved by the CMCC Research Ethics Board REB Approval # 1307X10 (Appendix II. *Research Ethics Board Approval CMCC).*

There is ongoing educational collaboration between CMCC and UOIT; participants were recruited through this collaboration. Participants were part of CMCC's Human Resources, Accounting, Information Technology, or Clinical Services Departments. Participants contributed to development and validation of process models for the aforementioned administrative and clinical departments. Participants included student and staff members involved in the patient journey at CMCC. Additionally, participants included staff and faculty involved in administrative processes: Hiring & Recruiting, Payroll and Benefits.

Section 1.6. Thesis Structure

The remaining thesis research is comprised of six chapters. Chapter Two presents a review of current literature, introducing concepts surrounding Quality (Section 2.1.) including Measuring & Managing (Section 2.1.1.), Lean Philosophies: Healthcare & Beyond (Section 2.2.), and Total Quality Management (TQM) & Systems-Thinking (Section 2.3.), Chapter two also discusses current literature related to Process Modeling (Section 2.4.), Process Modeling Tools (Section 2.4.1.), Applications of Process Modeling & Information Technology in Healthcare (2.4.2.), and Change Management (Section 2.5.).

Chapter three provides context for this research study, describing CMCC's clinical and administrative units. This chapter presents CMCC's motivation for process improvement and adopting new technologies.

Chapter four describes our research methods. This chapter begins with a description of Research Design & Overview of Common Methodology Elements (Section 4.1) that were used in all three case studies, including common process modeling tools. Justification of modeling tool is also (Section 4.2.). The next sections of chapter four specifiy methodology applicable to the individual case studies: *Case Study #1: CMCC Campus Clinic* (Section 4.3.), *Case Study #2: Process Modeling & Clinic Site Comparison* (Section 4.4), *Case Study #3: Integrating Technology across the Organization* (Section 4.5.).

Chapter five presents Case Results & Recommendations to CMCC This chapter is organized by results from individual cases studies. Data collection, process model construction, and simulation development are discussed in *Case Study #1: CMCC Campus Clinic* (Section 5.1.). *Case Study #2: Process Modeling & Clinic Site Comparison,* presents an assessment of contrasting process modeling tools (Section 5.2.1.), and a comparison between two clinical sites (Section 5.2.2). Results from the final case study, *Case Study #3: Integrating Technology across the Organization* (Section 5.3), discusses Quality Control (Section 5.3.1) and Process Flexibility (Section. 5.3.2), in CMCC's administrative units. Chapter five concludes with recommendations to CMCC's human resources department and senior management (Section 5.3.4).

Chapter six provides limitations of this research study as acknowledged by the researcher, and suggestions for future research.

The final chapter presents overall thesis conclusions. The research sub-questions, identified in Chapter one, are answered with reflection on cumulative research outcomes, thereby incorporating all three case studies. Continuous Quality Improvement & Sustaining Process Change are considered to provide CMCC with recommendations for effective implementation, sustainability and change management. This thesis concludes with summary cumulative of key findings.

Chapter 2. Review of Literature

This review of literature examines studies of process management, quality improvement, and change management. The first section outlines the notion of quality, including it's definition, measurement and management. We then discuss quality improvement strategies of Lean philosophies from a multi-discipline perspective, and TQM and systems-thinking. The second section presents an overview and comparison of process modeling techniques, including use and limitations, as well as a review of selected process modeling tools.

The next section presents results of a literature search conducted using databases: British Medical Journal (BMJ), Health Informatics Journal, Medical Literature Analysis and Retrieval System Online (MEDLINE), Cumulative Index of Nursing and Allied Health Literature (CINHAL), PubMed, Scholars Portal and Google Scholar. The search phrases "health informatics or health information technology or health communication technology and process modeling or process mapping or patient journey modeling or patient care mapping". Articles published before January 2002 or written in any non-English language were excluded. The search only included articles that were available through the University of Ontario Institute of Technology (UOIT) library. The results are synthesized to discuss the application of process modeling in healthcare under distinct thematic categories, namely: conceptualization and design of systems or technology, integration and implementation of health information technologies, adoption of health information technologies, and quality improvement and continuous quality improvement.

The final section of this chapter discusses organizational change management and change theories.

Section 2.1. Quality

Mohadegrad (2013) defines quality to be a conformance to pre-determined guidelines and standards which provide value and meet customer needs. The definition of quality is complex and multifaceted. Because quality is based on stakeholder perspective and contextual background, it is subjective and abstract (Campbell, Roland, & Buetow, 2000; Mosadeghrad, 2013). Research by Parasuraman, Zeithaml and Berry (1985), suggest that due to its intangible nature and heterogeneity, service quality is more difficult to define and evaluate than product quality. In context of healthcare services, quality is commonly defined as offering effective care that excellently contributes to patient well-being and satisfaction (Mohadegrad, 2013). As a result, value created by quality has strategic implications for an organization by way of increasing the organization's competitive advantage (Mosadeghrad, 2013). Edvarsson (1996) similarly claims quality affects consumer satisfaction as determinants of the organization's brand outlook and image. Considering this notion, he proposes that ideally, service quality will be approached from the customers' viewpoint (Edvarsson, 1996). Additionally, healthcare involves complex services and potentially a high level of risk. Patient education is often difficult as the technicalities of the provided services are not always easily understood by patients. This combination of characteristics, contribute to the difficulty in defining service quality (Edura Wan Rashid & Kamaruzaman Jusoff, 2009).

Current literature demonstrates varying views of the dimensions of quality in healthcare. In a healthcare services context, a patient-centred approach to assessing quality aims at creating a balance between addressing the patient experience, and the technical and scientific aspects of care (Campbell et al., 2000). Likewise Donabedian (1990) claims quality in healthcare can be categorized into: efficacy, effectiveness, efficiency, optimality, acceptability, legitimacy, equity. In this paradigm, efficacy is the delivery of care to the best of the provider's ability, and effectiveness is the degree to which improvements, as a result of this care, are demonstrated (Donabedian, 1990). Efficiency is minimal resource intensity in obtaining optimal care, whereas optimality is the most advantageous balance of trade-off between benefit and costs (Donabedian, 1990). Acceptability involves the patient's perception defined as conformance to the patient's expectation of factors of care such as provider relationship and accessibility to service (Donabedian, 1990). Legitimacy, on the other hand, accounts for compliance of social preferences aligned with attainment of the aforementioned efficacy, effectiveness, efficiency, and optimality (Donabedian, 1990). Finally, Donabedian describes equity to be fairness in distribution and effects of care (Donabedian, 1990). This paradigm suggests healthcare providers are tasked with balancing these varying dimensions against patient preferences and social preferences (Donabedian, 1990).

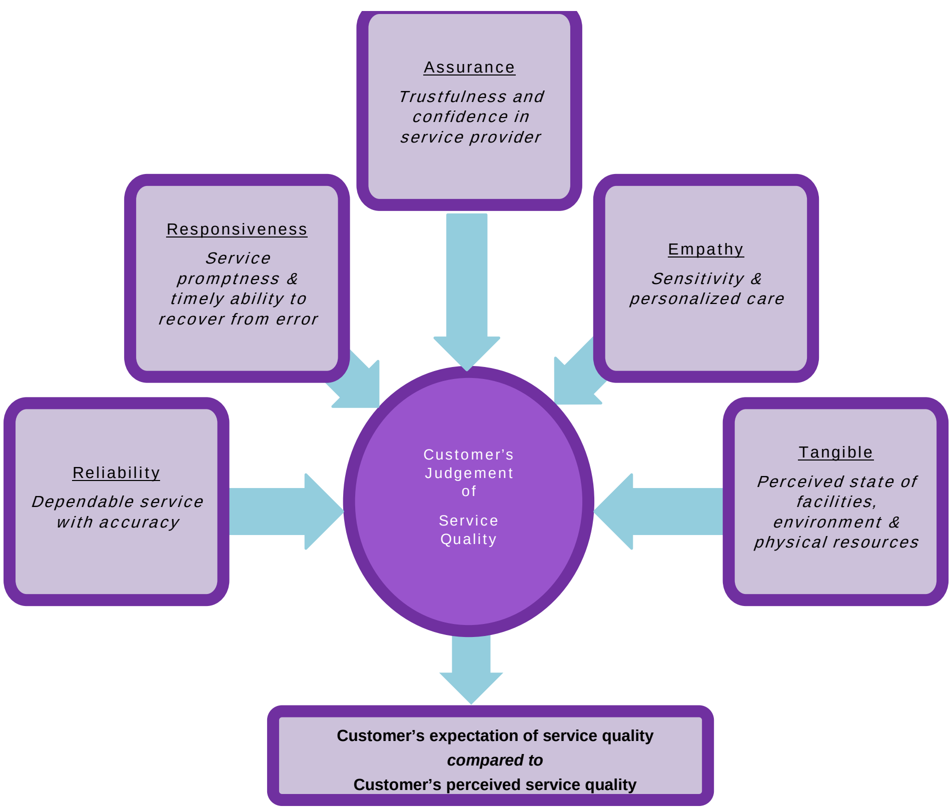
In contrast, Campbell et al., (2000) claim quality exists in two dimensions of access and effectiveness. Access is based on continuity and availability of care, whereas effectiveness is further broken down into aspects of clinical effectiveness and interpersonal care (Campbell et al., 2000). Both perspectives of quality accord with the complexity of individual patient circumstance and are in agreement with aligning the objectives of the healthcare professional, and the needs and expectations of the patient. Therefore, the definition of service quality in healthcare is based on the conjunction of service provision and patient perspective (Campbell et al., 2000; Donabedian, 1990). This thesis work uses this conceptual juxtaposition of service provision and patient perception as definition for service quality in healthcare. (Campbell et al., 2000; Donabedian, 1990). Likewise, Donabedian's quality framework provides the backdrop for this research and will be discussed in Chapter 7 (Section 7.1).

Section 2.1.1. Measuring & Managing

Service quality is evaluated during the delivery process as interactions between the customer and service providers, and customer satisfaction (J.A. Fitzsimmons & M.J. Fitzsimmons, 2006; Parasuraman, et al. 1985). The term satisfaction is based on the customer's judgement of the service quality, specifically the variation between customer's expectations of the service quality, compared to the customer's perceived service quality (Edura Wan Rashid & Kamaruzaman, 2009).

Edura Wan Rashid and Kamaruzaman Jusoff (2009) suggest that measuring service quality is based on how the customer understands quality, rather than an objective source. The customer's judgement is established based on five dimensions: reliability, responsiveness, assurance, empathy, and tangibles (J.A. Fitzsimmons & M.J. Fitzsimmons, 2006, 2014; Parasuraman et al., 1985). Figure 1 is a graphical representation of these judgement dimensions. Reliability is described as the provision of dependable service with accuracy, such administering error-free services on time, whereas responsiveness is described as service promptness and a timely ability to recover from errors with professionalism (J.A. Fitzsimmons & M.J. Fitzsimmons, 2006; Parasuraman et al.,1985). The service provider's skill in delivering the services and the ability to effectively communicate with the customer founds trust and confidence, thereby demonstrating the Assurance dimension (J.A. Fitzsimmons & M.J. Fitzsimmons, 2006; Parasuraman et al., 1985). Empathy refers to demonstrating sensitivity and providing personalized care by putting forth effort to understand the specific customer needs (J.A. Fitzsimmons & M.J. Fitzsimmons, 2006; Parasuraman et al., 1985). The final dimension, tangibles, is described as the perceived state of facilities, environment and physical resources, including materials and equipment (J.A. Fitzsimmons & M.J. Fitzsimmons, 2006; Parasuraman et al., 1985). Using these dimensions customers will form judgement of service quality, ultimately created as a comparison between expected and perceived results.

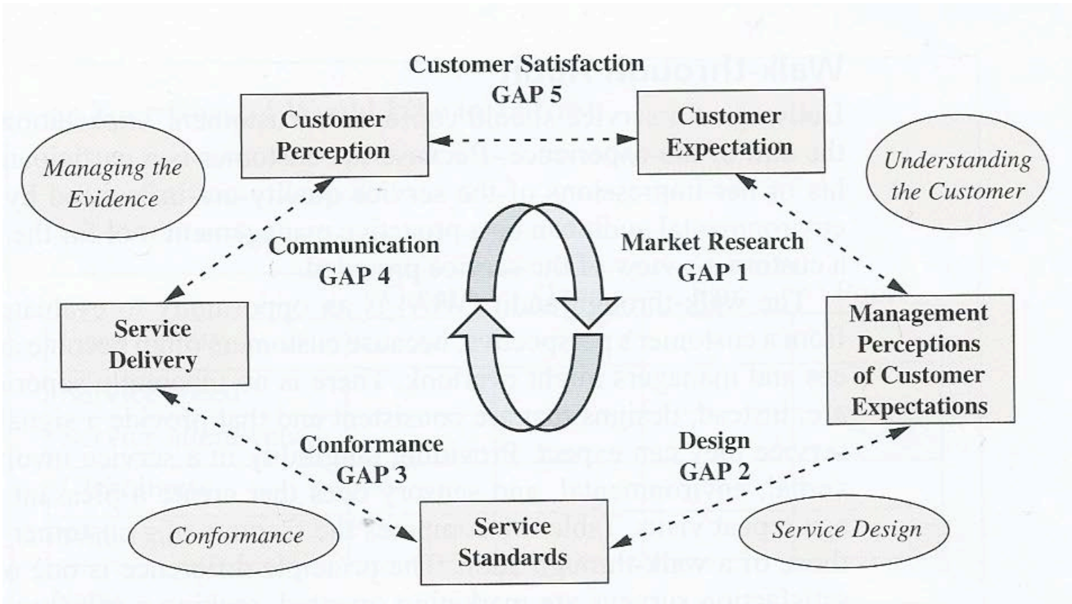
Figure 1. Customer's Judgement of Service Quality



Adapted from. Edura Wan Rashid, W., & Kamaruzaman Jusoff, H. (2009). Service quality in health care setting. International journal of health care quality assurance, 22(5), 471-482.

Measuring and minimizing the gap between the expected and perceived results produces customer satisfaction. This concept of gap minimization is demonstrated in the service quality gap model (Figure 2, GAP 5). Referring to Figure 2, the service quality gap model maintains that reducing GAP 1 through 5 respectively, in relation to market research, design, conformance, communication, and customer satisfaction, will result in increased service quality (J.A. Fitzsimmons & M.A. Fitzsimmons, 2006; Parasuraman et al., 1985). Market Research (GAP 1), refers to management's lack of understanding the customer and misinterpretation of customer's expectations. Design (GAP 2) addresses variance in service design, such as management's inability to convert accurate customer expectations into attainable, specified workloads and goals for the organization (J.A. Fitzsimmons & M.A. Fitzsimmons, 2006). Conformance (GAP 3) refers to the discrepancies between the expected service provision specification which are set internally by management, and the results of actual service provision (J.A. Fitzsimmons & M.A. Fitzsimmons, 2006). Communication (GAP 4) addresses the disparity between the organization's advertisement of their services and the actual service delivery, often resulting from a lack of transparency and inaccuracies of information transfer (J.A. Fitzsimmons & M.A. Fitzsimmons, 2006). Current research finds definitions for the attributes of the model varies, with some studies identifying additional gaps through decomposition of the aforementioned gaps (Candido & Morris, 2000; Lange & Coltham, 2005; Lewis, 1993). Nevertheless, GAPS 1 through 5 specified in Figure 2 remains the foundation of the service quality gap premise (Candido & Morris, 2000; J.A. Fitzsimmons & M.A. Fitzsimmons, 2006; Lange & Coltham, 2005; Lewis, 1993; Parasuraman et al., 1985).

Figure 2. Service Quality Gap Model



Source: Fitzsimmons, J. A., & Fitzsimmons, M. J. (2006). Service management: operations, strategy, and information technology. Irwin/McGraw-Hill. Adapted from Parasuraman, A., Zeithaml, V. A., & Berry, L. L. (1985). A conceptual model of service quality and its implications for future research. *the Journal of Marketing*.

Studies from varying industries, including trades beyond healthcare, maintain the principles of service quality dimensions, and the service quality gap model using SERVQUAL as an assessment tool (Finn & Lamb, 1991; Lee & Hing, 1995; Ilyas et al., 2013). SERVQUAL applies a survey consisting of paired questions based on the service quality dimensions. It uses a Likert scale to determine consumer quality perceptions. Based on positive or negative gap scores in quality dimensions, instances hindering the delivery of high quality services are identified. The scores derive from the customer responses to perception of quality minus customer responses based on the expectation of quality (Edura Wan Rashid & Kamaruzaman Jusoff, 2009). Figure 3 is an example of a SERVQUAL survey tool which uses the service quality dimensions, against questions geared towards customer perception and expectations in a veterinary practice setting.

Current literature raises concerns about the validity and reliability of the SERVQUAL tool. For example, Van Dyke, Prybutok, and Kappelman (1999) found the scoring construct to be unstable and had poor discriminant validity, claiming the tool produces inconsistent results. The dimensions of quality analyzed by the tool may differ in importance to the customer due to the customer's state of mind, therefore adding another variable that is unaccounted for in the current SERVQUAL approach (Landrum, Prybutok, Zhang & Peak, 2009). As a stand-alone method, SERVQUAL faces obsolescence, and must be integrated into other improvement frameworks to be applicable (McCollin, Ograjensek, Gob & Ahlemeyer-Stubbe, 2011). Butler, Oswald and Turner (1996), and Fowdar (2005) found that although SERVQUAL has applicability in some areas of healthcare, the tool and its features must be adapted to the purpose of the individual studies.

Figure 3. Example of SERQUVAL tool

RELIABILITY	1 The practice's ability to accurately diagnose my horse's problem using the most advanced technologies	1	2	3	4	5	6	7	8	9
	2 The practice's ability to provide me with an accurate prognosis for my horse, based on recommended treatment options	1	2	3	4	5	6	7	8	9
	3 The practice's ability to effectively treat my horse's problem using the most current therapeutic options	1	2	3	4	5	6	7	8	9
	4 The practice gives my horse the best chance for a successful measurable outcome	1	2	3	4	5	6	7	8	9
	5 The practice provides services that make my horse more comfortable to perform its job	1	2	3	4	5	6	7	8	9
	6 The practice's ability to meet my horse's dentistry needs	1	2	3	4	5	6	7	8	9
RESPONSIVENESS	7 The practice returns routine phone calls within 24 hours	1	2	3	4	5	6	7	8	9
	8 The practice can see my horse for a routine or non-emergency appointment within 48 hours	1	2	3	4	5	6	7	8	9
	9 The practice arrives within 15 minutes of scheduled appointment time, or I am otherwise informed	1	2	3	4	5	6	7	8	9
	10 The practice returns my emergency phone call within 15 minutes	1	2	3	4	5	6	7	8	9
	11 The practice can arrive at an emergency call within 45 minutes	1	2	3	4	5	6	7	8	9
	12 The practice uses electronic communication and responds to my questions within 24 hours	1	2	3	4	5	6	7	8	9
ASSURANCE	13 The practice does not surprise me with the amount of the bill	1	2	3	4	5	6	7	8	9
	14 The doctors clearly explain the diagnosis, treatment options and associated prognoses to me	1	2	3	4	5	6	7	8	9
	15 The doctors spend an appropriate amount of time with me and my horse during an appointment	1	2	3	4	5	6	7	8	9
	16 The practice is able to easily access medical records	1	2	3	4	5	6	7	8	9
	17 The practice provides client education, resources and useful and timely information	1	2	3	4	5	6	7	8	9
EMPATHY	18 The practice values me as client	1	2	3	4	5	6	7	8	9
	19 The practice knows me and my horse(s) and understands their job and work level	1	2	3	4	5	6	7	8	9
	20 The practice is interested in helping me and my horse(s)	1	2	3	4	5	6	7	8	9
	21 The practice makes communication convenient for me	1	2	3	4	5	6	7	8	9
TANGIBLES	22 The practice has modern equipment	1	2	3	4	5	6	7	8	9
	23 The practice vehicles are professional, clean and neat	1	2	3	4	5	6	7	8	9
	24 The veterinarians and staff look professional	1	2	3	4	5	6	7	8	9
	25 The practice provides facilities for haul-in appointments	1	2	3	4	5	6	7	8	9

Source: Manning, J. (2012). Equine Practice: What Clients Want. *Veterinary Practice News*. Retrieved from http://www.veterinarypracticenews.com/May-2012/Equine-Practice-What-Clients-Want/

‘Walk through audits’ is another measure of service quality adapted from the service quality dimensions and the service quality gap model (J.A. Fitzsimmons & Maurer, 1991). The audits involve assuming the customer’s perspective to conduct a systematic, objective environmental evaluation of service provision to reveal opportunities for improvement and tangible service cues (J.A. Fitzsimmons & Maurer, 1991). These audits are based on the notion that the entire process of service provision should be conformed to customers’ expectations as to increase customer satisfaction, thus increasing probability of return visits or referrals (J.A. Fitzsimmons & Maurer, 1991; Lai-Ping Leong Koljonen & Reid, 2000). J.A. Fitzsimmons and Maurer (1991) conducted a study applying the walk through audit technique to examine environmental variables influencing tipping behaviour as a measure of customer satisfaction in a restaurant setting. Their findings suggested the audit uncovered areas of improvement for staff training and opportunities for service expansion. A similar method was used by Lai-Ping Leong Koljonen and Reid (2000) to observe new client services in a Hong Kong based law firm. The walk through audit in this study examined supporting facilities, implicit and explicit services. They found the tool to be useful in evaluating the customer’s perspective. However, the study recommends caution in interpreting results due to the absence of comparative metrics given the inherent absolute scale of the walk through audit assessment (Lai-Ping Leong Koljonen & Reid, 2000).

Another approach to measuring service quality is based on organizational sciences and engineering, with focus on structure, process and outcome (Campbell et al., 2000). In this approach, structure is composed of organizational aspects such as materials, facilities, and human resources. The process signifies the actions being undertaken, and the outcome denotes the effects on the consumer (Campbell et al., 2000). This three component basis for assessing quality is inherently linked to Donabedian (1988) and suggests that an optimal structure enables a good process which further delineates the likelihood of ideal outcomes.

The challenge for an organization to improve quality is to identify inefficiencies or gaps in service provision. This thesis aims to address this challenge by incorporating the aforementioned fundamentals of defining, measuring and managing quality. Direct input from patients or customers, which explicitly measure quality and satisfaction, was not collected. However, the research design incorporated customer and patient focused methods, such as specialized process modeling tools, to gain indirect patient or customer perspective; customer and patient focused Process Modeling. Process Modeling tools are discussed in Section 2.4. We will combine understanding quality of services from a customer standpoint and process modeling, largely focusing the analysis on structure, process and outcomes.

Section 2.2. Quality: Lean Philosophies - Healthcare & Beyond

Originating in the 1950's, the Lean philosophy is rooted in the manufacturing industry from the Japanese Toyota Motor Corporation. The philosophy was formed to sustain competitive advantage at a time where resources were limited and rival companies threatened survival (Hines, Holweg & Rich, 2004). This approach has logistic and quality focus with an emphasis on organizing complex processes (King, 1997; Shirazi & Pintelon, 2012). Lean promotes a holistic design of operations to enable continuous process improvement, quality control, and efficiency by incorporating human behaviours and technology with process flow.

Lean concentrates on eliminating waste and loss, increasing standardization to decrease process complexity, and creating good working conditions for employees (Radnor, Holweg & Waring, 2012; Stone, 2010). The Lean philosophy advocates using the least amount of resources to deliver timely, customized service or product to the customer. Value is a key component of Lean. Value in Lean systems is described as the capability to supply the customer's expectation of service or product with the least time between request and provision (Atmaca & Girenes, 2013; Joosten, Bongers & Janssen, 2009). Lean efficiency is created by separating processes into steps of value, activities directly contributing to the customized service or product, and steps of non-value or waste (Aherne, 2007). The aim of Lean is to eliminate the identified non-value added or wasteful subprocesses. Common examples of waste according to the Lean philosophy include: overproduction, unnecessary movement, retaining inventory, manual processing, delays, and errors (Aherne, 2007). Lean also involves managing controlled process flow with consideration of flexibility of tasks and outputs, and controlling variability in process design (Joosten et al., 2009). In context of Lean, continuous improvement means the system must strive for perfection, and be applicable to constant review. (Young, Brailsford, Connell, Davies, Harper & Klein, 2004).

Figure 4 summarizes the commonalities of Lean implementation. First, implementation scope must be established to maintain manageability and focus. Customer-facing concentration should be assumed to identify value from a customer's viewpoint and map the process for the product or service. Lean projects involve making decisions based on first-hand knowledge, promoting walk through and ethnographic study of the process (Dombrowski & Mielke, 2014). Mapping the process is aimed at creating a better understanding of the process elements, as well as identifying a value stream and challenging non-value steps (Burgess & Radnor, 2013; Bamford, Forrester, Dehe & Leese, 2015). Next, the process should be redesigned by eliminating non-value steps and creating and standardizing a continuous process flow. The redesigned process should incorporate a means to monitor the implemented changes. (Burgess & Radnor, 2013; Bamford et al., 2015). For true Lean implementation, the premise of creating value for the customer and eliminating waste must be embedded into the organization's culture. This creates a movement of sustainable change and continuous improvement (Burgess & Radnor, 2013)

Figure 4. Summary of Lean Implementation.

Adaption Source: Burgess, N., & Radnor, Z. (2013). Evaluating Lean in healthcare. International Journal of Healthcare Quality Assurance, 26(3), 220-35. doi:http://dx.doi.org/10.1108/09526861311311418

Current research indicates a wide acceptance to embracing a Lean approach for quality improvement initiatives in health care (Young & McCLean, 2009). In the healthcare industry, Lean-thinking aims to create ideal circumstances where fewer trade-offs need to be made to achieve maximum outputs of optimal quality of care (Joosten et al., 2009). The focus with applying Lean principles is on forming a detailed understanding of the specific tasks and processes that are conducted, rather than solely creating a solution (King, 1997). For instance, rather than considering the provision of healthcare services in context of acquisition of care, Lean-thinking enables the view of individual steps in the process of resolving the presenting complaint of a patient, and the care being provided is an outcome of a series of tasks; Lean enables the individual steps, and the process in its entirety, from arrival to discharge (Ben-Tovim, Dougherty, O'Connell, & McGrath, 2008; De Souza & Pidd, 2011).

A common criticism of Lean relates to socio-technical aspects of process improvement. The criticism is that focusing on standardizing work using newly implemented technology creates repetition, denotes a lack of motivation for workers, and negatively effects working human conditions (Sugimori, Kusunoki, Cho & Uchikawa, 1977; Joosten et al., 2009). It is argued that from this perspective, standardization results in changes in dynamics and job characteristics. For example, reduced complexity of a process in healthcare could allow for the same tasks to be completed by less trained physicians, thereby allowing more professionally advanced physicians to deal with more complicated cases empowerment (Hines et al., 2004). Successful Lean implementation must consider sociotechnical implications in conjunction with operational efficiencies by ensuring that managers are aware of their role in creating an environment where interactions between team members in the targeted system lead to better performance. The implementation must therefore align with organizational strategic objectives and incorporate respect for human dimensions of motivation, ownership and empowerment (Hines et al., 2004). In addition, although a criticism of Lean is seen in staff reductions and similar workforce change, Joosten et al., (2009) and Young et al., (2004) propagate the idea that Lean first creates extra capacity by eliminating waste and alleviating resources. Specific to healthcare, Lean also exhibits the challenge of forming a clear patient journey pathway or care flow in the complex information flows and handovers of care. Disconnects between clinical entities further propagate this challenge in deciphering optimal care pathways (Ben-Tovim et al., 2008; De Souza & Pidd, 2011; Joosten et al., 2009; Young et al., 2004).

Another approach to process improvement involves combining simulation modeling with Lean philosophies for process analysis. For purpose of this thesis, simulation is defined as an analysis technique which recreates and then manipulates a real-world scenario. Controlled experimentation and examining the behaviour of the model output serves as a means of understanding dynamic process elements for operations at a low level of abstraction, as well as a predictive tool for decision support at a higher level of abstraction (Sokolowski & Banks, 2011). Although simulations provide a reflection of real- world scenarios without interference, thereby posing minimal to no risk, this method of analysis can be very time consuming and costly (Chang, Jen & Dahlgaard-Park, 2013; Sokolowski & Banks, 2011).

Helquist, Deokar, Cox and Walker (2012) suggest virtual process simulations may support organizations to identify and manage risk, uncertainties and opportunites.

Examples of these variabilities include directions of strategic organizational shifts, or operational process change involving resources or scheduling. Often these variabilities will impact costs incurred by the organization. Similar to Sokolowski and Banks (2011), Helquist et al. (2012) claim that creating an initial detailed, graphical depiction of a process, identifying inputs and outputs, followed by simulating the events, can lead to pre-determination of uncertainties through experimentation; controls can be established through this experimentation. Although simulations can be applied to increase process efficiency and optimization, it is crucial to involve management in creating the simulations to support credibility and acceptance (Sinreich & Marmor, 2005). In order to be effective, simulation models must also be flexible and easily understood by the targeted audience (Sinreich & Marmor, 2005)

In addition to strategic improvements, simulations are an effective tool in evaluating service-oriented or customer-facing processes using discrete event queuing models (Winkler, Ziekow & Wienberg, 2012). For example Kumar (2011) used simulations to optimize surgical processes in a hospital based in the United States. Experimentation through simulations allowed management to identify issues of capacity planning, resources allocations and service throughput time. The study found that simulations can be successfully applied to optimize patient flow as well as assist management in effective planning (Kumar, 2011). Sharma, Abel, Al-Hussien, Lennerts and Pfrunder (2007) conducted a study to optimize customer-facing, facility management process in a German Hospital, and validate a proposed future Lean process flow. In this study, simulations were conducted following Lean process mapping, leading to the discovery of non-value added activities and ideal resource allocations.

Although the results of this study proved to be beneficial to the organization at operational and strategic levels, the researchers state apparent limitations due to the inherent probabilistic characteristics and possibilities of deviations from the model's assumptions. In addition to healthcare, current literature supports the use of simulations in public affairs. A study conducted by Winkler et al (2012) used simulations to evaluate and improve citizen-facing mobile applications, created as an e-initiative for municipal infrastructure issue reporting. Using simulations, the researchers were able to determine the level of feasibility of the new initiative, thereby demonstrating benefits outweighing the initial costs of creating the simulation (Winkler et al., 2012). This thesis project will demonstrate translation of a static process model to a dynamic simulation, and discuss simulation development in *Case Study #1: CMCC Campus Clinic*.

Section 2.3. Quality: Total Quality Management (TQM) & Systems-Thinking

TQM is a comprehensive management philosophy, which uses a combination of systems-thinking, process management, and human behaviour theories to incite continuous quality improvement (Bryan, 1996; Hackman & Wageman, 1995; Richards, 2012). Evidence indicates this philosophy for improvement is not limited to a single discipline; it has been applied in industries ranging from transportation (Paz Salmador, Bueno & Maranhao, 2008) and service (Dotchin & Oakland, 1994), to construction (Maher Altayeb & Bashir Alhasanat, 2014) and telecommunication (Chao-Ton Su & Shih-Yuan, 2001). TQM approaches are based on the assumption that costs associated with poor quality are greater than the costs of managing or creating processes that yield outcomes of greater quality and subsequently greater value (Hackman & Wageman, 1995). TQM assumes that every employee's work contributions within an organization significantly impacts the outcomes, therefore continuous improvement training and employee motivation are labelled as essential success factors Bryan, 1996; (Hackman & Wageman, 1995; Richards, 2012). Furthermore, TQM applies a systems-based approach to quality improvement through process management strategies such as modeling and analysis (Hackman & Wagemen 1995; Conti, 2010). It holds that determining and controlling process variability improves outcome and quality (Hackman & Wagemen 1995). Conti (2010) argues that with systems-thinking, the process is considered from a holistic perspective by considering behaviours, performances, and relationships as a combined effect of all variables. Therefore the relations and interdependencies of these process variables determine the systems outcomes; whereas value flows define relations of the system including relations between the organization and its environment (Conti, 2010). This thesis will incorporate principles of TQM to examine the individual targeted processes, as well apply a higher level abstraction to determine the effects of process change on the organization as a whole.

Section 2.4. Process Modeling

Business processes are essentially organizational sub-systems carrying out specific functions or organizational goals while creating outputs from inputs. Process modeling is a method used to create an abstract representation of the elements of reality of the business processes, and the relationships between people, activities, information, and technology (Biazzo, 2002; Curtis, Kellner, & Over, 1992). The models are an instrument to evaluate and analyze these elements and relationships relevant to the purpose or goal of the process (Curtis et al., 1992). Therefore, modeling languages vary depending on the type of map created and purpose of the project (Biazzo, 2002). Process models are used as a tool to reduce process complexity and increase process control (Becker, Rosemann & Von Uthmann, 2000; Biazzo, 2002). Current literature supports increased applicability of process modeling as a multi-industry organizational strategy for analysis and improvement as an approach to incorporate multiple elements of an organization, surpassing the perspective limited to the computer-human interface (Biazzo, 2002; Curtis et al., 1992). Process modeling is used as a strategy to maximize innovative implementations of technologies by assessing risks involved and facilitating change (Greasley, 2006). It is also used to define objectives for identifying information transfer and data errors, and analyzing business performance for optimization of outcomes (Borthick, Bowen, & Gerard, 2008).

Customer-centric process modeling is an organizational analysis strategy governed by the customer's needs of the process and interpreted as a valuation of workflow and degree to which the outcome matches the intended results (Biazzo, 2012). Benefits of this approach have been supported by current research (Young et al., 2004; Percival, Catley, McGregor & James, 2009). Creating a process model of the patient journey demonstrates the patient's experience of the service provisions while separating the subprocesses into a series of tasks. Ultimately, these separated tasks sequentially depict the overall care pathway from admission to discharge (Percival et al., 2009). In addition to considering the patients' perspective, process mapping in clinical settings has proven to serve as a starting point for quality improvement projects, while engaging stakeholders with increased communication to achieve a common goal (Trebble, Hansi, Hydes, Smith & Baker, 2010; Percival et al., 2009; Percival, 2015). However challenges exist with establishing an appropriate method to create these process maps. Conventionally, process modeling was used for experts in information or mechanical systems design using specialized terminology. This offers the obstacle of an easily interpretable universal language to mapping the care pathways (Percival et al., 2009). In addition, we need to consider the nature of multidisciplinary health care settings where many staff roles are involved with providing care. The process mapping therefore must include accessibility to all stakeholders, avoiding over display of text, while still conveying the appropriate information (Ben-Tovim et al., 2008).

Evidence suggests process modeling has limitations, specifically difficulties of comprehension with interpreting model results, and a lack of common language for modeling design. This limitation is especially apparent when considering the varying levels of technical expertise and backgrounds involved in the creation of models (Becker et al., 2000; Coppola & Panaroni, 1997). Coppola and Panaroni (1997) argue there is also risk in misinterpretation of the models with semantic errors and misjudgement which could cause significant economic consequences. There are limitations in terms of expenses and tools used for designing process models. These limitations depend on the scope and granularity of the model as well as the specific software used for creation. Studies also suggest there is risk in oversimplification of process attributes with macro-level granulation and linear workflows due to the inconvenience of constructing the models or simply misinterpretation of the scope (Coppola & Panaroni, 1997; Becker et al., 2000). Furthermore, Biazzo (2002) distinguishes the limitations of process modeling to incorporate and explicitly demonstrate cultural, political and social aspects of organizational behaviour such as power relations, status hierarchies and individual attitudes.

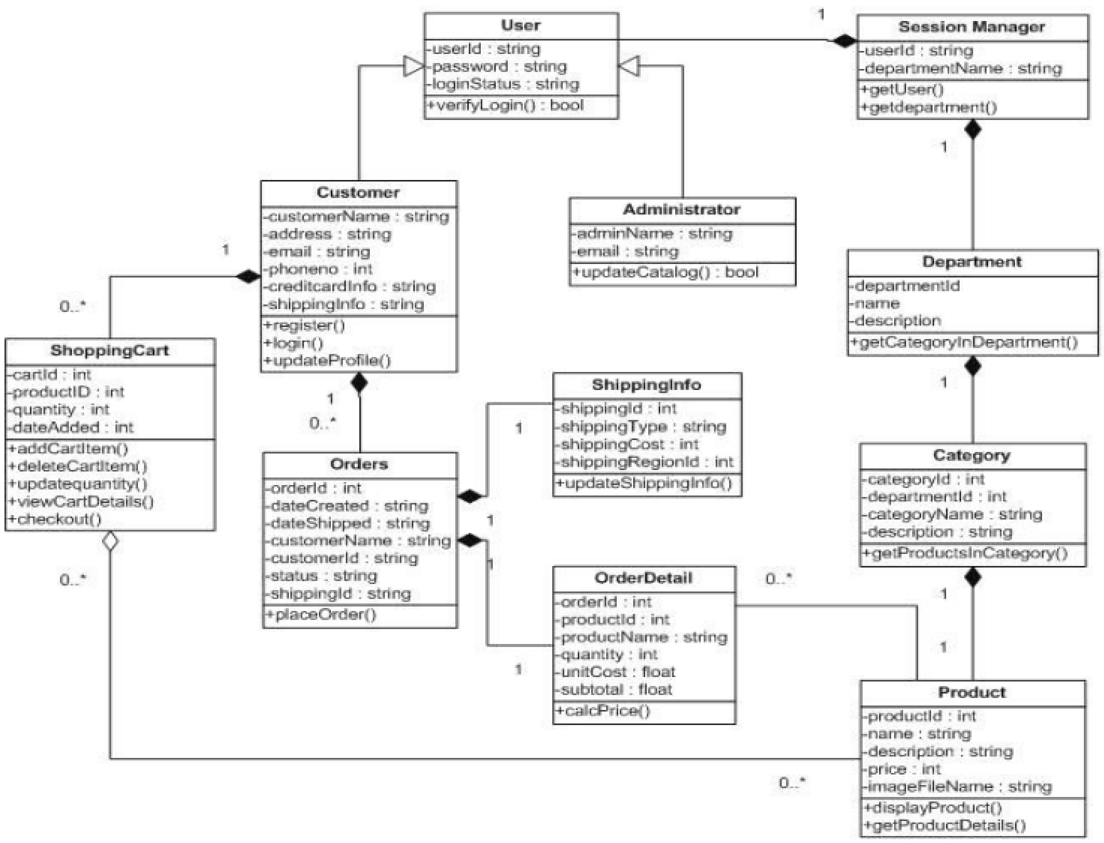
Section 2.4.1. Process Modeling Tools

This section provides an overview of use and limitations of selected process modeling tools. These tools are used to create a graphical depiction of process elements, including information flow, to assist in understanding the process design and underlying organizational or customer needs. Based on a review of literature, a summarized comparison of each tool is presented including consideration of visual complexity, focus, ease of use, primary audience, granularity, resource intensity, technology and soft factors. The modeling tools examined include: *Unified Modeling Language (UML), Business Process Modeling Notation (BPMN), Value Stream Mapping (VSM), Service Blueprinting, Patient Journey Modeling Architecture (PaJMa), Customer-centric Process Modeling Methodology (CCPIM), Traditional Flowchart*.

Section 2.4.1.1 Unified Modeling Language (UML)

Unified Modeling Language (UML) is based on object-oriented process modeling, primarily used for modeling requirements for systems design. An example of this tool is shown in Figure 5. This process modeling tool uses sets of diagrams and use cases related to system class, components, and deployment (Zhang, Jiao, & Helo, 2007). It is a dominant modeling language in the software industry and it is argued that this commonality enhances communication between software designers, proprietors and vendors (Siau & Cao, 2001). However, current literature raises criticism of UML relating to methodological comprehensiveness and complexity. Siau and Loo (2006) found that UML modeling was complex and difficult to learn without a solid understanding of technological architecture. In addition, this technique is focused on systems design and deployment, which tends to hinder incorporating analysis and documentation aspects of system requirements.

Figure 5. Example of UML Process Modeling Tool.

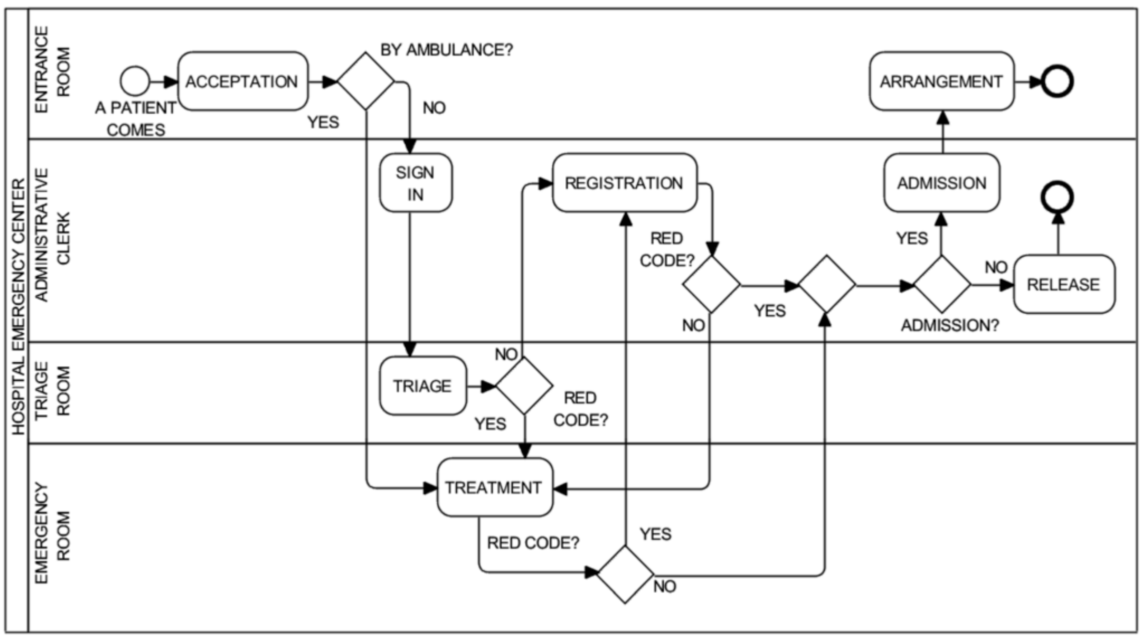


Source: Karasneh, B., & Chaudron, M. R. (2013, March). Extracting UML models from images. In Computer Science and Information Technology (CSIT), 2013 5th International Conference on (pp. 169-178). IEEE.

Section 2.4.1.2 Business Process Modeling Notation (BPMN)

Business Process Modeling Notation (BPMN) provides a standardized format to flowcharts, with characteristics of process flows embedded into its schema (Muller & Rogge-Solti, 2011; Lam, 2009). An example of this tool is shown in Figure 6. BPMN is a modeling technique which uses “swim lanes” and “pools” to organize the separate elements of the overall process. Artefacts are used to specify supporting information which does not directly associate with the sequence and message flow (Lam, 2009). Flow objects and connecting objects such as gateways, activities and events, are used to demonstrate the sequence of the process (Lam, 2009; Shapiro et al., 2011).

Figure 6. Example of BPMN Process Modeling Tool.



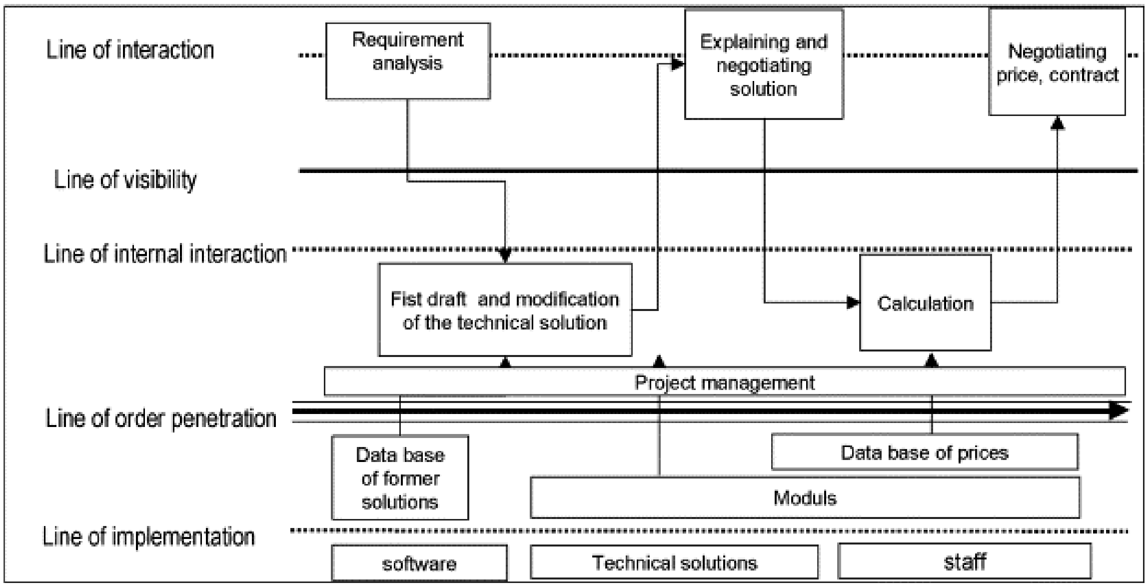
Source: Cimino, M. G., & Vaglini, G. (2014). An Interval-Valued Approach to Business Process Simulation Based on Genetic Algorithms and the BPMN. Information,5(2), 319-356.

Recker (2010) argues there are difficulties in translating process flow to BPMN which can be attributed, in part to ambiguous semantic modeling rules, and a lack of support for process decomposition, but also the requirement of formal training in its use. Muller & Rogge-Solti (2011) have identified that BPMN lacks of proper role integration and user-interface depiction. Similarly, Milton & Johnson (2012) suggest that BPMN does not account for props and physical evidence, which could be beneficial in communicating aspects of information technology along the process flow.

Section 2.4.1.3 Service Blueprinting

Service Blueprinting is a simplistic approach of high-level process mapping in contrast to the technical approaches of the previously mentioned UML and BPMN. An example of this tool is shown in Figure 7. It uses graphical notations of process elements to convey service innovation flows of human to human interfaces, and human to technology interfaces rather than systems design (Bitner, Ostrom & Morgan, 2008). Similar to Customer-Centric Process Improvement Methodology (CCPIM) and Patient Journey Modeling Architecture (PaJMa), Service Blueprinting offers a customer-centric view of the targeted process (Bitner, Ostrom, & Morgan, 2008; Percival et al., 2009; Percival, 2015). This perspective is presented using process flow placed along swimlanes which account for physical evidence, customer actions, invisible/visible employee actions, and support processes. The process flow simultaneously aligns across lines of separation indicating visibility and interaction (Bitner, Ostrom & Morgan, 2008; Fließ & Kleinaltenkamp, 2004). Liang, Wang and Wu (2013) argue that although service blueprinting has the benefits of adaptability and being easily understood by frontline workers, customers, and service employees, this modeling technique is limited to a generalized view of the process. It therefore has limits on levels of granulation and conveying complex scenarios or specified components of a service process (Liang et al., 2013). Similarly, Barberieri et al. (2013) have identified traditional service blueprinting to lack soft factors of human behaviours influencing services including motivation, emotion, and satisfaction.

Figure 7. Example of Service Blueprinting Process Modeling Tool.

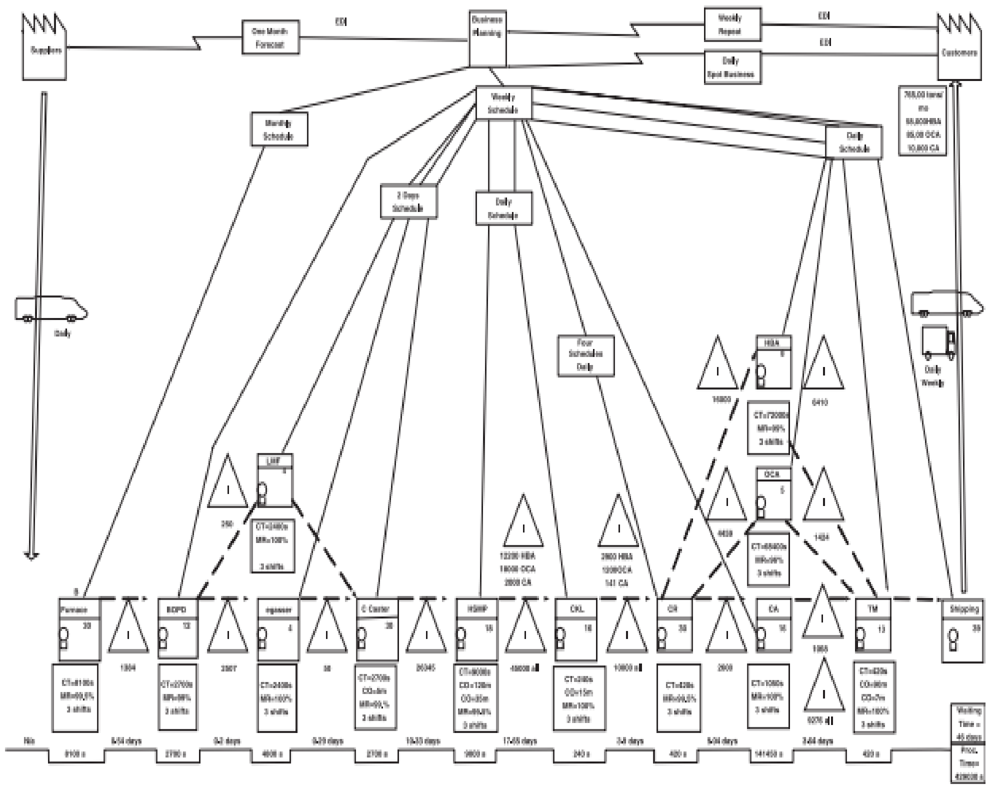


Source: Fließ, S., & Kleinaltenkamp, M. (2004). Blueprinting the service company: Managing service processes efficiently. Journal of Business Research, 57(4), 392-404.

\Section 2.4.1.4 Value Stream Mapping (VSM)

Value stream mapping is a simplistic process modeling technique originating in the manufacturing industry which involves a visual representation of current and future states of process, information and material flow. It is coupled with Lean principles of customer focus, eliminating waste, and identifying value added time and non-value added time (Rother & Shook, 2003; Hines & Rich, 1997). Figure 8 demonstrates an example of VSM. Although Braglia, Frosolini and Zammori (2009), state that using VSM provides the benefits of a flowchart medium that promotes discussion between employees and managers, the tool is unable to convey complex processes. Limited to only demonstrating singular, linear processes, VSM lacks the ability to show process variability and significant technological integration (Braglia et al., 2009). Similarly, Serrano Lasa, Ochoa Laburu and de Castro Vila (2008) examined the practicality of VSM. They maintain creating the models was resource and time intensive, requiring personnel sufficiently trained in Lean theories.

Figure 8. Example of Value Stream Mapping

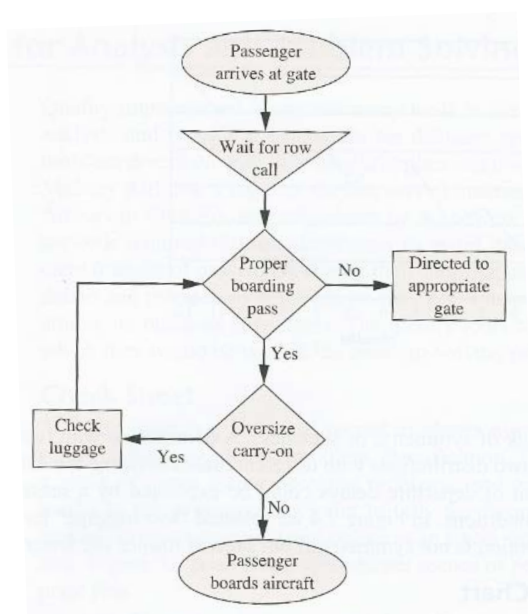


Source: Abdulmalek, F. A., & Rajgopal, J. (2007). Analyzing the benefits of lean manufacturing and value stream mapping via simulation: A process sector case study. *International Journal of Production Economics*, *107*(1), 223-236.

Section 2.4.1.5 Traditional Flowcharting

Traditional flowcharting is a simplistic process modeling tool, logically depicting ordered information flows and tasks, including start and end points (J.A. Fitzsimmons & M.J. Fitzsimmons, 2006). Figure 9 is an example of traditional flowchart. This tool's usage stems from programming and software design, but was quickly adapted to other industry areas including manufacturing and quality improvement (Caplan, 1997; J.A. Fitzsimmons & M.J. Fitzsimmons, 2006; Howard, 2003). Symbols representing actions and decisions are connected by directional arrows to show vertical process flow and loops (Caplan, 1997; J.A. Fitzsimmons & M.J. Fitzsimmons, 2006). However, due to its simplicity, the tool is unable to show complex processes. Nevertheless, it can be used as a starting point for complex process analysis, by serving as a conceptual modeling tool to support the creation of subsequent models. In these cases, the subsequent models will use alternative process modeling tools such as the ones that have been described in this chapter: UML (Section 2.4.1.1), BPMN (Section 2.4.1.2), Service Blueprinting (Section 2.4.1.3), VSM (Section 2.4.1.4). The subsequent sections describe the process modeling tools PaJMA (Section 2.4.1.6) and CCPIM (Section 2.4.1.7). PaJMA and CCPIM can also use traditional flowcharting as a starting point for conceptual process modeling.

Figure 9. Example of Traditional Flowcharting Process Modeling Tool.

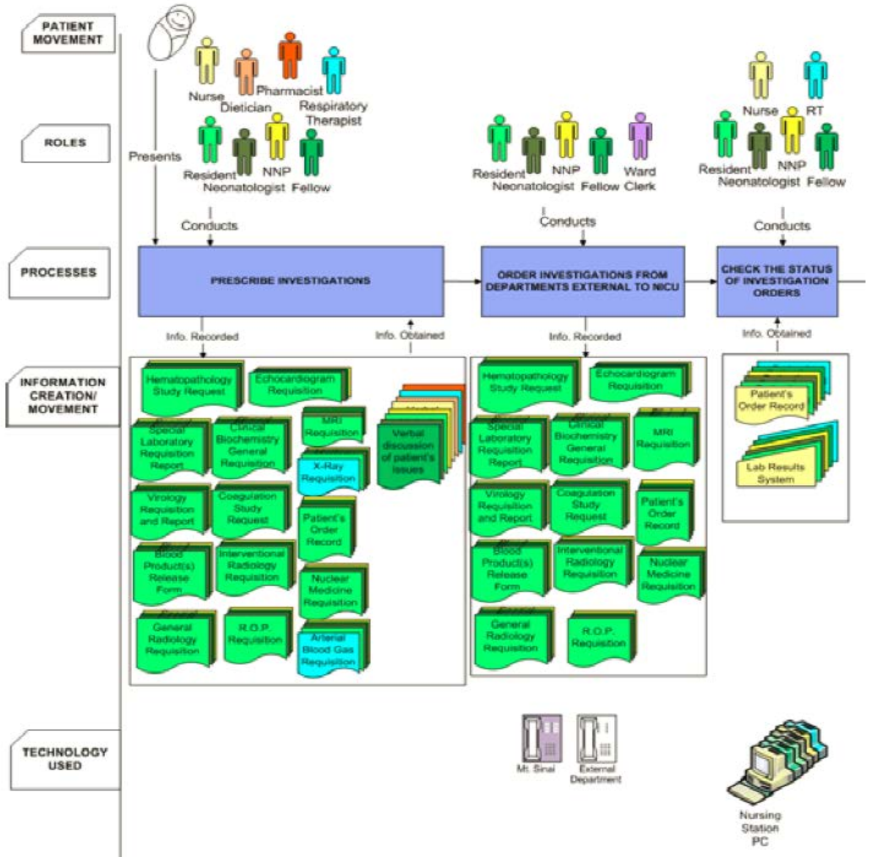


Source: Fitzsimmons, J. A., & Fitzsimmons, M. J. (2006). Service management: operations, strategy, and information technology

Section 2.4.1.6 Patient Journey Modeling Architecture (PaJMA)

PaJMA is a process modeling tool specific to the healthcare domain that maps the patient care flow. Figure 10 is an example of this tool. PaJMa is visually appealing and simple to understand, and can therefore be applied to any audience with minimal training to interpret the elements (Percival et al., 2009). The model uses the metric layers of patient movement, staff roles, processes, information creation/updated, technology used, protocols/guidelines followed, patient needs and time metrics. PaJMa uses a color coding scheme to show access to information and technology. With this scheme, each role is assigned a specific color. This specific color is carried over to the information and technology metrics layers to show which role has access to which item of information (Percival et al., 2009). Although the model is visually appealing by incorporating a color code, the process of collecting data and modeling the information is exhaustive and resource intensive; this is due to the increased number of elements and metrics represented. Validating and verifying the process map is significantly time consuming due to scheduling and conflicting perspectives of collaborators.

Figure 10. Example of PaJMA Process Modeling Tool.

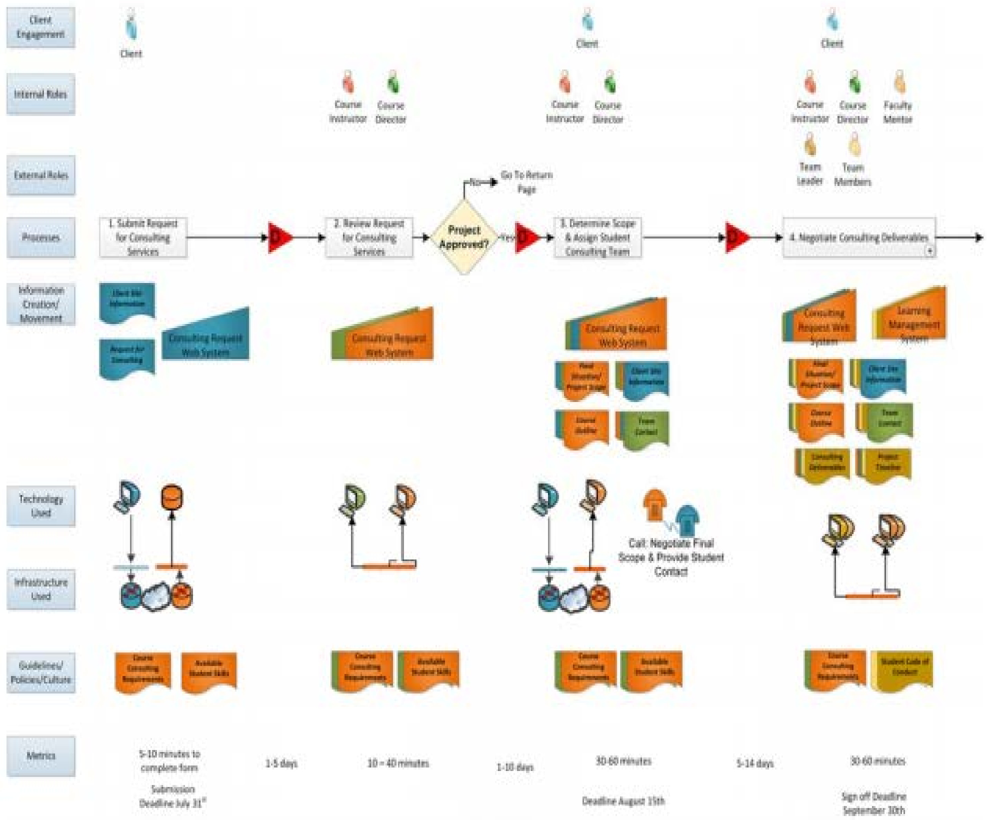


Source: Steadman, A., McGregor, C., Percival, J., & James, A. (2012). Using PaJMa to Enable Comparative Assessment of Health Care Processes within Canadian Neonatal Intensive Care Units. In Advance in Health Informatics Conference (AHIC 2012).

Section 2.4.1.7 Customer-Centric Process Improvement Methodology (CCPIM)

Similar to PaJMA, CCPIM uses a color coding scheme to illustrate role ownership, technological accessibility and documentation ownership for process elements, which has implications for data sharing and privacy, but also accounts for soft factors through identification of cultural or social needs. CCPIM was specifically created to be easily interpreted by novice users; it is used as a communication tool to interpret a process from the customer's view, thereby assists process innovation and change management (Percival, 2015). Figure 11 shows an example of CCPIM.

Figure 11. Example of Customer-centric Process Improvement Methodology



Source: Percival, J. (2015). A visual process model for improved technology-based service design" *International Journal of Process Management and Benchmarking*

Section 2.4.1.8 Comparison of Tools

Table 1 summarizes attributes of each previous described process modeling tool in a comparative format. The visual complexity category is based on the level of graphical detail presented by each tool. UML was found to be the most visually complex tool and Traditional Flowcharting was found to be least visually complex. Primary focus describes the centre of construct and process interpretation. CCPIM, PaJMA, Service Blueprinting, VSM, and Flowcharting have a customer-focused approach. In contrast, UML is software- oriented and BPMN uses swim lanes to show role-focus.

Table 1. Comparison of Process Modeling Tools

Process Modelling Tool	Visual Complexity (Low-High)	Focus	Ease of Use (Low-High)	Level of Training Required (Beginner-Expert)	Primary Audience	Granularity	Resource Intensity	Technology	Soft Factors
UML	High	Software	Low	Expert	Software designers & Proprietors (IT)	Flexible	Yes	Explicit	None
BPMN	High	Role-Based	Low	Expert	Analysts & Software Designers (IT)	Flexible	Yes	Implicit	None
Service Blue Printing	Medium	Customer	Medium	Novice	Employees & Managers (non-IT)	Limited	No	Explicit	None
VSM	Medium	Customer	Medium	Expert	Employees & managers (non IT)	Limited	No	Implicit	None
Traditional Flowchart	Low	Customer or Role-Based	High	Beginner	Employees & Managers (non-IT)	Limited	No	Implicit	None
PaJMA	Medium	Customer	High	Novice	Collaborative	Flexible	Yes	Explicit	None
CCPIM	Medium	Customer	High	Novice	Collaborative	Flexible	Yes	Explicit	None

The ease of use category explains the level of effortlessness and intuitiveness involved in practical applications of each tool. The simplistic flowchart tool and color-coded CCPIM and PaJMA tools have the greatest ease of use, whereas UML has the least. Level of training category refers to the level of technical competency needed to effectively construct and use each tool. BPMN, UML and VSM tools are found to require expert level competency; however CCPIM, Service Blueprinting, and PaJMA are novice level tools. The Flowchart was found to have the most ease of use, as a beginner level tool. The Primary Audience category describes the type of role targeted to engage in dialogue. BPMN and UML tools are heavily geared towards an IT audience, while Service Blueprinting, VSM and Flowcharts were specifically non-IT oriented. PaJMA and CCPIM are collaborative tools geared towards a multidisciplinary audience. Granularity demonstrates the ability to inherently decompose or amalgamate process steps or activities. Resource intensity categorizes whether a high consumption of time and effort is true in applying the modeling tool. UML, BPMN, PaJMA and CCPIM had flexible granularity and greatest intensity of resources, whereas VSM, Flowcharting and Service Blueprinting were limited in their ability to demonstrate granularity and remained the least resource intensive. Technology in Table 1 refers to the demonstration of information technology components such as interface or hardware. In this category, UML, CCPIM, PaJMA and UML explicitly demonstrated technological components; however, BPMN, VSM and Flowchart rely on implicit evidence of technology. It is noted that each process modeling tool fails to account for soft factors such as human motivation and emotions.

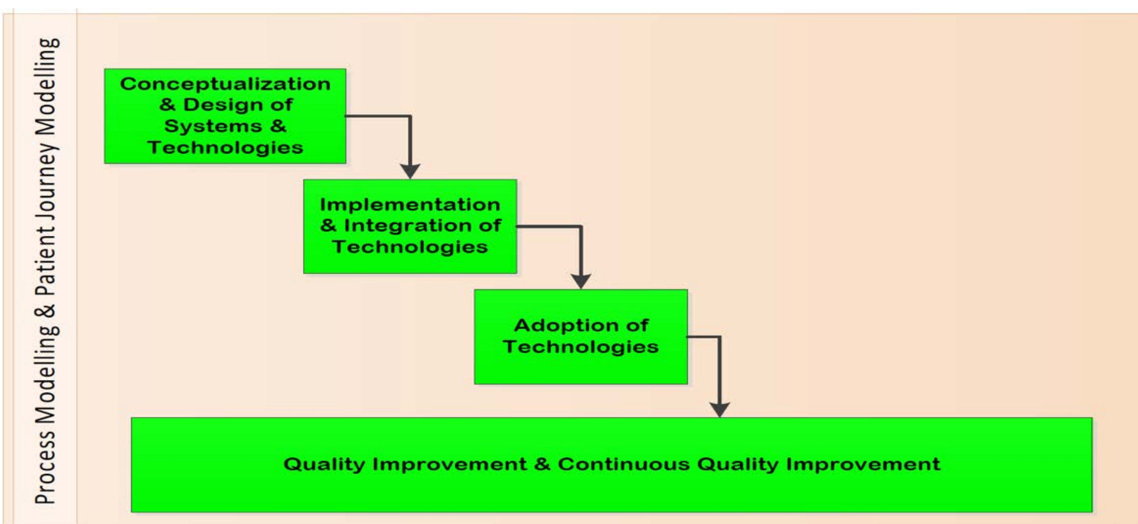
Section 2.4.2. Applications of Process Modeling & Information Technology in Healthcare

A literature search was conducted using major indices and journals including, British Medical Journal (BMJ), Health Informatics Journal, MEDLINE, CINHAL, PubMed, Scholars Portal and Google Scholar. The search phrases used were: “health informatics or health information technology or health information communication technology and process modeling or process mapping or patient journey modeling or patient care mapping”. The phrases were sectioned and combined in various orders to maximize the results. The search results were narrowed, excluding articles published before January 2002, or written in any language other than English. The search also only included articles that were available through the library of the University of Ontario Institute of Technology (UOIT).

In the next phase, each identified abstract was reviewed. Articles were excluded if the aims, methods and results of the studies were not relevant to the research scope. With this strategy, we ensured that research focused on articles surrounding process modeling or patient journey modeling in relation to Health Information Technologies (HIT) and Information Communication Technologies (ICT), rather than a generalized approach to process modeling in healthcare. Furthermore no limitations were placed to constrain the area within the domain of health care to provide a broader range of literature thereby increasing research perspective. A total of 96 articles were identified, of which 20 were considered relevant.

Each article was read and summarized, and relevant information was extracted to populate a summary matrix using Microsoft Word 2012. The matrix included reference information, a summary of the research aims, findings, methodology, possible limitations, possible future research opportunities, and emerging themes. The matrix was then used to create a concept map, using Microsoft Visio 2012 to connect and compare emerging themes in the current literature. The concept map is represented by Figure 12. Four distinct thematic categories emerged (see Figure 9): *Conceptualization and Design of System or Technology, Integration and implementation of health information technologies (HIT), Adoption of HIT, Quality Improvement & Continuous Quality Improvement.*

Figure 12. Concept map connecting and comparing emergent themes.



Section 2.4.2.1 Conceptualization and Design of System or Technology

Using process modeling to demonstrate integration of HIT, with regards to existing clinical practices, is the crucial first step in understanding the benefits these technologies can provide to an organization. This step allows for the understanding of the complexities of the health care delivery and the needs of the system (Bouamrane, McGee-Lennon, Brewster, & Mair, 2011). This idea is supported by findings of a 2012 research study conducted in residential aged care facilities, which analyzed ICT to assist with the information exchange process of medication management (Georgiou, Tariq & Westbrook, 2013). Purposive sampling was used to select participants to capture a greater range of participant perceptions. Semi-structured interviews were conducted, and the resulting data used to construct process models using BPMN. The models revealed a comprehensive picture of the complex, dynamic process activities, including involvement with external stakeholders. Major areas of consideration that were used for designing the required information systems were identified. These areas included: temporal dimensions of sub processes, relevant artefacts, and the occurrence of complex, heterogeneous communication channels to transfer information. However, it was noted that the BPMN model was unable to provide time metrics for analysis; therefore the researchers suggest further studies should look at quantifiable outcome measures, such as the time it takes to complete each process activitiy in the medication management process. This would strengthen the results, lead to a greater understanding of the process and requirements of the technology (Georgiou et al., 2013). Alternatively, Percival et al. (2009) developed a PaJMA model to examine the patient's journey through a neonatal intensive care unit (NICU) at Sick Kids Hospital in Toronto, Canada. The PaJMA method was found to be flexible in comparison to BPMN, presenting the possibility of including additional extrapolated through identification of elements of information flow and technology used, clinical guidelines/protocols, patient needs, and time metrics (Percival et al., 2009).

In addition to understanding the clinical process to support systems design, process modeling is used to establish system requirements through identifying the needs of the end-users, and assist in communication between end-users and IT developers. Stinccini, Joubert, Quaranta, and Fieschi (2005) propose a process modeling technique, joining IDEF0 (Integrated Definition for Function Modeling) and SADT (Structured analysis and design technique) to create a structured, web-based tool that amalgamates enterprise modeling techniques. The tool was flexible as it supported different levels of granularity, depending on the process chosen to be modelled through linkages of hierarchy of data sets (Stinccini et al., 2005). This type of process mapping empowers health professionals to contribute to the development of the process model and technical analysts to effectively build technical maps for systems development. It serves as a linkage between the two distinctly different professions, health professionals and technical analysts, with the same objective of creating an effective health information system or technology (Stinccini et al., 2005).

Section 2.4.2.2 Integration and Implementation of Health Information Technologies

In addition to the use of process modeling to advance the design and conceptualization of health information technologies, the search produced literature related to integration and implementation of these technologies. Current research emphasizes the importance of a holistic approach to integration of health information technologies and systems; a holistic approach gives consideration to the connections between individual areas of the organization or system, and the relation of individual areas to the organization or system as a whole (Proudlove & Boaden, 2005). Adoption of new technologies in a health care setting is complex and cross-disciplinary. It is imperative that all stakeholders have aligned of vision for the future state, and consider interdisciplinary communication strategies to ensure successful integration and implementation (Proudlove & Boaden, 2005).

Samarnayake and Kiridena (2011) conducted a study examining using event-driven process modeling of health care service acquisition and patient journeys. The research was to be applied to an enterprise resource planning system as a software tool to predict logistics and required resources for patient care in order to support this theory; however it had not been applied since publication. The authors reported an inconclusive outcome and further research is required (Samarnayake & Kiridena, 2011). Another application for process modeling is to assist in project implementation of information systems. These information systems serve as a centralized database and point for information access and retrieval, increasing efficiency and often integrate strategic management, operational, and clinical data (Vishwanth, Singh, & Winklestein, 2010; Proudlove & Boaden, 2005). Vishwanath et al (2010) claim that existing literature on health information technology based workflow focuses on few distinct, individual processes. However, this view is contradicted in a 2005 study (Proudlove & Boaden, 2005), conducted for the National Health Services in England, United Kingdom. The researchers examined how information and information systems can be used to support patient flow through the change from bed management system to a holistic. In this study, the information system incorporated operational data as well as patient care flow data to support system integration (Proudlove & Boaden, 2005). Patient journey modeling was applied to show the current state of the system which needed effective management and the centralization of data in a range of network acute care hospitals. The integration allowed for information sharing to take place across the care pathway for the patient (Proudlove & Boaden, 2005).

Besides conversion or upgrade of information systems and technologies, current literature examines process modeling as an approach to examine inter-organizational, cross-functional uses for health information technologies. VSM is a common method that supports modeling cross-functional processes (Snyder, Paulson & McGrath, 2005). This claim is supported by evidence from a 2005 case study conducted in the United States, involving modeling a current state patient journey and operational processes from two medical clinics. Similar processes were modeled at a second health care facility as part of a community based electronic health initiative. The maps were connected to each other to assist with the implementation of a new inter-organizational EHR system. Although the study specified the use of observations of the clinic personnel to form the models, it was unclear whether interviews were conducted to support and validate the findings. The study was unable to draw a solid conclusion as to whether both clinics benefitted from the implementation of the health information technology, due to a learning curve related to adoption of a new technology (Snyder et al., 2005). Instead, the researchers suggest subsequent studies to remap the processes with appropriate outcome measures once the system is completely rectified and staff are comfortable with it's use (Snyder et al., 2005). The researchers used VSM methodology and were unable to show sub processes and tasks, it did not account for roles or time; therefore this approach did not necessarily provide a comprehensive view of the processes. Establishing these role and time metrics would provide an additionally outcome determinant for analysis. The study emphasized case findings but did not offer adequate information about participation selection or data collection methods (Melnyk, Stewart, & Swink, 2004; Snyder et al., 2005).

Furthermore Jenkings (2007) found process mapping could also be used as a tool for advancing health information communication projects. This was demonstrated through distribution of electronic health records between primary and secondary care facilities for diabetic patients. Jenkings (2007) used a pre-implementation and post-implementation case study design with site visits for workplace observations, questionnaires and informal interviews, as part of data collection method. The data were used to construct process models representing the workflow and care flow comparing pre and post implementation. These models had a special drill-down feature embedded in the maps to provide additional context and granularity to the sub processes, as well as icons for graphical representation of elements (Jenkings, 2007). Despite the adaptable flexibility of the modeling tool, the application in this case was not entirely successful. Evaluation of the application of the models was limited due to time constraints of the enactment of the electronic health records system. Although observational techniques to gather data were used, they did not directly observe patient-clinician interactions instead relied on questionnaires to clinicians to obtain related data (Jenkings, 2007). This presents a limitation of the study as direct observations would serve as a means to strengthen the results (Carthey, 2003).

Section 2.4.2.3 Adoption of Health Information Technologies

The previous section discussed the use of process modeling to integrate and implement health information technologies. Current literature indicates that examining the acceptance and adoption of the technologies gives insight to the impact and results of the change initiative. This section discusses development and analysis of process models to understand impact and barriers to adoption of new health information systems.

Ford (2010) modeled the careflow process from eight substance abuse agencies; agencies varied in their current stage of system integration The study was qualitative research and used semi-structure interviews for data collection. Results from the interviews were used to develop process models using Microsoft Visio 2007 (Ford, 2010). The study resulted in identification of inefficiencies within the careflow process, a quality improvement program for the facilities (Ford, 2010) Additionally, process modeling and analysis led to realize barriers to HIT adoption such as a lack of public health related perspectives of HIT and participant discomfort with using computers (Ford, 2010). The process modeling tool was not identified, however it was mentioned that the method did not incorporate quantitative measures. This is a potential limiting factor to validity of the results. Future research should consider incorporating quantitative measures such as time spent on a process activtity, or delays. Percival et al., 2009; Ford, 2010).

In contrasting research design, Westbrook, Coiera, Gosling and Braithwaite (2007) used mixed methods approach to examine the integration of an online evidence retrieval system, they used critical incident and journey mapping techniques. The research included sixteen clinical nurse specialists and 13 hospital based specialist physicians as participants. Two semi-structured interviews were conductedfollowed by construction of the illustrated journey maps of clinician use of the specialized HIT. The journey mapping aimed to demonstrate a system wide perspective, gauging the adoption of HIT with quantifiable measures. However, the authors acknowledge that because the journey mapping measures were comparative, a definitive result pertaining to specific outcomes were unattainable in this case (Westbrook et al, 2007). For example, to the results could not determine whether a specific feature of the HIT is responsible for a specific improvement. This lack of specificity is a limitation of this study. Nevertheless the results indicated that the HIT had a significant positive impact on clinician decision making and patient care (Westbrook et al, 2007).

Another perspective to consider relating to HIT adoption is the concept of "work-around". Vogelsmeier, Halbesleben, and Scott-Cawiezell (2008) described this term as a form of informal temporary practice for handling exceptions to typical work flow such as overriding an alert given by a clinical decision support system. The study was conducted at a mix of five American, Midwestern nursing homes exploring the relationship of work-around relative to the implementation of an electronic medical record. Coding techniques were used to recognize and subsequently classify casual links between the work-around blocks and events. The study found that process modeling facilitated integration of technology, and identified work-around behaviour associated with HIT adoption, allowing for corrective implications to improve efficiency of processes and maximize patient safety. The researchers obtained data through direct observations, and key informant interviews to construct the process maps. The data were supported through secondary analysis of field notes and expert panel validation. However, it is evident that the limited number of observations and outliers of occurrences of specific situations were limiting factors in this study (Volgelsmeier et al., 2008).

Section 2.4.2.4 Quality Improvement & Continuous Quality Improvement

The final emergent theme reflected the concept of quality improvement and continuous quality improvement. In this theme, we considered process improvement and increasing efficiency or augmenting benefits, in comparison with process re-engineering and conducting process simulations.

Creating a process map to model current and future states of existing processes is an effective technique to identify inefficiencies and depict optimal goals. Tariq, Georgiou, Westbrook, Lyhne and Marks (2012) conducted a qualitative study to understand the process of care handover in an aged care residential setting. The study aimed to identify bottlenecks in the current process of information exchange and develop references of how ICT can benefit patient outcomes and workflow. Purposive sampling was used to ensure several scopes of interest with participant selection. The researchers conducted 11 focus groups, and 54 semi-structured interviews and observations. The resulting information was coded using a pre-developed five category coding system, and translated into process models. The study was able to identify a need for increased communication between health professionals and suggest a need for mobile technology to support existing processes. However there, was an evident limit in the focus of scope for this study, only considering handoff of care between shifts in a single residential aged care facility. Future research could look at a broader range of continuous inefficiencies in health information exchange, as well as a specific measurement of impact of handover information flows on patient care (Lyhne et al., 2012)

Bayer, Petsoulas, Cox, Honeyman and Barlow (2010) examined stroke care planning through simulation modeling. Their study used simulation modeling to help develop an understanding of the current system and provide a target to improve the design of future services. The researchers described a model to support the patient journey through an acute care hospital, community rehabilitation service and home care provision (Bayer et al., 2010). Although the model was able to provide current inefficiencies, effectively simulate hypothetical scenarios to increase resources, incorporating health information technologies, the data used for the model posed as a limitation to the study as it was obtained from existing records and local and nation statistics. In contrast, observational methods of data collection would have further validated this study (Carthey, 2003; Dreyer et al., 2010).

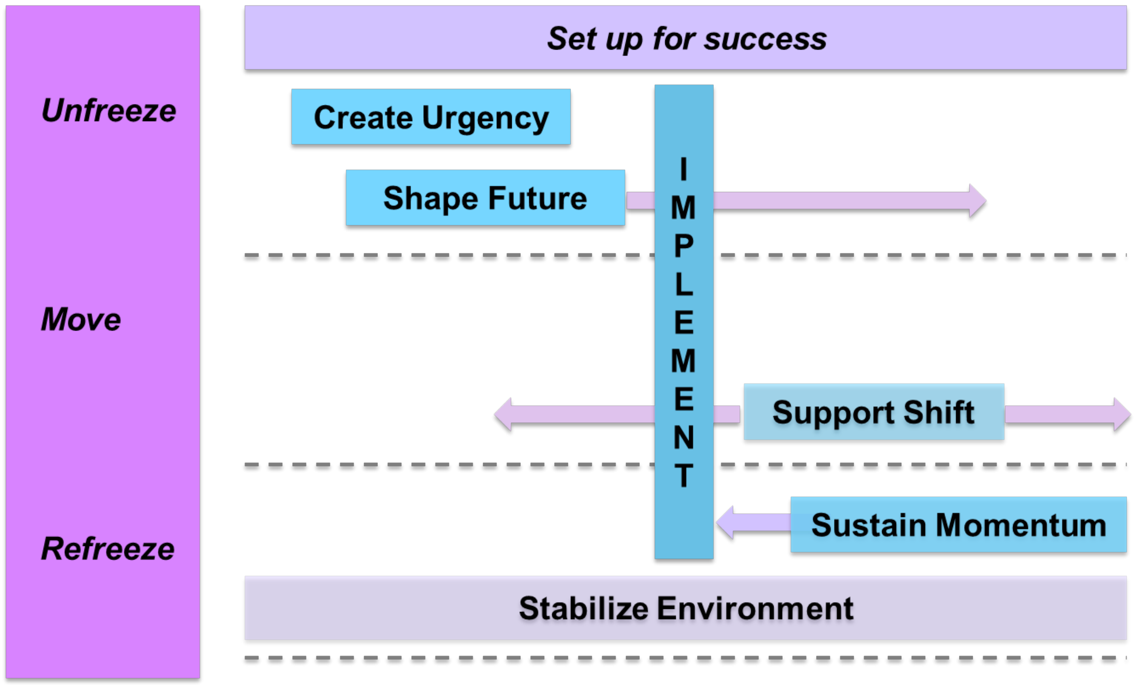
Section 2.5. Change Management

Effectively managing change is essential to minimize dysfunctionality and ambiguity brought on by the conditional shift in status, outcomes or processes (Bamford & Daniel, 2005). Hashim (2013) suggests cause of change can be categorized by external and internal stimuli. Change caused by factors peripheral to the organizational structure such as a change in customer preferences, political or societal pressures or pressure from competitive forces constitute external triggers to change. On the other hand, internal causes such as restructuring of organizational teams, inadequacy of knowledge transfer are internal triggers (Hashim, 2013). Similarly, Stanleigh (2008) found technological advancements, innovation, globalization or declining sales to contribute to catalyzing change within an organization. Engaging stakeholders to embrace change will aid organizations to competitively evolve and ensure profitability (Pãun, 2014).

Challenges of change management vary depending on the size, location and type of organization (Hughes, 2007). Often change management fails when there is a lack of employee engagement at all levels of the organization, insufficient allotment time to adapt to the change, and insufficient understanding of what drives the nature of the change (Stanleigh, 2008).

There are various change models founded on strategic principles and human psychology; the change models provide theory to guide practical applications of change management (Pãun, 2014; Carter, 2008). The Kurt Lewin change model traces back to the 1950's. Figure 13 is a visual representation of the Kurt Lewin change model. It is a framework that explores the question: "What does one have to do if he owns an ice cube, but he wants for it to have another form?" (Pãun, 2014, p.9). According to the Kurt Lewin change model, the ice cube must be melted, the state of matter must change, and it must be refrozen. Metaphorically, the ice cube's changes represent deconstructing an outdated system, transitioning to a new system, and consolidating the transition (Burnes, 2004; Lewin, 1947; Pãun, 2014).

Figure 13. Kurt Lewin Change Model

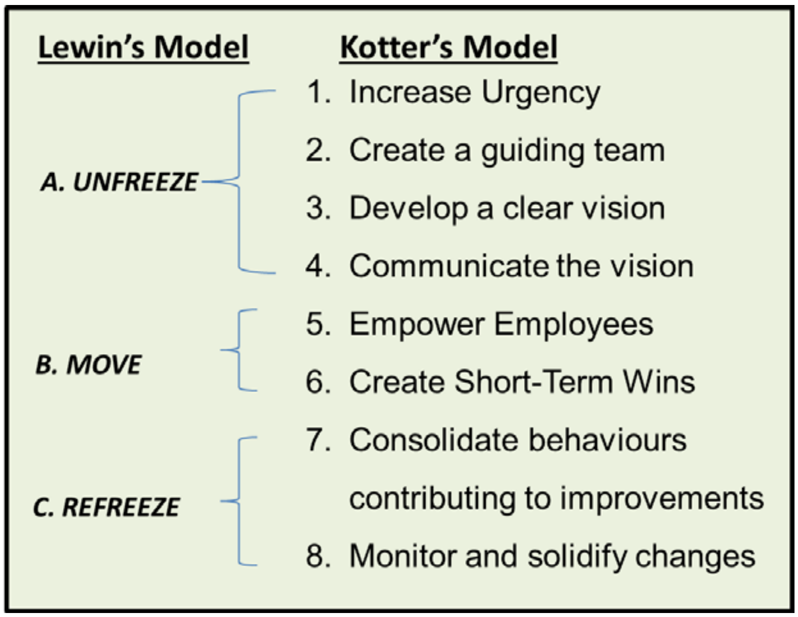


Source: Carter, E. (2008). Successful change requires more than change management. The Journal for Quality and participation, 31(1), 20.

Lewin places contextual significance on human behaviour and group dynamics for each identified phase of change (Lewin, 1947; Burnes, 2004). Motivation for change must be established with urgency, prior to de-structuring (Burnes, 2004; Pãun, 2014). Resistance to change in various forms will undoubtedly occur. However, the degree of resistance is dependent on whether the people having to adapt agree with the proposed change (Luo, Hilty, Worley & Yager, 2006). "Unless each level perceived the intended changes to be their own interests, they may not cooperate with implementation (Luo et al. 2006, p.466)". To overcome resistance and relieve the human anxieties typically exhibited when acquiring unfamiliarity, individual opposing opinions within groups should be challenged in a manner that will inherently shape the pursued change (Pãun, 2014). By challenging stances using open communication, and the progression of time to allow for comfort in adopting the new form, Lewin suggests humans will re-evaluate their perspectives of the current state and their roles within the current state to form an emergent foundation of differed thinking in the change process (Burnes, 2004; Carter, 2008; Pãun, 2014). Incorporating positive reinforcements to encourage adoption of the new method is a strategic method to sufficiently sustain the change (Carter, 2008; Pãun, 2014). Consolidating the change to a steadied environment through formally defining human responsibilities will clear ambiguity, converting the new elements into tangible practices and establish trust with those involved (Burnes, 2004; Carter, 2008; Pãun, 2014).

Four decades later, using Lewin's model as groundwork, Kotter (1996) presented a linear eight step change model specifically concentrating on fundamental changes in business management. Figure 14 contrasts Kotter's change model and Lewin's change Model. Similar to Lewin, Kotter identifies the importance of beginning the change process with creating urgency and endorsing increased communication throughout the change to provide direction and empowerment (Kotter, 1996; Lewin, 1947; Pãun, 2014). Kotter also suggests positive reinforcement for those embracing the change, and creating circumstances enabling sustainability to solidify the change (Kotter, 1996; Pãun, 2014). However, Kotter's linear model limits applicability in complex changes, indicating inflexibility as each step in the model is solely a result of the prior step and can therefore also never overlay stages (Appelbaum, Habashy, Malo & Shafiq, 2012). Also, both models emphasize organizational hierarchies and a top-down tactic to implementation, conflicting with the need to engage stakeholders at all levels of the organization for effective adoption of change (Pollack & Pollack, 2015). The inflexibility and potential irrelevance to complex organizational changes are factors leading some studies to suggest Kotter's and Lewin's models are outdated (Pollack & Pollack, 2015; Appelbaum et al.,2012).

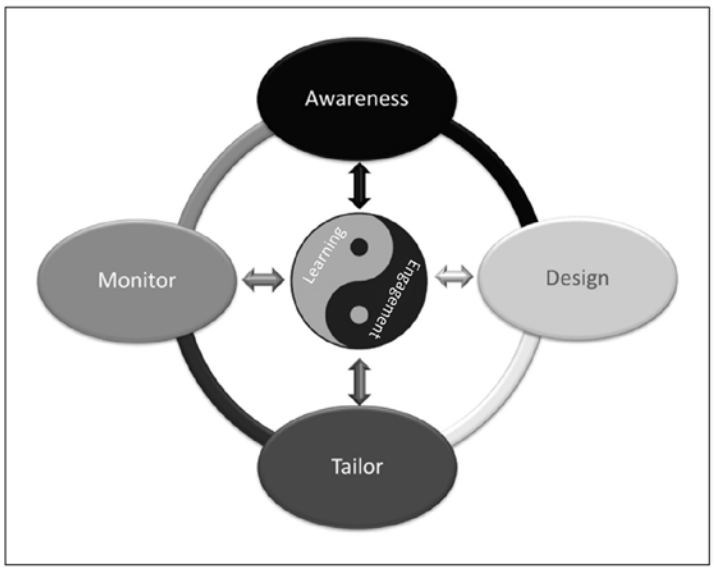
Figure 14. Comparison of Lewin and Kotter Change Models.



Adapted from Sources: Carter, E. (2008). Successful change requires more than change management.The Journal for Quality and participation, 31(1), 20. Pãun, M. (2014). Models of change. Valahian Journal of Economic Studies, 5(3), 7-14.

In contrast to the linear approaches to change, insinuated by Lewin and Kotter's models, Worley and Mohrman (2014) present a new theory for change, called The Engage and Learn Model (see Figure 15). Rather than a formal change model which infers excessive control of progression, their theory is "a descriptive model of change and set of organizational change routines- the recurring processes that characterize an organization- that allow an organization to change itself continuously", (Worley & Mohrman, 2014, p. 217). Unlike Lewin and Kotter's work, this approach has no starting point, allowing for entry at any stance within the model (Worley & Mohrman 2014). This suggests the elements of change incorporated within the model are linked, but occurring concurrently at any given time throughout the organization. In this sense, change is regarded as a complex, dynamic force of interdependent flow to be set off and propelled through routine and continuous efforts across the organization, rather than sequential transformative occurrences (Worley & Mohrman 2014).

Figure 15. Worley Mohrman Change Theory.



Source: Worley, C. G., & Mohrman, S. A. (2014). Is change management obsolete?.Organizational Dynamics, 43(3), 214-224.

Despite these ideological differences, there are overlapping similarities between these three change models. Each approach highlights the significance of human factors and strategic management contributing to organizational change. Pre-establishing motivation is vital for effective change through creation of a sense of urgency. While Lewin and Kotter's model explicitly account for creating urgency in change management, Worley and Mohram's (2014) model, the urgency can be attributed to a balance of constant engagement and learning between people across the organization. When the balance is achieved, there is an awareness of a need to adapt to existing or future trends as competitive strategy (Worley & Mohrman 2014). Additionally, in order to support the transition to a changed state, modes of stakeholder communication, leadership and collaboration, must be promoted through the design of the change process. While Lewin and Kotter's model are primarily top-down approaches to collaboration, Worley & Mohrman's Engage and Learn model promotes collaboration at all levels of the organization coupled with the premise that change interventions or management tools must be also be tailored to suit the organization's needs (Pollack & Pollack, 2015; Worley & Mohrman, 2014). Finally, the examined change models overlap in their explanation of the need for a mechanism to monitor change efforts and detect error through direct review, ultimately aiding sustainability of the adopted change (Kotter, 1996; Pãun, 2014; Worley & Mohrman, 2014).

This thesis will examine the use of process modeling to enhance service quality, operational flow and technological integration. . Change concepts mentioned in this review will be combined and applied to analyze the targeted processes. Change management barriers specific to each department will be identified and recommendations will be provided in Chapter 7 to support process efficiencies.

Chapter 3. Study Context

Canadian Memorial Chiropractic College (CMCC), founded in 1945, is an academic institution involved in education, research, and patient ("About CMCC", 2015). CMCC is a non-profit, private institution consisting of 750 students, and 200 staff and faculty. CMCC has a central campus in Toronto and eight external clinics across the Greater Toronto Area ("About CMCC", 2015).

Motivated by changing market forces, and the possibility of better educational and clinical outcomes, CMCC's clinical education division recently underwent an extensive project to convert their paper-based health records to electronic health records (S. Rutherford & A. Tibbles, personal communication, June 19, 2015). When selecting the appropriate software, in addition to sufficient information management, the project team considered CMCC's unique environment of combined chiropractic academics and clinical practice in a non-for-profit setting. CMCC required a highly-customizable system which would be reasonably priced, sustain specialized chiropractic billing, and support intern education and clinician supervision. Ultimately, the project team chose open-sourced Open Source Clinical Application Resource (OSCAR), software with evidence of applications in similar practice environments (S. Rutherford & A. Tibbles, personal communication, June 19, 2015). The shift to electronic records drove the focus of *Case Study #1:CMCC Campus Clinic* (Section 4.3) & *Case Study #2: Process Modeling & Clinic Site Comparison* (Section 4.4).

The new EHR went live mid-March of 2013, beginning with parallel conversion for one week, followed by a phased approach, adapting new clinical teams each week. The phased conversion continued at the campus clinic until total conversion had been attained at the end of May 2013. The external clinics were phased into conversion beginning in July. By September 2013, the 6 targeted CMCC's clinics, main campus, Sherbourne, South Riverdale, Bronte, and St. John's were using the new EHR. *Case Study #1:CMCC Campus Clinic* focuses on the main campus clinic and *Case Study #2: Process Modeling & Clinic Site Comparison* focuses on the main campus clinic and an external clinic, Sherbourne, located in downtown Toronto, Ontario.

Clinical practice at the campus and external clinics consists of groups of 8-9 interns supervised by one clinician. Each group is called a "pod". There are two intern rotations at the Main Campus Clinic. One rotation is on Mondays, Wednesdays and Fridays, and the second rotation is on Tuesdays, Thursdays and Saturdays. As the clinics are teaching facilities, one of the clinicians' role is to oversee the care provided by interns (students). Clinic administrative activities are supported by the reception team. With the exception of 1 hour after the clinic opens, and 1 hour for a break, two receptionists are present at the front desk during all clinic hours. The clinical schedule at the campus clinic rotates with 3 pods practicing from 8am-2pm, and switching to another 3 pods at 12pm. The second group of pods continues to practice until the end of clinic hours between 4pm-8pm, depending on the day of the week. However the external clinic (*Case Study #2*), Sherbourne, has a schedule that rotates beginning with 1 pod in the morning, and a second pod from 12-3pm. This scheduling difference between locations is mainly due to the fewer number of treatment rooms and physical space at the external clinic.

Following adoption of new technology systems in clinical departments, CMCC's Human Resources, Information Technology (IT), and Accounting administrative units embarked on a shift to incorporate new information systems. This initiative was based on the need for the organization to maintain competitive advantage and reduce expenditure. Implementing the new technological systems also stemmed from an effort to streamline processes and create best practices. This was seen as a challenge by management as the units were small, with employees that had remained with their respective unit for many years and were accustomed to traditional processes. This was especially true for the IT department which focused on improving services for other divisions and lacked the time and resources to focus on their own internal processes. On the other hand, the Accounting department and Human Resources department were establishing entirely new information systems and wanted to determine the ideal process for implementing Payroll function as an electronic service, and t Hiring and Recruiting of new staff or faculty. CMCC needed to increase efficiency and optimize processes by overcoming barriers, such as inefficient or lack of communication and data sharing, created by functional department silos. (*Case study #3*) examine technological integration and the accompanying process changes in the Human Resources department. Although *Case study #3* focuses primarily on the Human Resources Department, work with similar scope and research design was conducted by UOIT Faculty of Business Capstone students in other CMCC administrative departments. The additional departments included Finance & Accounting and Information Technology Services. The Business Capstone students' project produced similar results to our own. The students' work demonstrates our research study can be replicated in multiple departments at CMCC.

Each of these departments was interested in pursuing their own process improvement and technology integration after learning about the research and changes taking place in the clinic. Each of the areas had either just recently or were in the process of implementing a new information system to support their area functions and improve efficiencies. The senior leadership team of the organization had a mix of clinical and administrative backgrounds. The process modeling methodology used in this research was selected with consideration of this mix. By developing the process models we aimed to promote an interdisciplinary common language. A common language could potentially unify strategic planning and metric evaluation tasks across the organization, regardless of the department or function.

Chapter 4. Methodology

This chapter explains the research design and methods of the individual case studies within this thesis. The first section presents the Research Design and Common Research Methodology Elements unifying the case studies. *(Note, the common research methods including, interviews, focus groups, thematic analysis and direct observations, are explained in detailed context of each individual case study later in this chapter.)* This is followed by an explanation of how Research Ethics Board Approval was obtained and justification of modeling tools relative to the thesis research questions.

The next section presents the detailed data collection of the first case study set at CMCC's campus clinic, followed by data collection of *Case Study #2: Process Modeling & Clinic Site Comparison* set at CMCC's external clinic. The final section presents the research methods conducted in the administrative units at CMCC, specifically detailing the Human Resources Department as an example of the methodology used in each administrative department.

Section 4.1. Research Design & Overview of Common Methodology Elements

This research study uses a mixed methods design. The research was primarily qualitative; however quantitative data were gathered to support the strength and complement the qualitative measures. The quantitative analysis derives from time metrics obtained during observations and development of simulations developed in the first case study. This is further discussed in Section 4.1.3 and Section 5.1. In addition, Thematic Analysis was used in each case study. This will be further discussed in Section 4.1.2. Concurrent triangulation strategy was applied to the mixed study design as the qualitative and quantitative findings are cross-validated as a means of offsetting weaknesses in the opposing methods (Bowling & Ebrahim, 2005).

Convenience sampling was used for random participant selection involving the most easily accessible subjects based on availability, and time and date of the study observations. Dates were selected based on calendar availability. Participants were those scheduled to work. In the clinical setting, this included the associated pre-scheduled new patients, and existing patients' re-evaluation of their condition and treatment. Re-evaluation patients were included because of the similarity of new patients. The process is similar in terms of the need for re-intake and re-assessment, with the exception that re-evaluations are in fact not new patients to the clinic itself. This method resulted in the least costly outcomes in terms of time and effort while still exhibiting data trends to draw conclusions for the case studies. Direct input from patients or customers was not collected. However, the research design incorporated customer and patient focused methods, such as specialized process modeling tools, to gain indirect patient or customer perspective.

We realize convenience sampling could have resulted in misrepresentations due to unequal population representation or outliers, affecting generalizability (Bowling & Ebrahim, 2005; Brewis, 2014; Pearce, Christian, Smith & Vance, 2014). This is an acknowledged limitation of the study. To overcome this potential limitation, results were analyzed with scepticism and constant reflection through extensive reflective journaling. Current literature maintains adequately describing the conditions of the investigative procedures contributes to the eradication of misinterpretations of results (Farrokhi & Mahmoudi-Hamidabad, 2012). The sample sizes chosen in each case study was based on a flexible, iterative study design and, the assertion that the appropriate sample size is one that sufficiently answers the research question. Marshall (1996) suggested that when research design is flexible with a cyclical or iterative method to support sampling and data collection, the number of participants needed to answer the research question becomes more apparent as the research progresses. This assertion remained true as each case study developed and will be discussed in more detail in the subsequent sections.

Section 4.1.1. Interviews & Focus Groups

In each case study semi-structured interviews were conducted. These interviews were conducted face-to-face with open-ended questions from a prepared interview guide (Appendix III. *Interview Guide*). The semi-structured interview method was specifically chosen to allow for the interviewer to clarify ambiguities in responses, as well as allow for greater depth in responses by further probing the interviewee. Use of the interview guide also allowed sequential responses overcoming potential question order biases (Bowling & Ebrahim, 2005).

A 2010 study focused on nursing clinical practices used a similar method of semi-structured interviews using open-ended questions and an interview guide (Baumbusch, 2010). The study found the interviewees were able to provide spontaneous, in-depth responses (Baumbusch 2010). Harvey-Jordan & Long (2001) support this finding, stipulating that using semi-structured interviews provides rich data, giving the interviewees opportunity to freely discuss information, and flexibility for the interviewer to interpret interview results and identify linking themes. However, some limitations of this method include: external factors, such as difficulties in scheduling time to complete an interview, and potential bias if the interviewee is intrinsically restrained in their responses. The use of semi-structured interviews with open-ended questions from a predetermined guide as a data collection method presented limitations in the form of possible errors by the interviewer and potential interviewer bias. To overcome these limitations, the interviews were recorded and transcribed verbatim, and participants were given free choice to participate in the study. In addition, the interviewer ensured confidentiality without identifiers linked to responses and reflective journaling was conducted. The reflective journaling was conducted on the premise that bias can be minimized when the interviewer recognizes prejudice and reflects on predisposed opinions, subsequently replacing the bias with impartial stances (Ratner, 2002)

In addition to one-on-one semi-structured interviews, 13 focus groups were conducted. As this research project involved measuring quality which included complex, multidimensional process elements, using focus groups allowed participants to openly engage with one another and the interviewer to collectively examine the processes. Kitzinger (1995) and Wilson (2012) suggest this method is especially useful when research is aimed towards service improvement as it fosters expressing criticisms and exploration of different solutions.

The group setting provides participant the opportunity to express their views, which may have been less accessible in a one-on-one interview, thus encouraging participants to voice their unique concerns (Kitzinger, 1995; Wilson, 2012). This openness also encourages feedback and exploration of personal responses in relation to the opinions of others' within the group through debate (Bowling & Ebrahim, 2005;

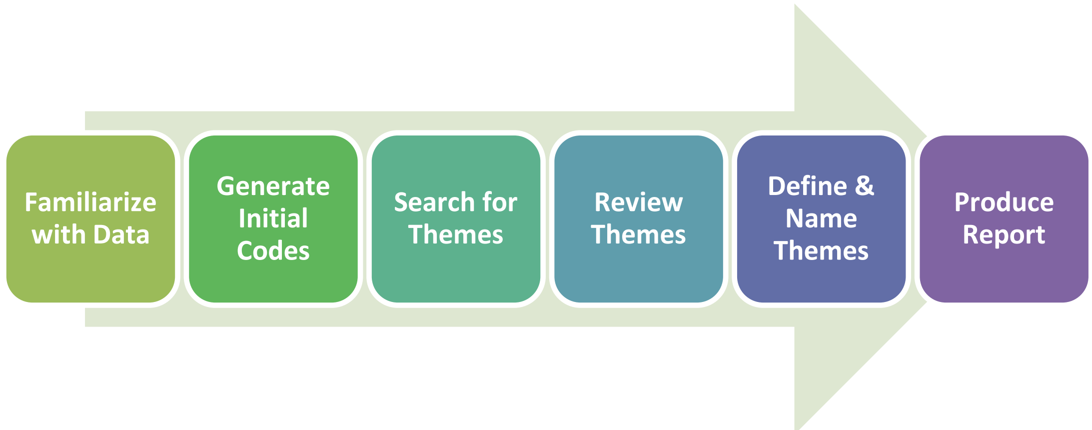
Wilson, 2012). Still, the focus group approach presents similar limitations to semi-structured interviews. For example, difficulties with scheduling, and the possibility the participants may be reluctant to share information, for reasons unknown, despite encouragement from the researcher. Although there is also the possibility of limitations in the form of “group thinking”, where participants exhibit consensus to avoid conflict within the group (Wilson, 2012), no indications of this concern were observed during any focus group session.

The results of the interviews and focus groups were digitally recorded, manually transcribed verbatim. Although transcription presented simplified format of data for the analysis process, DiCicco-Bloom & Crabtree (2006) point out that transcription of qualitative data may hinder accuracy due to subjectivity and environmental interference. The transcripts are essentially based on the transcriber’s interpretation of spoken word, which may be difficult to decipher as well as susceptible to technical disturbances due to insufficient audio capabilities (DiCicco-Bloom & Crabtree, 2006). The transcript was checked for errors or typographical mistakes through proofreading.

Section 4.1.1.1. Thematic Analysis

This research applied Thematic Analysis based on a framework by Braun and Clarke (2006). The research sub-questions presented in Chapter 1 served as a general guide to objective for data interpretation, analysis and coding. Thematic Analysis included both manifest and latent data content. Manifest content was based on clear semantics, whereas the latent content was mainly abstraction of the interpreted data (Braun & Clarke, 2006). Figure 16 is a visual representation of our thematic analysis process.

Figure 16. Thematic Analysis Process



Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative research in psychology, 3(2), 77-101.

As discussed in Section 4.1.1, interviews were digitally recorded and transcribed verbatim by the interviewer. Each interview was conducted by the same interviewer to repeatedly replicate the interview conditions and maintain consistent methodology. Each transcript was read-over twice to gain familiarity of the datasets and preliminary ideas were generated and noted. Codes were identified within each individual dataset by noting interesting patterns, ideas and issues of potential interest. The codes were systematically reviewed and interpreted to identify overarching concepts and patterns. The overarching concepts and patterns were categorized into groups describing potential themes in the datasets. The potential themes were repeatedly reviewed and analyzed against the initial codes and the entire dataset for validation, and to establish clear definitions. The defined themes and initial codes were used to support developing process models and process analysis in each Case Study. Defined themes and codes were also used to support discussion of findings as related to our research sub-questions, identified in Chapter 1.

Campbell, Quincy, Osserman and Pederson (2013) argue that the practice of coding qualitative research poses concerns of difficulty in establishing a unit of code as the unitization is based on subjective, free responses from open-ended questions. There is an element of subjectivity, similar to the aforementioned transcription method, based on the researcher's attempt to make sense of the interviewee's perspective (Braun & Clarke, 2006; Popping, 2012). Current literature suggests coding open-ended questions, similar to open-ended format used in this research project, is considerably more difficult than coding structured questions (Aberbach & Rockman, 2002; Campbell et al, 2013; Cooper & Schindler, 2003; Popping, 2012).

Despite the challenge, coding was chosen as an effective strategy for this research project. Categorizing the large amount of data would help identify critical themes needed to answer the research sub-questions identified in Chapter 1. To negate concerns for subjectivity, similar data were collected from multiple sources for this study. Data analysis to generate codes was comprehensive. Codes and analysis were iterative processes and repeatedly checked against other codes and entire datasets (Braun & Clarke, 2006).

Section 4.1.2. Direct Observations

In addition to the data collected from semi-structured interviews and focus groups, direct observations were made to examine process activities and specifically record time measures. The observations were conducted in this order to act as a medium of validating the preliminary findings from the interview and focus group. The use of observations to support preliminary findings is a strategy suggested by Harvey-Jordan & Long (2001) to strengthen reliability and overcome methodology limitations. A benefit of direct observations is data are obtained in real time in a natural environment without the possible respondent filters posed in questioning during interviews or focus groups (Bowling & Ebrahim, 2005). The interviewer remains unobtrusive, not interfering with the actions of the participants in order to propagate the effects of observing in a natural environment. It also allows for flexibility in interpreting the events as they occur, taking into account the complexity and variation associated with the patient journey. Yet, these observations were time consuming and difficult to coordinate due to scheduling. Potential participant bias from awareness of being observed resulting in atypical behaviour is a common limitation in observational data collection (Bowling & Ebrahim, 2005, Harvey-Jordan & Long, 2001). However, Cooper & Schindler (2003) find that participants are less likely to exhibit behaviour bias in observation compared to questioning. This suggests that incorporating observations within the methodology of the study strengthens reliability.

Section 4.1.3. Research Ethics Board Approval

Consent for this research project (REB # 13-001), was obtained through the UOIT Research Ethics Board (Appendix. I) and the CMCC Research Ethics Board (Appendix II), access to Clinic authorization from CMCC's Clinical Education unit, and UOIT Course-Based Research Approval. All participants of the interviews and focus groups provided signed consent to data collection. Participation in this research was entirely voluntary with no risk to participants and the participants were able to withdraw from the study at any time. Staff roles were a potential identifier in the completed process models. Due to the size of the departments at CMCC, and the number of participants corresponding to each staff role, confidentiality was not possible.

Participants were advised that data would not be confidential due to roles being potential identifiers. This was also stated explicitly in the consent forms which were signed before the interviews were conducted. To maintain anonymity, numbered identifiers were used for observational data rather than individual names. *Case Study #1: CMCC Campus Clinic* incorporated anonymous contribution using post-it notes as described in detail in section 4.3.3. The focus of this research was on the process of care rather than specific patient health data; patient consent was not required. Patients were involved as subjects during patient observations and the access to clinic authorization from CMCC's Clinical Education Department included access to patient populations, clinic facilities, staff, faculty, and health record information.

Section 4.2. Justification of Modeling Tools

In order to construct these process models, there was a need to understand the elements of the process flow as well as the interdependencies and decisions related to the process elements. To verify and validate the models, multiple perspectives needed to be accounted for. This is especially true considering the multiple internal and external roles involved in each examined process.

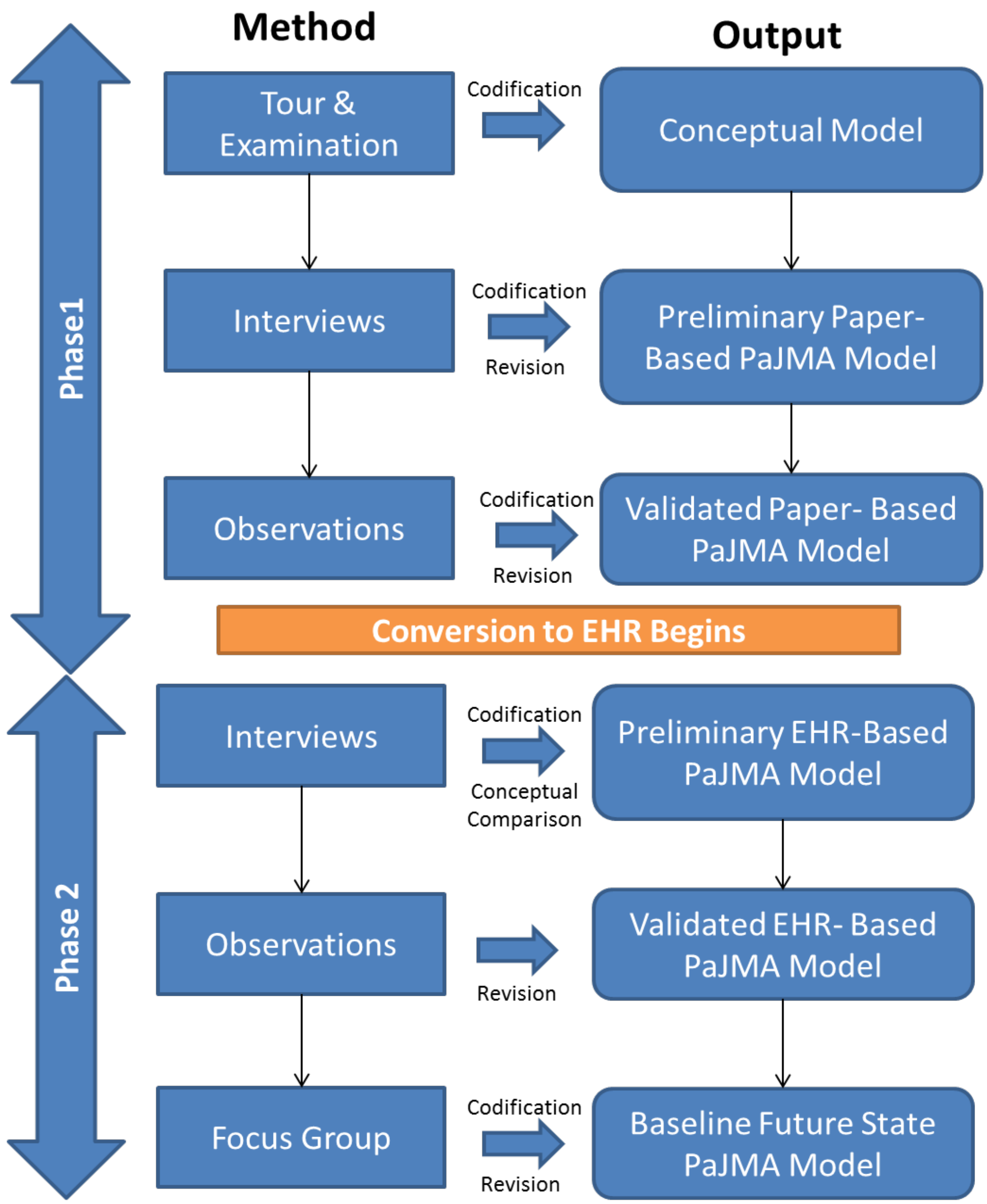
In each case study, mapping and analysis were used to examine a targeted process. PaJMA (*Case Studies #1 & #2*) and BPMN (*Case Study #2*) were used to map clinical processes, whereas CCPIM (*Case Study #3*) was used to map administrative processes. CCPIM and PaJMA were chosen given their similarity in design; their use shows a continuity of methodology among the presented case studies involving different departments. In addition to similar design, these tools are both user-centric, with metric layers demonstrating patient or customer movement, and patient or customer needs. Therefore, PaJMA and CCPIM were appropriate in considering the patient or customer oriented processes examined in each case study. CCPIM and PaJMA addressed the thesis research question through measures of compliance, quality control, communication and information flow, and flexibility. These measures were addressed due to the tools' inclusion of color code and explicit metric layers demonstrating: *internal/external roles*, *information flow, technological infrastructure, policy/guidelines*, and *time*. BPMN was selected as a comparable technique of process modeling as part of (*Case Study #2*). The use of BPMN as a comparable technique addressed the thesis research question by accounting for model construct, representation of metrics and capacity to integrate technology.

Section 4.3. Case Study #1: CMCC Campus Clinic

The remaining sections of this chapter address methodology and data collection for individual case studies. This section describes the research methodology used to create the current and future state process maps, pre- and post- EHR implementation at CMCC's main campus clinic. The process maps were used as a basis to create dynamic simulations. The development of the simulation is discussed in Chapter five (Section 5.1.).

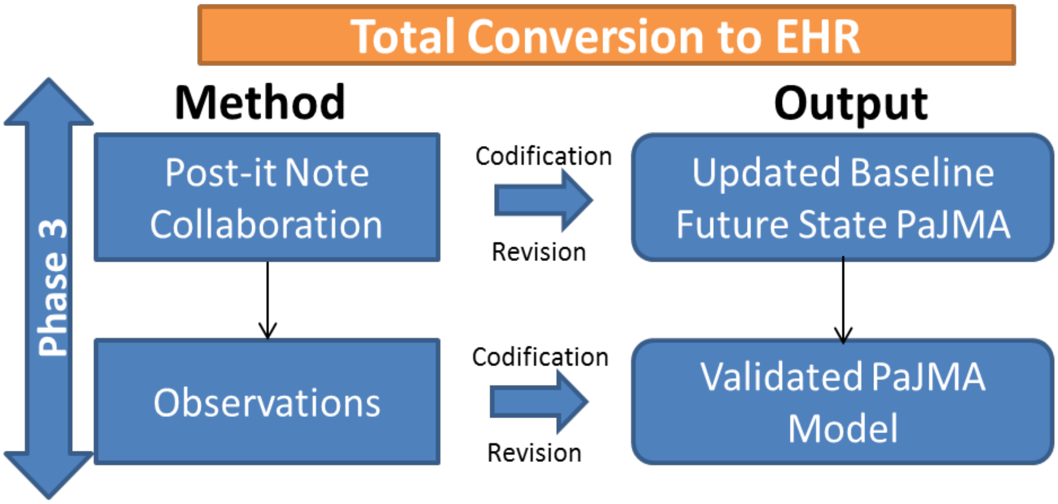
The case methods begin by outlining the construction and initial validation of current state paper-based (Phase 1) and EHR-based models (Phase 2) with the corresponding methods and outputs represented by Figure 17. Figure 18 illustrates data collection and research outputs involved in re-examination and validation of the future state after total conversion to EHR, further described in Phase 3 of this case study.

Figure 17.Overview of Methodology: Case Study 1, Phase 1-2.



(Case Study 1 CMCC Campus Clinic, Phase 1 Current State- Paper Records, Phase 2 Initial Validation of Current State- EHR & Future State Baseline)

Figure 18. Overview of Methodology: Case Study 1, Phase 3



Case Study #1: CMCC Campus Clinic. Phase 3 Post-Total Conversion, Revisiting Future State Baseline with Collaboration and Observations)

Section 4.3.1. Phase 1: Current State- Paper Records

The data collection procedure for this case study began with a facilitated tour of the CMCC Clinic. About 1.5 hours was spent creating observational field notes to document the clinic and reception layout to understand the physical environment of the process. Observation notes were also taken related to the information storage capacities and clinical documents associated with the careflow process such as intake and assessment forms that were examined documenting the physical environment, and information storage capacities provided context for creating the patient journey models in later stages of the study. Additionally, clinical guidelines and standard practice documentation that were available to clinicians and interns studied based on purpose of the documentation, which specific roles, including the patient, had access to the documents, storage protocols, and whether the document was endorsed or updated by any roles. The documents were also used as references in following interview stages.

The data collected from the field notes were open coded and applied to form the conceptual representation of a patient journey at CMCC. This conceptual representation was translated using PaJMA based on use of paper records

Semi-structured interviews (Appendix III. *Interview Guide*) were conducted using convenience sampling with 1 receptionist, 1 clinician and 2 interns. The interview questions were focused on the perceived contribution of the staff member's individual role to the patient journey process flow. The collected documents and conceptual representation were used as a device to help interviewees explain the contribution of documents and policies related to the patient journey process. This resulted in a total of 5 interviews. A diverse group of interviewees was selected to include representation from each role. The diversity offers inclusive perspectives from multiple roles involved in the same patient journey process. The data collected from the interviews was coded based on properties of process flow, PaJMA metrics including roles involved, information flow, technology, protocols and clinical guidelines, patient needs, estimated time and compared with the previously created conceptual PaJMA representations as described earlier in this case study. The findings from the comparison were applied to create modified versions of the two existing PaJMA models. Next, a minimum of 10 observation hours over a span of 7 days were spent examining the patient journey. Time metric in minutes were recorded for 5 unique patients selected by convenience sampling. The observed time values were incorporated into the time metric layer of the preliminary model, resulting in the creation of a modified version of the paper-based PaJMA model.

Section 4.3.2 Phase 2: Initial Validation of Current State- EHR & Future State Baseline

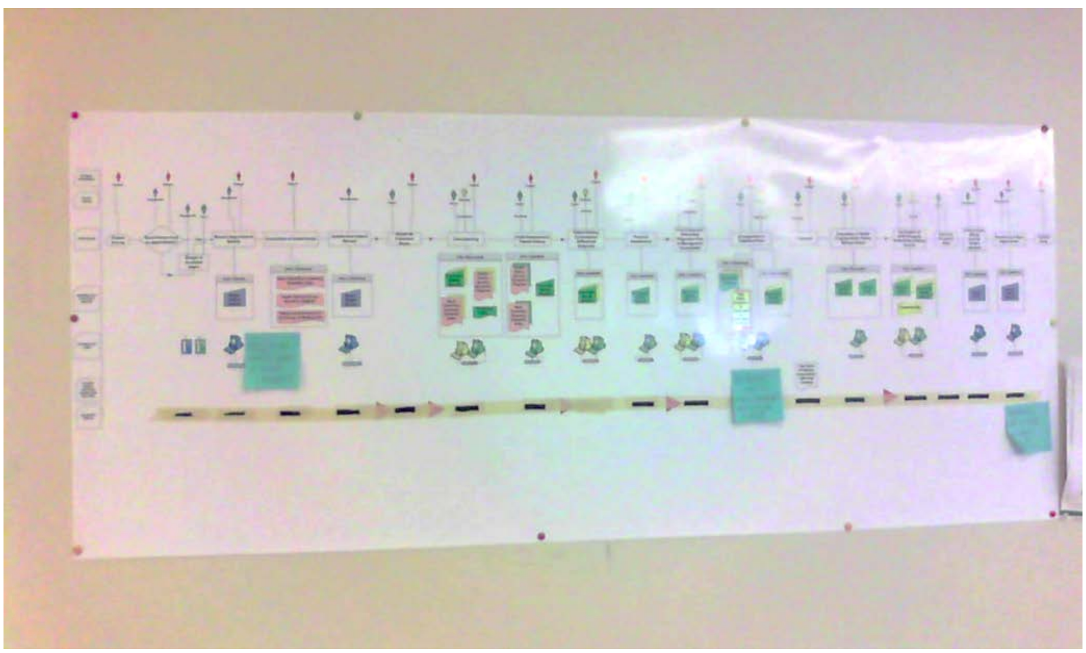
Following the transition from paper records to EHR adoption, the research methods as described in Section 4.3.1 were repeated in their entirety to demonstrate patient journey maps outlining usage of the new technology. However, considering a tour and examination to provide an overview of the process and information storage had already been conducted when creating the paper-based mode, Phase 2 research began with semi-structured interviews. A different group of participants at the same Campus Clinic were interviewed (Appendix III. *Interview Guide*), consisting of 1 receptionist, 1 clinician and 2 interns. These participants were selected given the requirement of having used the EHR in practice. This is especially important considering CMCC had phased conversion therefore not all roles had used the EHR at this point, narrowing the exclusion criteria for participation. The interview results were coded using a similar approach as the interviews conducted to create the paper-based models in section 4.3.1 (Phase 1). The codes were focused on properties of process flow, and PaJMA metrics including roles involved, information flow, technology, protocols and clinical guidelines, patient needs, estimated time. The codes were linked to form descriptions of process flow and compared to the conceptual model created in Phase 1 to support accuracy, and then applied to create an EHR-based PaJMA model. A minimum of 10 observation hours over a span of 7 days were spent examining the patient journey. Time metric units in minutes were recorded for 5 unique new patients, selected by convenience sampling and the previously stated inclusion requirement of EHR usage. These patients were new to the clinic as well as new patients to this study. The selected hours and timeline of this phase was similar to Phase 2 to reflect methodological consistency.

Both process models were presented in a single focus group setting consisting of 2 interns, 4 clinicians, and 2 Administrative staff. The focus group participants were preselected by clinic management. Models were verified through comparison against preliminary models, validated by focus group responses and analyzed for consistent themes amongst process models. Process analysis was applied to evaluate areas of inconsistencies, redundancies and bottlenecks. Upon presentation of the EHR-based PaJMA model, the focus group participants suggested estimated time metric goals to act as a reference for process improvement. These time metrics were added to the existing EHR PaJMA model to create a future state map.

Section 4.3.3. Phase 3: Post-Total Conversion: Revisiting Future State Baseline with Collaboration and Observations

Following a complete transition to electronic records, the future state model from Phase 2 was enlarged, printed, and posted in the campus clinic common area. The display was an invitation for staff, faculty and students to verify and validate that the PaJMA model reflected the new current state patient journey, post-complete adoption of the EHR. A supply of post-it notes accompanied the invitation. The post-it notes were color coded based on staff role. All clinicians, interns and administrative staff were invited to participate in validating the model by recording changes or updates on the color coded post-it notes and directly onto the displayed model. This approach aimed to empower staff and faculty, and encourage hands-on participation to understand individual roles and process elements in context of the process flow. The approach also intended to promote process ownership and a bottom-up approach to change management. The PaJMA model was displayed in the common clinical area for two weeks as shown by Figure 19. This length of time was chosen to allow adequate response time before the clinic semester had finished. Although reminder emails could have been sent in an effort to produce greater responses, the outcome was considered successful as the color coded post-it notes suggested that all staff roles had had been represented. The resulting data were theoretically coded, as described in Section 4.1.1, to find linkages between concepts and develop formation of overarching themes.

Figure 19. Example of displayed PaJMA model



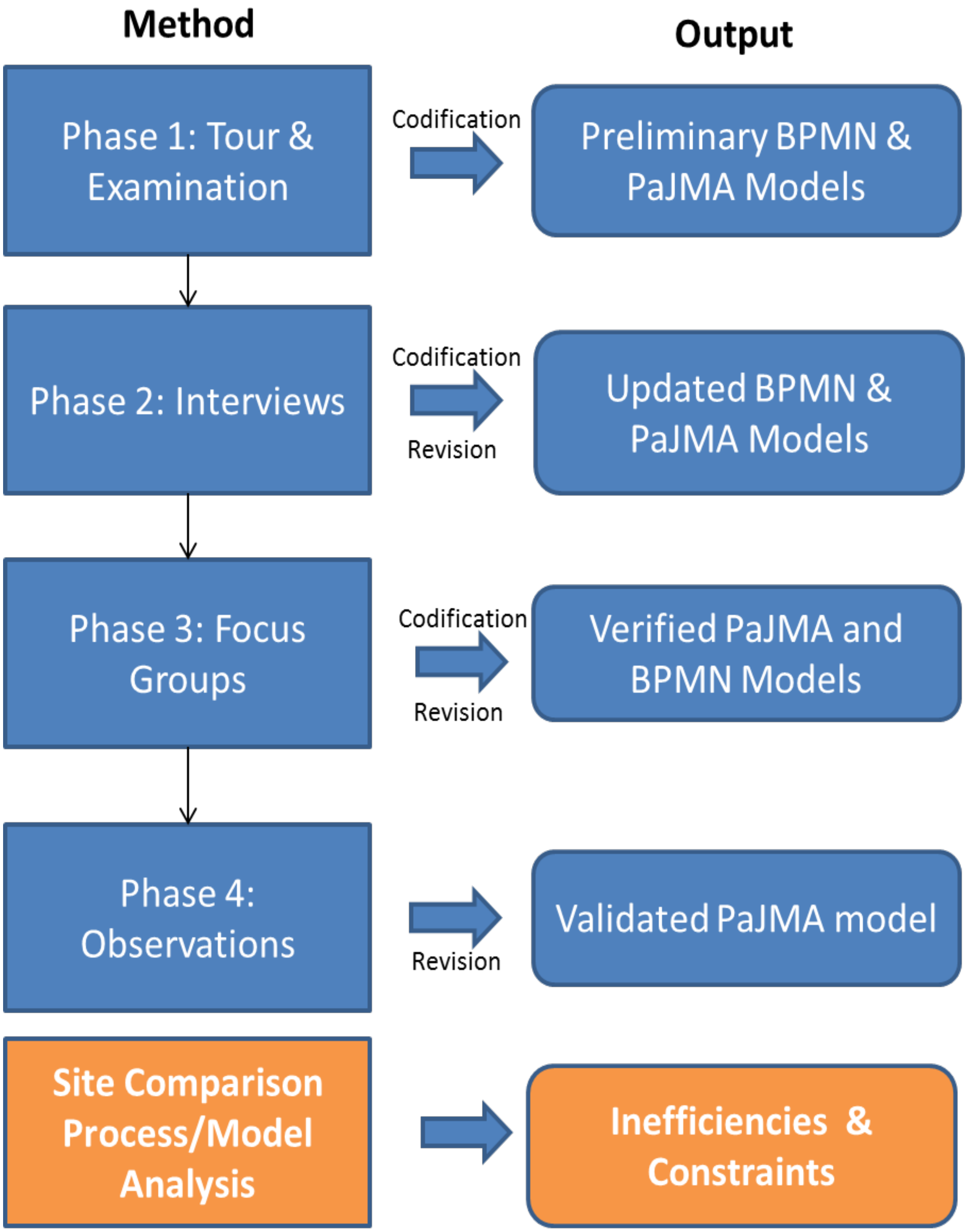
The codes were analyzed to reflect categories of suggestions based on improvement of process flow, suggestions directly related to sequence actions including roles involved, and suggestions involving data or information elements. All contributions were taken into account for codification. The data were translated and compared with the existing model, resulting in modifications of process flow.

To validate the modified process map, additional patient observations were conducted. Similar to *Case Study #1: CMCC Campus Clinic*, Phase 1 & Phase 2, convenience sampling was used in order to show a representative sample while balancing the study timeline with clinical scheduling. The advantages and disadvantages of this type of sampling are noted in Section 4.1 of this chapter. Five different clinical pod groups were included in this study to ensure a diversified range of population sample representation. A total of 20 hours were spent observing new patients and patients requiring case re-evaluations over a span of 14 days. Fifteen unique cases were identified consisting of 6 new patients and 8 re-evaluations. Time metrics in minutes were documented for each step in the process. The time metrics were added to the time metric layer of the process map. At this stage although time metrics were established, the validation did not result in significant changes to the process model, therefore the model was considered saturated and complete. The completed process model was used as a basis to develop a dynamic simulation model. The challenges of transitioning from the static process model to dynamic simulation model are described in Chapter 5 (Section 5.1).

Section 4.4. Case Study #2: Process Modeling & Clinic Site Comparison

This case study aims to provide a comparison between CMCC's main campus and external clinical site. The data collection phases for this case are detailed in the following section. The methods and outputs associated with each phase are shown graphically in Figure 20.

Figure 20. Overview of Methodology: Case Study 2, Phase 1-4



Case Study #2: Process Modeling & Clinic Site Comparison

Section 4.4.1. Phase 1: Baseline Model

Similar to the facilitated tour conducted in *Case Study #1:CMCC Campus Clinic*, the data collection process began with a facilitated tour of the clinic and reception area to establish process context and physical environment. Field notes, relevant to the patient journey, were recorded based on various types of information storage and data collection methods used at the clinic. Additionally, special attention was paid to any relevant documentation used to outline protocols and guidelines, such as confidentiality agreements. The field notes were coded based on relevance to process properties including process flow, roles involved, information created or updated, specified contributing documents, technology used, clinical guidelines and policies, and patient needs. The developed code and linking concepts were compared with the conceptual EHR-based patient journey model from Section 4.3.1.This method of using a baseline model was appropriate given the theoretical assumption that the patient journey model at the clinic is similar to the main campus clinic. The comparison was translated into process models with two distinct representations of a single patient journey using PaJMA and BPMN modeling methods. The two models were constructed using Microsoft Visio 2010 software. The two patient journey models were used as an instrument to reference the process during the interviews conducted in the subsequent data collection stages.

Section 4.4.2. Phase 2: Interviews

Semi-structured interviews with a predetermined interview guide (Appendix III. *Interview Guide*) were arranged with 4 interns, 1 clinician, and 1 receptionist. The interview guide used open-ended questions based on the procedures and perspectives associated with the patient journey to verify the existing process representations. The PaJMA and BPMN models were shown to participants for reference during questioning. These interviews were digitally recorded and transcribed verbatim. The transcript was coded for apparent distinctions of process attributes suggested by the participants, and compared with the existing PaJMA and BPMN models to determine modifications to process flow including role contribution, clinical guidelines and policy, information flow and documentation, technology, and patient needs.

Section 4.4.3. Phase 3: Focus Group

In order to verify the new patient journey models, a single focus group was held with 9 interns, 1 clinician and 1 receptionist. This participant group included the participants of the semi-structured interviews of Section 4.4.2. However, it was recognized that using a different group of participants could have provided a greater sample representation. Due to the size of the external clinic, limited staff availability, incorporating additional participant groups was not feasible for this case study. During this meeting, the process models were presented and collaboratively examined. The participants offered their opinions and identified areas of improvement to the model construct. The participants also verified process steps and attributes. Open dialogue and post-it notes were applied to a projected version of the process maps. Similar to the post-it note collaboration technique mentioned in Section 4.3.3, the post-it notes were color coded based on role and the hands-on aspect of engaging all staff gave them a sense of ownership and empowerment (Joshi, 2013). The results were analyzed based on linking emerging concepts of process improvement and technological integration.

The verification method yielded no significant changes in process flow; therefore the models were considered finalized and ready to validate.

Section 4.4.4. Phase 4: Observations

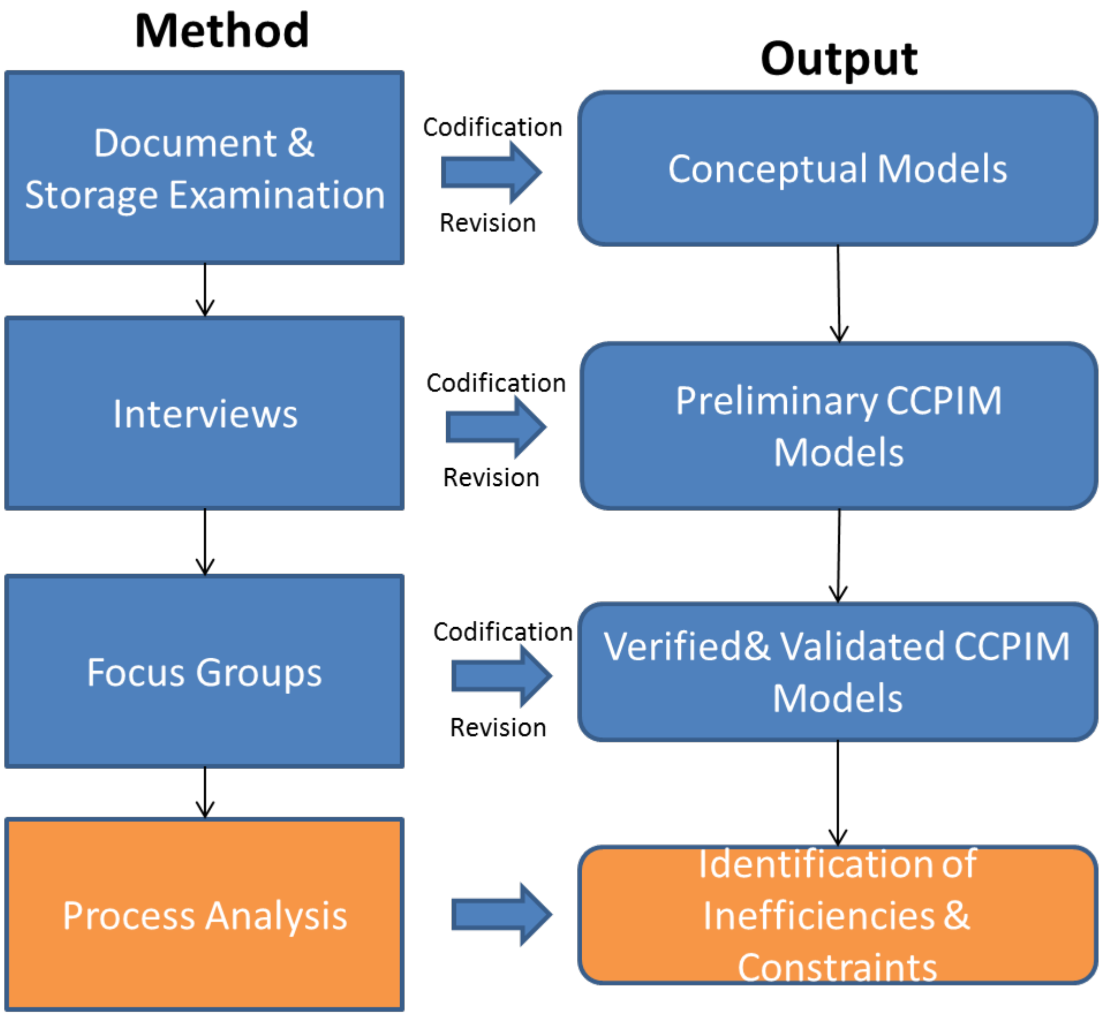
Following process verification through focus group, direct patient observations were arranged. The observations included examination of the entire patient journey as the time spent on each process step based on the constructed PaJMA model was recorded in minutes. Similar to the observations in Section 4.3.1, these cases were selected based on convenience sampling including two different clinical pod groups. Since this study was conducted at CMCC's external clinic site, these clinic pod groups were part of the external clinic site. Two clinical groups were selected with consideration of the smaller physical size and number of clinical groups compared to the main campus clinic examined in the first case study. The observations included seven unique cases of which three were new patients and four were re-evaluation cases totalling ten observation hours. This number of observational hours was chosen as a balance between the study timeline, clinic scheduling and obtaining a representative sample of cases. The advantages and disadvantages of convenience sampling are discussed in the first section of this chapter. The obtained time values were used to update the time metric layer of the existing PaJMA models, resulting in the validated EHR-based PaJMA model.

The resultant PaJMA and BPMN process models were each selectively coded based on characteristics of model construct, representation of metrics, and applicability in integrating technological components. Coding results were analyzed to identify emergent themes and assessed against the two types of models to formulate comparative assumptions. The PaJMA model resulting from this case was compared to the PaJMA model developed in the first case study. The models were examined using process analysis concentrated on comparatively evaluating process flow and metric layers, and identifying inconsistencies and redundancies.

Section 4.5. Case Study #3: Integrating Technology Across the Organization - Administrative Units

This final case study examines the processes of the administrative units within CMCC. The data collection phases outlined in the following section outline the methods employed while investigating processes in the Human Resources department. Figure 21 represents the methods and outputs of each research phase.

Figure 21. Overview of Methodology: Case Study 3



Case Study 3: Integrating Technology Across the Organization

Section 4.5.1. Phase 1: Document & Storage Examination

This case focuses on the Human Resources, Information Technology Services and Accounting and Finance administrative units at CMCC. Two undergraduate capstone teams representing the Faculty of Business and Information Technology conducted data collection and model development in the Accounting and Finance and Information Technology Services departments while the primary researcher conducted research methods within the Human Resources Department. Distributing data collection and modeling enabled greater applicability and representation of findings, and overcame time constraints of the project. Given the similar methodology applied to investigation in these units, an explanation of methods is provided in the following section by detailing the research conducted in Human Resources department.

Given the smaller size of the department's physical space, fewer numbers of employees, and readily available documentation of standards and procedures directly related to targeted processes in comparison to the clinical departments of Case Study #1 and Case Study #2, this study began with an examination of documents rather than a facilitated tour. Existing procedural documentation and policies relating to each of the targeted processes were reviewed, specifically focusing on methods of executing tasks, mention of departmental policy and guidelines, expectations and contributions of internal and external roles, and information capacities and documents. The findings were coded based on the specified focuses and translated to form conceptual representations of each targeted process using Microsoft Visio 2010 software.

Section 4.5.2. Phase 2: Interviews

Three semi-structured interviews using an interview guide (Appendix III. *Interview Guide*) were conducted with 3 administrative staff. These participants were chosen for interview due to their primary contribution to or ownership of the targeted processes determined by their given role responsibilities. Each interview lasted 30-45 minutes, and were digitally recorded and transcribed verbatim. The data collected from the interviews were coded based on emergent themes related to process improvement. Data were also coded based on properties of process flow including roles involved, information flow, technology, protocols and clinical guidelines, patient needs, and estimated time. The coded data from these interviews were combined with conceptual representation to construct preliminary process models using the Customer-centric Process Improvement Methodology (CCPIM) and Microsoft Visio 2010 software.

Section 4.5.3. Phase 3: Focus Groups

The process models were presented in 11 focus groups sessions consisting of 2-4 participants of the HR department. The entire HR department is small and consisted of only five individuals. Of these 11 sessions, 7 sessions were held to examine the Hiring and Recruiting Process and 4 sessions to examine Payroll and Benefits. Each participant was selected based on direct involvement in the targeted process. Process models were enlarged and posted on a wall in the meeting rooms during the focus groups. During the focus group sessions, participants were encouraged to apply Post-it notes directly onto the projected models for collaborative approach to data collection and contributor empowerment. This method was similar to data collection in the previously mentioned clinical case studies (Refer to Section 4.3.2 & Section 4.4.3). The focus group meetings resulted in lists of revisions to be used in updating versions of the process models. Conducting multiple focus group meetings producing accompanying refinements was a research method selected to advance and strengthen model validation. Additionally, estimated time metrics for each subprocess were established based on participant consensus during focus groups for the Hiring and Recruiting processes. Non-value added time was considered to be in the form of process delays resulting from handover or time spent on a task which does not directly provide value to the customer. This non-value added time was also identified by consensus of focus group participants, established during the final focus group meeting for the Payroll, Benefits and Hiring and Recruiting models. Although the use of direct observations, similar the methods used in *Case Study #1: CMCC Campus Clinic*, Phase #1 & #2 and *Case Study #2: Process Modeling & Clinic Site Comparison*, Phase #3, would have yielded more accurate time metrics, participant consensus was obtained during final focus group sessions to determine time estimations. This uses of participant consensus overcame the constraints of the study timeline and limited tangible instances of the processes being studied. The finalized models were examined using process analysis identify areas of constraints, inconsistencies and redundancies. Underlying challenges to process improvement were determined based on quality control, flexibility, technological integration and change management.

Table 2 presents a summary of data collection methods for Case Study 1. Table 3 summarizes data collection methods for Case Study 2, and Table 4 summarizes data collection methods for Case Study 3.

Table 2. Summary of Data Collection Methods (Case Study 1)

Case Study	Location	Data Collection Methods	Result
Case Study #1: CMCC Main Campus Clinic Phase 1 Current State- Paper Records (*section 4.3.1*)	Main Campus Clinic	Preliminary observational field notes • Duration: 1.5 hours	Conceptual model
Case Study #1: CMCC Main Campus Clinic Phase 1 Current State- Paper Records (*section 4.3.1*)	Main Campus Clinic	Semi-structured Interviews • 4 Interviews • 4 Participants • Duration: 30-45 minutes per interview	Preliminary Paper-Based PaJMA model
Case Study #1: CMCC Main Campus Clinic Phase 1 Current State- Paper Records (*section 4.3.1*)	Main Campus Clinic	Observations • 5 Unique New Patient Journeys • Duration: Minimum 5 observation hours over a span of 7 days	Validated Paper-Based PaJMA model
Case Study #1: CMCC Main Campus Clinic Phase 2 Initial Validation of Current State- EHR & Future State Baseline (*section 4.3.2*)	Main Campus Clinic	Semi structured Interviews • 4 Interviews • 4 Participants • Duration: 30-45 minutes per interview	Preliminary EHR-Based PaJMA Model
Case Study #1: CMCC Main Campus Clinic Phase 2 Initial Validation of Current State- EHR & Future State (*section 4.3.2*)	Main Campus Clinic	Observations • 5 Unique patient journeys, including new patients and re-evaluations • Duration: Minimum 5 observation hours over a span of 7 days	Validated EHR-Based PaJMA Model
Case Study #1: CMCC Main Campus Clinic Phase 2 Initial Validation of Current State- EHR & Future State (*section 4.3.2*)	Main Campus Clinic	Focus Group • 1 Focus Group • 8 Participants • Duration: 60 minutes	Baseline Future State PaJMA model
Case Study #1: CMCC Main Campus Clinic Phase 3: Post-Total Conversion: Revisiting Future State Baseline with Collaborations and Observations (*section 4.3.3*)	Main Campus Clinic	Post-it Note Collaboration • Invited participation from all internal roles that were directly involved in the Patient Journey (interns, clinicians, receptionist) • Duration: Displayed for 2 weeks	Updated Baseline, Future State PaJMA Model
Case Study #1: CMCC Main Campus Clinic Phase 3: Post-Total Conversion: Revisiting Future State Baseline with Collaborations and Observations (*section 4.3.3*)	Main Campus Clinic	Observations • 15 Unique patient journeys, including new patients and re-evaluations • Duration: Minimum of 15 hours over a span of 14 days	Validated PaJMA Model

Table 3. Summary of Data Collection Methods (Case Study 3)

Case Study	Location	Data Collection Methods	Results
Case Study #2: Process Modeling & Clinic Site Comparison **Phase 1: Baseline Model** ***(section 4.4.1)***	External Clinic	Preliminary Observational Field Notes • Duration: 1 hour	Preliminary BPMN & PaJMA Models
Case Study #2: Process Modeling & Clinic Site Comparison **Phase 2: Interviews** ***(section 4.4.2)***	External Clinic	Semi-Structured Interviews • 6 Interviews • 6 Participants • Duration: 30-45 minutes per interview	Updated BPMN & PaJMA Models
Case Study #2: Process Modeling & Clinic Site Comparison **Phase 3: Focus Group** ***(section 4.4.3)***	External Clinic	Focus Group • 1 Focus Group • 11 participants • Duration: 45-60 minutes	Verified PaJMA & BPMN Models
Case Study #2: Process Modeling & Clinic Site Comparison **Phase 4: Observations** ***(section 4.4.4)***	External Clinic	Observations • 7 Unique patient journeys, including new patients and re-evaluations • Duration: 10 hours	Validated PaJMA Models

Table 4. Summary of Data Collection Methods (Case Study 3)

Case Study	Location	Data Collection Methods	Results
Case Study #3: Integrating Technology Across the Organization - Administrative Units **Phase 1: Document & Storage Examination** ***(section 4.5.1)***	Human Resources Department	Preliminary observational field notes • Document & storage examination • Duration: 3.5 hours	Conceptual models
Case Study #3: Integrating Technology Across the Organization - Administrative Units **Phase 2: Interviews** ***(section 4.5.2)***	Human Resources Department	Semi-structured Interviews • 3 Interviews • 3 Participants • Duration: 30-45 minutes per interview	Preliminary CCPIM Models
Case Study #3: Integrating Technology Across the Organization - Administrative Units **Phase 3: Focus Groups** ***(section 4.5.3)***	Human Resources Department	Focus Groups • 11 Focus Groups • 2-4 Participants • Duration: 11 hours	Verified & Validation

Chapter 5. Case Results & Recommendations

This chapter presents the results of the individual case studies within this thesis. Each subsection focuses on the results and recommendations for that specific case study only. The first section outlines *Case Study #1: CMCC Campus Clinic*, focused on process modeling and analysis at the CMCC central clinic site location. The next section describes results of *Case Study #2: Process Modeling & Clinic Site Comparison* with a comparison between the CMCC external clinic (Sherbourne Clinic) and CMCC central Campus Clinic (*Case Study #1: CMCC Campus Clinic*). A comparison between process modeling tools PaJMA and BPMN are also discussed. The final section outlines the results of *Case Study #3: Integrating Technology across the Organization*, focusing specifically on the Human Resources Department at CMCC.

Section 5.1. *Case Study #1: CMCC Campus Clinic*

This section presents the main findings of process modeling the patient journey at CMCC Campus clinic pre- and post- adoption of a new EHR system. This section will also present the development and challenges of creating a dynamic simulation model from a static process model.

Section 5.1.1. Process Modeling & Analysis

The case study results demonstrated that process modeling using PaJMA supports the integration of new information technologies. In this case, process modeling, specifically PaJMA, proved to support health information management quality improvement, and efficiency. The models were created with extensive iterative validation to ensure accuracy. Models were validated using a bottom-up approach to establish buy-in by including participants at all levels of the organization. In the focus groups, validating the process models generated discussion between interdisciplinary participants which allowed for clarity of the process from a holistic systems perspective. The PaJMA process models enabled Lean-focused assessment of current and future states. The analyses served as a means to measure and manage processes, and monitor process change outcomes for continuous improvement.

After analyzing the PaJMA models, it was evident that implementing the EHR allowed for a centralized database. The database integrated data from multiple sources, and captured the data in real time measurements, which could be used for further decision making and research. In contrast, the current state paper-based information system demonstrated inefficiencies and redundancies of information management. It was imperative to address this outcome, as the redundancy and poor information management practices confirm a potential for medical errors or inaccuracies which could potentially affect patient safety. The final models provided a medium of analysis of the specific units of information involved in each subprocess. With this explicit account and granularity, we were able to determine which specific documents remained in paper form although the electronic system had been established, thus creating another outcome measure for the project.

By using color-code for each information element and staff role in the PaJMA visual representation, we were able to visually interpret how the information is being transmitted between stakeholders, and which roles have access to what specific items of information. This outlines responsibility and accountability of each staff role in terms of collecting the information and disseminating the data during each subprocess. It was found that the PaJMA methodology is increasingly applicable in interdisciplinary team settings. The generated PaJMA models demonstrated the significance of communication during specific subprocesses such as the clinician's verification and authorization of documents which are to be compiled by the intern at CMCC.

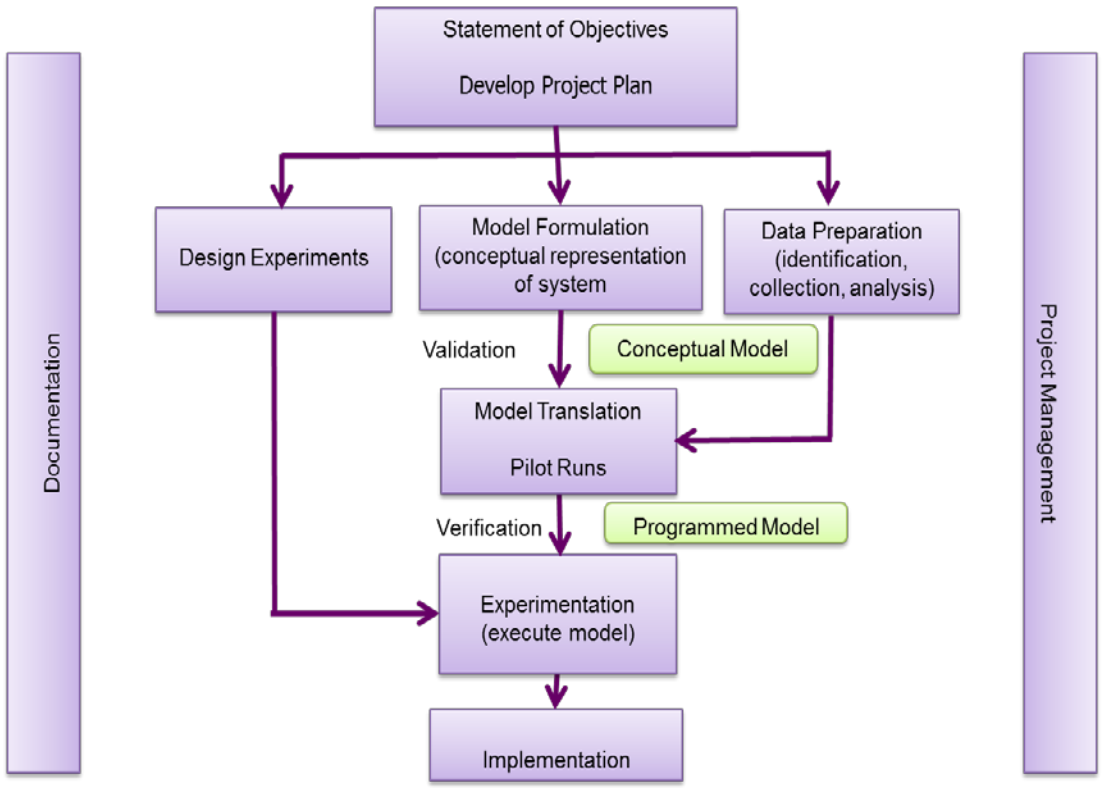
Section 5.1.2. Development of Simulation Model

The remainder of this case study reflects the challenges during the transition of a static patient journey process models to a dynamic simulation queuing model demonstrated in a software-based simulation. Computer simulation of the patient care process is aimed at explicitly quantifying the relationships of the process variables and allowing for extrapolation of performance measures.

The data quality and developmental challenges of this transition explored to enable better planning for the integration of simulation in future process modeling and improvement projects where there is potential for significant value added outcomes through the use of simulations for complex analysis.

Comprehensive PaJMA process models included time metric data to describe the patient care process at the CMCC central site. These were produced in Phase 2 of the research, prior to simulation efforts. As described in Chapter 4, data were collected by means of verification and validation of the patient care process using patient observations, and comparison of time measures against EHR timestamped logs. The verified time measures were reflected in the time metric layer of the final PaJMA models. The resultant PaJMA process models helped to illustrate logical flow and relationships among process elements, key steps of the simulation development process. By creating these static process models we were able to gain an understanding of the process flow, objectives, inputs, outputs and the integration of these elements as a holistic system. This collective understanding served as basic foundation for the conceptual model as described in Figure 22 of the framework used for creating a computer simulated process model.

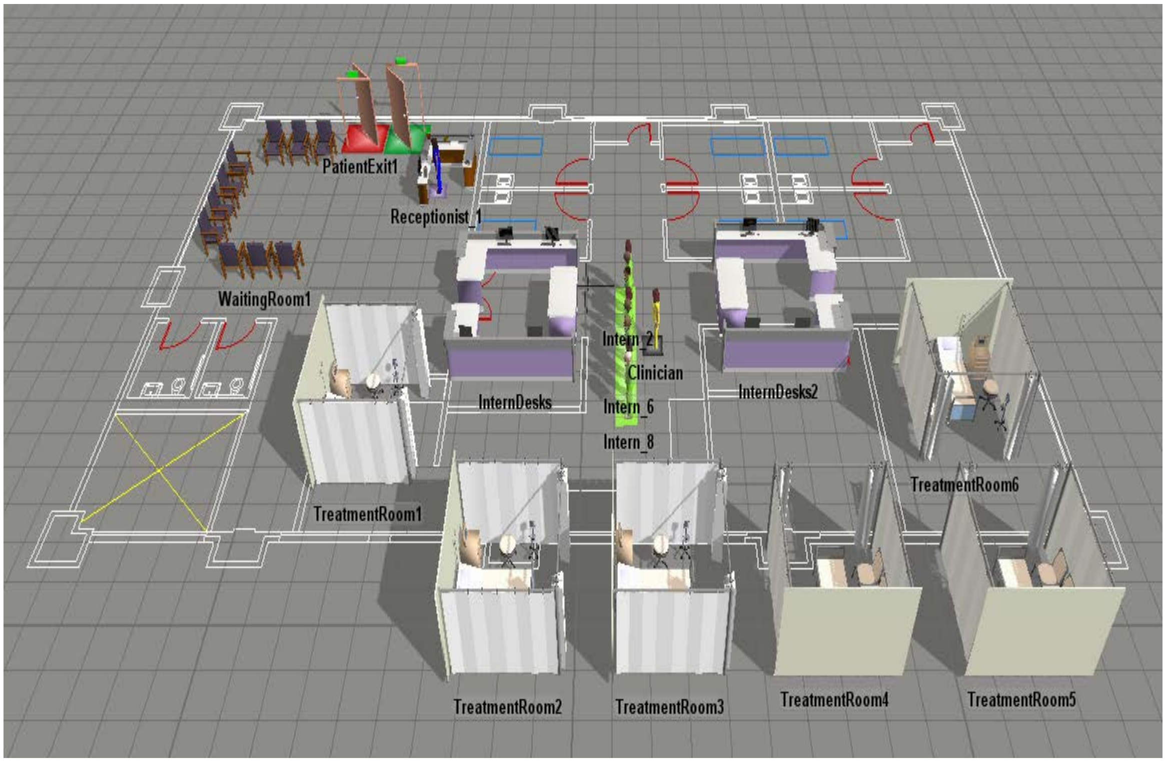
Figure 22. Simulation Model Development Framework.



Beaverstock, M., Greenwood, A., Lavery, E., & Nordgren, W. (2011). *Applied simulation* (1st ed.). Orem, Utah.: FlexSim Software Products.

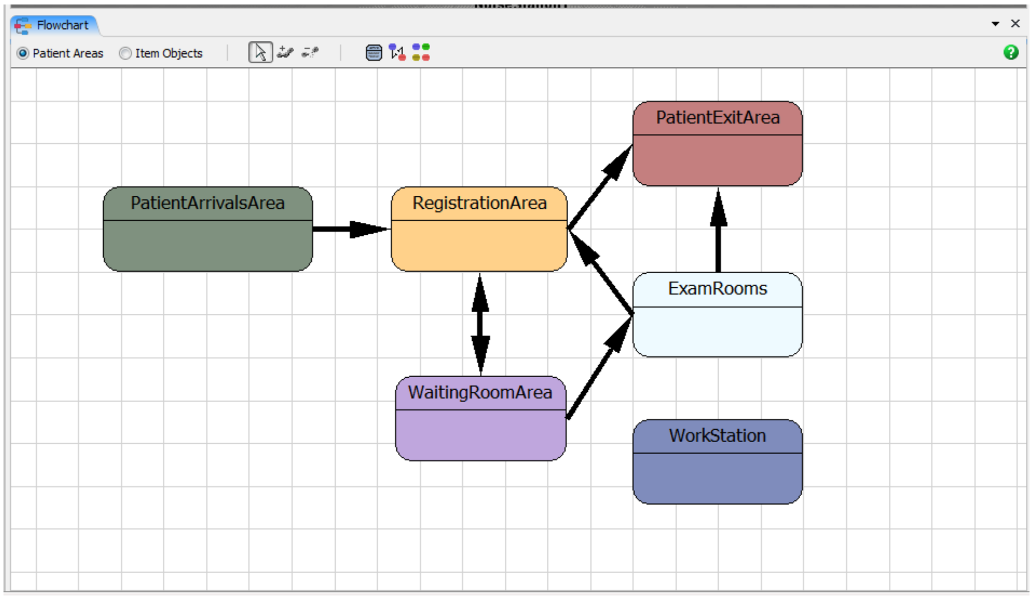
Process flow within the PaJMA models identified physical entities involved in processing and treating patients, logical sequences of events. Decision points branched to determine varying process flow routes. To construct the simulations a simple floor plan including these physical entities was created using the objects provided within the Flexsim software. The floor plan was not an identical replication of the CMCC campus clinic. However, the floorplan and simulated physical environment showed the main areas of the clinic, such as treatment area and waiting area. The layout of the floorplan is an important addition to the PaJMA model as it allows for the integration of non-value added transition time of clinicians and patients as they move between treatment rooms. The physical entities included: reception, intern pods, treatment area. Figure 23 shows an example of an approximated general clinic floorplan using Flexsim simulation software. The inherent flexible granularity of the PaJMA methodology led to simple identification of which physical areas were required to create a simulated floor plan reflective of the CMCC main campus clinic. The floorplan was customized with features such as change of color to the walls, desks, beds and fixtures. These visual elements are critical in gaining clinician and administrator buy-in of the resulting analysis as they can more easily identify the simulated space as representing their work environment (Donnelly & Kirk, 2015). The software provided the option of scaling the floor plan to reflect the distances between physical spaces within the clinic by importing CAD architectural drawings. However, this thesis research did not include a custom scaled floor plan as the data from the PaJMA models did not capture actual architectural distance between the reception area, intern pods and treatment rooms. The general layout of the CMCC clinic was approximated and reflected in these floor plans; there is opportunity for greater accuracy. In future research, accounting for physical distance between physical spaces may affect the simulation results and performance data.

Figure 23. Example of an approximated clinic floorplan created using Flexsim software



Once the floor plan had been created, logical sequences of patient movement between the locations were specified by arrowed connections, using the Flexsim Flowchart tool. Figure 24 shows an example of the flowchart tool. The PaJMA model was based on a patient-centric view of the process and included an explicit patient movement metric layer. This feature of the PaJMA methodology allowed for simple translation of patient movement to the Flexsim flowchart tool.

Figure 24. Example of flowchart tool outlining logical process flow of patient journey.



Resources were added to the simulation based on the field notes and PaJMA models. The resources can be seen in Figure 23. We added resources to the simulation model based on the assumption that CMCC main campus clinic had 8-9 interns supervised by one clinician. This was determined during the data collection phase by field notes and patient observations. The PaJMA models did not explicitly represent the total number of resources at the clinic; however, it did demonstrate the number of resources involved in a single patient journey. Eight interns, one receptionist, and one clinician were chosen as resource objects when building the simulation, as we aimed to create a general representation of average staff resources at this stage. Once the resource objects had been added, they were easily customized by changing the color of the resource group to coordinate with the PaJMA model and maintain consistency between the static and dynamic mediums. Both the Flexsim simulation and the PaJMA model used *green* to represent interns, *yellow* to represent clinicians and *blue* to represent receptionists. Once again, the similarity of colour coding of roles allowed for easier translation of concepts and understanding as clinicians moved from considering the PaJMA model to the simulation.

After creating staff resources, the Flexsim Patient Track tool was used to input patient centred process activities and their respective times in measures of minutes. The Flexsim Patient Track tool corresponded with patient location during the patient journey. Patient location information was extrapolated from the PaJMA model by identifying and grouping together subprocesses where the patient remained in a single location, such as a treatment room or waiting area. Table 5 shows the translation of subprocesses identified in the PaJMA model to the Patient Track.

Table 5. Translation of PaJMA subprocesses to Flexsim Patient Track.

Subprocess identified from PaJMA model	Translation into Patient Tracker	Roles Involved	Delays Included
• **Patient Arrives**	Arrival	• Patient	No
• **Record Appointment Details** • **Completion of Intake Forms** • **Update New Patient Intake Forms** • **Update New Patient Record**	Registration	• Patient • Receptionist	Yes
• **Delay**	Waiting Room	• Patient	Yes
• **Escort to Treatment Room**	Escort to Treatment	• Patient • Intern	No
• **Case Opening** • **Initial Assessment/Patient History** • **Delay** • **Patient History Consultation/Differential Diagnosis** • **Physical Assessment** • **Final Diagnosis/Differential Diagnosis/Plan of Management Consultation** • **Arrangement of Treatment Plans** • **Treatment** • **Completion of SOAP Progress Note/Patient Billing Invoice** • **Verification of SOAP Progress Note/Patient Billing Invoice**	Treatment	• Patient • Intern • Clinician	Yes
• **Escort to Reception Area**	Escort to Reception	• Patient • Intern	No
• **Verify Patient Billing** • **Invoice/ Collect Payment** • **Scheduling of Next Appointment**	Book New Appointment	• Patient • Receptionist	No
• **Patient Exits**	Exit	• Patient	No

The patient's arrival, *Arrival*, was a trigger event, signaling the start of the simulation, with no duration or delay. Recording appointment details, completion of intake forms, updating new patient intake forms, updating new patient records, and the delay experienced by the patient when waiting to be greeted by the intern were classified as *Registration*. The patient traveling unattended from the registration desk to the waiting area was shown as *Waiting Room*. The patients escort to the treatment room, *Escort to treatment*, was a trigger event signaling a location change. The actions taken by the clinician and intern to assess and treat the patient were classified as *Treatment* in the Patient Tracker. These actions included PaJMA subprocesses: Case opening, Initial Assessment/Patient History, Patient History Consultation/Differential Diagnosis, Physical Assessment, Final Diagnosis/Differential Diagnosis/Plan of Management Consultation, Arrangement of Treatment Plans, Treatment, Completion of SOAP Progress Note/Patient Billing Invoice, Verification of SOAP Progress Note/Patient Billing Invoice. Educational and clinical consultations between the intern and clinician, which take place in the intern pod area while the patient remains in the treatment room were classified as Treatment. Escorting the patient to the reception area, *escort to reception*, was a trigger event signaling a location change. Verification of the patient billing invoice, collecting payment and scheduling the next appointment from the PaJMA models were translated to *BookNextAppt* in the patient track. The patient's departure was classified as *Exit*, a trigger event concluding the simulation track.

Once patient centred activities were identified based on location and inputted into the simulation, we specified the type of activity and processing time. Table 6 shows the patient track activity with corresponding activity type and processing time. Activity type was selected from a predetermined drop-down list in the software. The patient's arrival and Exits were classified as milestone events with no duration or delay. *Waiting Room* was classified as activity type involving the patient to travel unattended. The *Escort to Treatment*, and *Escort to Reception* were classified as activity types involving resources escorting the patient. These activities had no processing time. Registration, Treatment and Book Next Appointment, were classified as processes. For these activities, the suggested triangular distribution was selected from a drop-down menu. Triangular distribution was ideal for new patient journey simulation as the distribution generated random numbers, selecting numbers in the middle most frequently (Flexsim Software, 2014). Triangular distribution is applicable to show communication, conceptualization and approximation in simulation models. It is also the ideal distribution pattern for models with known characteristics and bounds (Hoover & Perry, 1990). The PaJMA model included a time metric layer indicating a range in units of minutes for each subprocess. The data from the PaJMA time metric layers were cross validated with time data collected during patient observations to infer minimum, maximum, and mode values for each Patient Track activity. Although the PaJMA model indicated a range of minimum and maximum values, it did not show mode. Therefore, mode was determined using the average time as indicated in the patient observation notes. The minimum, maximum and mode values were added to the Patient Track Activity for processes *Registration*, *Treatment*, and *Book Next Appointment* to complete the Patient Track.

Table 6. Patient track activities with type and processing time

Patient Track Activity	Activity Type	Statistical Distribution (min,max,mode)
Arrival	Milestone	None
Registration	**Process**	Triangular (8,25,20)
Waiting Room	Patient Travels Unattended	None
Escort to Treatment	Escort Patient	None
Treatment	**Process**	Triangular (42,148,102)
Escort to Reception	Escort Patient	None
Book Next Appointment	**Process**	Triangular Distribution (0,6,5)
Exit	Milestone	None

After completing the Patient Track, staff were assigned to work with the patient for relevant patient track activities by clicking staff requirements and selecting a drop-down menu. The PaJMA model had explicitly shown staff required for each subprocess in the staff roles metric layer, which made for simple translation into the simulation model. Reception staff was assigned to assist the patient with *Registration* and *Book Next Appt*. Intern staff was assigned to *Escort to treatment*, *Treatment*, and *Escort to Reception*. Clinician was assigned to *Treatment*. *Arrival* and *Exit* did not require staff assignment.

Section 5.1.3. EHR Timestamp

The process model, accompanying time metric data and field notes from the previous phases in this case study were analyzed to generate computer simulations using Flexsim software. Direct observational time metric data were easily translated to process activity times in the simulation. The time metric data provided enough information to derive minimum, maximum and mode values required for the simulation. In order to increase the accuracy of the simulation, a timestamped activity log for one week based on access to the EHR by a single random pod of interns was extracted by clinic management. This data were collected to support the validation of the observational time study and the use of this as appropriate data for other weeks and clinicians. The timed activity was sequentially analyzed and compared with the observational data to logically match for process validity.

The extracted dataset was displayed and manipulated in Microsoft Excel. The data were cleansed by using Excel software features to identify and remove duplicate entries. The timestamps included fields representing date, time, action, content, and patient file number. Patient file numbers were unique patient identifiers (ID). Although less exhaustive and resource intensive compared to direct patient observations, manually organizing the dataset required time and effort.

Deriving and establishing context to the timestamps was a challenging task. The timestamp entries were sorted by patient file number to identify and group together EHR access based on unique IDs. Total time duration of each unique ID interaction was manually calculated by subtracting end time value from start time value for each group. This demonstrated clear short or long total time durations associated with unique IDs. Short entries were comprised of many timestamps, with a single unique ID, lasting a total of 0-3 minutes. Long entries included multiple entries associated with a single unique ID, for a total time of 15 minutes or more. Therefore, a clear discrepancy between short and long entries was established. Considering the dataset did not pose inclusion or exclusion criteria, it is possible that the EHR access timestamps included new patient, re-evaluations, only treatment, or other updates to the patient file. The shorter entries could have been reflective of these patient file updates. Total time durations for long entries were similar to ranges identified through patient observations.

The long timestamp entries were further analyzed by calculating elapsed time values. The elapsed time between each individual timestamp within longer time entries was calculated. The elapsed times between entries were used to provide context to the timestamps. The elapsed time values accounted for time between EHR access by the intern or clinician. The long timestamp data for unique patient IDs proved to generally match with the PaJMA model including time metrics. The long timestamps from the interns showed instances of 2 or more significant elapsed time values within each grouped unique ID. This trend was reflective of the consultations and delays identified in the PaJMA process models. A similar pattern was identified with the number of consults when the clinician access timestamps were examined. The EHR access logs demonstrated similarities to the EHR access explicitly shown in the information creation/update metric layer and corresponding staff roles of the PaJMA model.

Section 5.1.4. Challenges & Future Research

Although thorough analysis led to emerging patterns with the dataset, the timestamps still lacked detail in describing characteristics of the patient-intern-clinician interactions beyond EHR access. The data analysis relied heavily on assumptions of interaction and access context environment. The sample size was also very small, therefore the results are possibly not a complete reflection of the entire patient population or every patient journey. Considering a single pod's activities were examined for only 1 week, the method poses some limitations in comparison to including a greater number of pods over a lengthier period of time. Future research should include a larger sample size and diverse population for greater reliability of results. Although total time duration was inferred, the timestamp analysis was unable to yield details or context of time spent on individual sub processes and patient interactions. Furthermore, although the timestamped were real-time replication of access to the EHR, the selection of the pod may have been subject to bias by clinic management.

Developing the Patient Journey simulation by translating the PaJMA process model into the Flexsim simulation proved to be simple, as both tools were patient-centric. PaJMA is a patient-centric methodology with explicit metric layers demonstrating process flow. Development of the PaJMA models supported understanding of process elements, flow and interdependencies. This understanding served as a basis for creating the conceptual model and transitioning to the dynamic computer simulation. Although the process model was useful in accounting for activities, resources, process flow, process time, and the patient, it was not able to clarify the scheduling requirements as needed to create the simulation. Scheduling patterns of the clinic environment were a significant module in developing the dynamic simulation model. For this study, any scheduling information was taken from field notes and observational data rather than the PaJMA model. If this study is tp be replicated for future research, PaJMA should be adapted to include a metric layer explicitly indicating limitations or requirements of scheduling activities. Also, the software should be examined prior to developing the static process model to determine requirements of the simulation based on the type of software. This would ensure the use of more of the software's features and possibly more valuable data for running the simulation could be collected at the same time as the development of the PaJMA model.

Section 5.2. Case Study #2: Process Modeling & Clinic Site Comparison

The purpose of process mapping is to demonstrate the roles, responsibilities, technology needs, and information flow necessary for patient care (Mclaughlin, Rodstein, Burke & Martin, 2014). There are a variety of methods that have been used and adapted for healthcare to enable visual analysis of patient journeys. This section will compare two such methods, PaJMA and BPMN. Each model provides a different representation of data to support process improvement and change management initiatives. These will be compared across three main categories: *Model Construct, Representation of Metrics*, and *Integration of Technology*. The resultant PaJMA models are further analyzed between two CMCC clinical sites. The analysis aims to provide a holistic comparison of a patient journey between the clinical sites under context of the previously explained categories Model Construct, Representation of Metrics, Integration of Technology. The comparative analysis will be used to identify any inconsistencies within the process and evaluate the standard of patient journey process at CMCC. The case study concludes with a Summary of Analysis.

Section 5.2.1. Comparison between Process Modeling Tools

This section provides a comparison between the BPMN and PaJMA process modeling tools as related to Model Construct (A.), Representation of Metrics (B.), Integration of Technology (C.). The purpose of analyzing these categories is to compare the format and build between the process modeling tools. Through this comparison, assumptions will be drawn about the tools' ease of use and translatability. Incorporating Lean process analysis, Representation of Metrics discusses the process modeling tools' ability to explicitly account for process metrics significant to the patient journey. This is significant as process metrics are used to measure and then manage process quality. The final category, Integration of Technology, evaluates each process modeling tools' account of technologies, specifically the new electronic health record system at CMCC. The tools' are examined as a means to support the adoption of such technologies and as an integral component of the comprehensive patient journey.

Section 5.2.1.1 Model Construct

In considering the construct of the models, we examined the overall format of each method. The models were analyzed based on the ease of use, interpretability, complexity, and ability to accurately and explicitly depict process elements relevant to the patient journey. The PaJMA excerpt (Figure 25) differs from the comparable black-and-white BPMN segment (Figure 26) through inclusion of a comprehensive color-coding scheme.

Figure 25. Comparison between clinical sites : PaJMA (A)

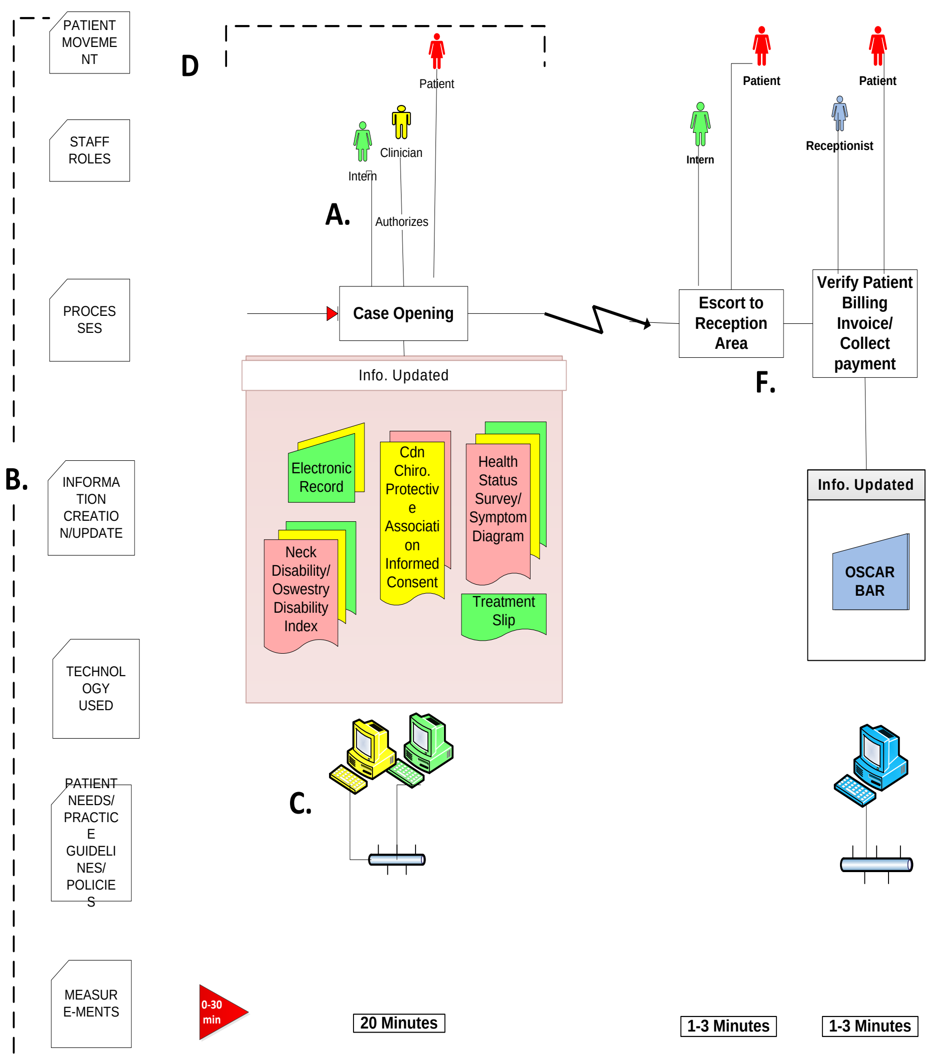
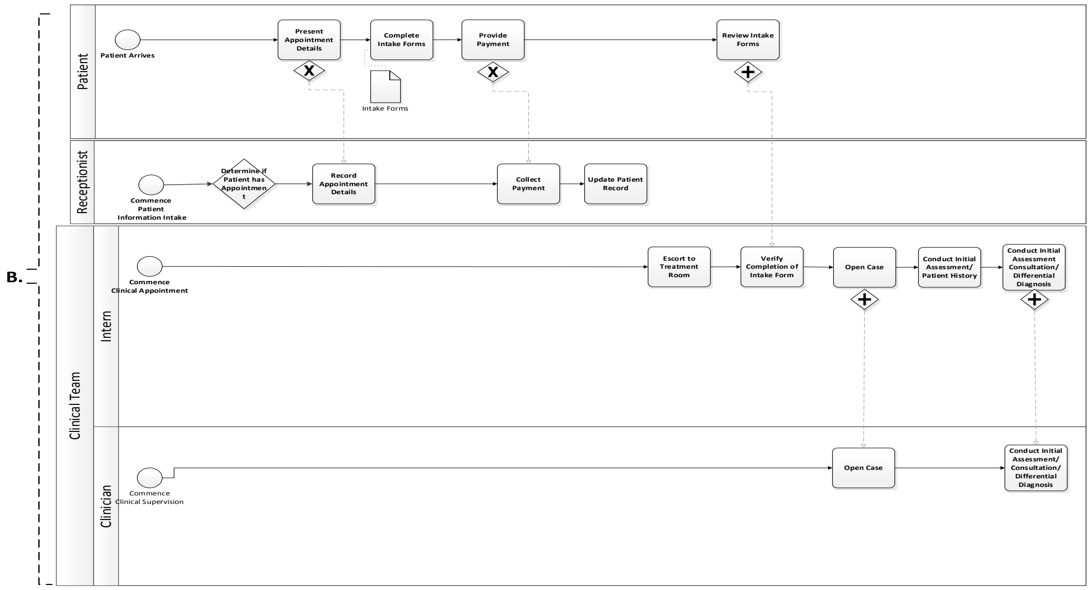


Figure 26. Comparison between clinical sites: BPMN



The color-code, a secondary coding of data, demonstrates accessibility modalities and accountability for individual items of information. For example, referring to letter A (Figure 25), color is used to identify instances when the clinician needs to authorize the intern's compiled data into the EHR, including the data requirements and the devices used to access the information. Capacity to demonstrate this accountability enables verification that clinical guidelines are followed, and that interns are being adequately supported by their supervising clinicians. The role-data usage information is also valuable for privacy compliance and security. Location requirements for safeguards can be easily identified; compliance with location requirements should be in place to secure information and access to the EHR. Similarly, letter A (Figure 25) shows the importance of interpersonal communication between the clinician and intern in completing the subprocesses of the patient journey. In contrast to the PaJMA color-coded scheme, with reference to letter B (Figure. 26), the black and white BPMN model is constructed with swim lanes and pools to organize the staff roles, then further breaks down the process from left to right. In this way, the results indicate each swim lane provides details of the process in terms of completion with each staff role. The PaJMA model is also read left- to right but due to its unique construct, it allows the process to further be vertically isolated (Letters B & D Figure. 25). Vertical isolation allows examination of each subprocess through a lens of additional granularity. Granularity with PaJMA is centered on patient experience, whereas BPMN focuses on individual staff roles. To account for when the patient is involved in a process activity or decision that requires multiple staff roles, the PaJMA model is much less complex than BPMN, as all roles remain in the single layer ; there is no need to link multiple swim lanes spanning across the model. Multiple swimlanes and complex linkages, as evident with BPMN, affect interpretability of the model.

In addition to interpretability, the level of complexity for creating each model differs. Due to the multiple layers and data elements represented in the PaJMA model (Figure. 25), collecting the data and developing the model requires significant investment of time to initially prepare. Once the models are developed, their maintenance is easy due to their intuitive nature. Modification to the PaJMA models to reflect complex process change is simplified, due to the capacity for isolating metric layers. The BPMN model requires less effort in data collection due to its focus on specific roles for each lane and the limited amount of information with respect to policies, guidelines, metrics, and technology usage. However, modifying the BPMN model to reflect updates or changes to a process can be complex, which results in more difficulty with model maintenance. For example, a process change that requires modifications to multiple staff responsibilities requires complex changes to swimlanes and linkages, and the model construct as a whole.

Section 5.2.1.2 Representation of Metrics

The constructed PaJMA model provides clear metric layers (Letter B, Figure 25) representing patient movement, activities, information creation and update, protocol/guidelines and time. In terms of the metrics in the BPMN model, we accounted for some compliance elements through the inclusion of roles, activities, and artefacts of information. BPMN did not account for protocols or guidelines used, a significant shortcoming when applied to modeling in health care scenarios. It also did not account for the use of time, clinical, or other operational metrics. This lack of quantitative metrics hinders the usability of the BPMN process models for Lean quality improvement analysis. Considering the complexities of the health domain and the need to monitor the quality and efficiency of the patient's journey, it was found that the lack of metric data in the BPMN model was a significant limitation of this methodology for mapping the patient journey.

Section 5.2.1.3 Capacities for Technological Integration

As the strategic use of technology for improved patient safety becomes an expectation of all patients, the integration of the technology to support patient care must be considered in all process improvement projects. BPMN failed to account for the newly implemented EHR at CMCC. The PaJMA model provided a holistic representation of the journey, incorporating both the technology interface needs, as well as the underlying communications infrastructure (Letter C in Figure 25). The BPMN model (Figure 26) demonstrated sequence of events, in addition to the separation of the swim lanes and multiple start and end points, but no indication of how the information is accessed or mode of communication between roles which includes the patient. This dynamic feature demonstrates a significant contrast to the PaJMA method. Considering that most organizations are considering some form of e-health system, the use of PaJMA with the additional information and technology layers it has, is more effective in modeling the patient journey.

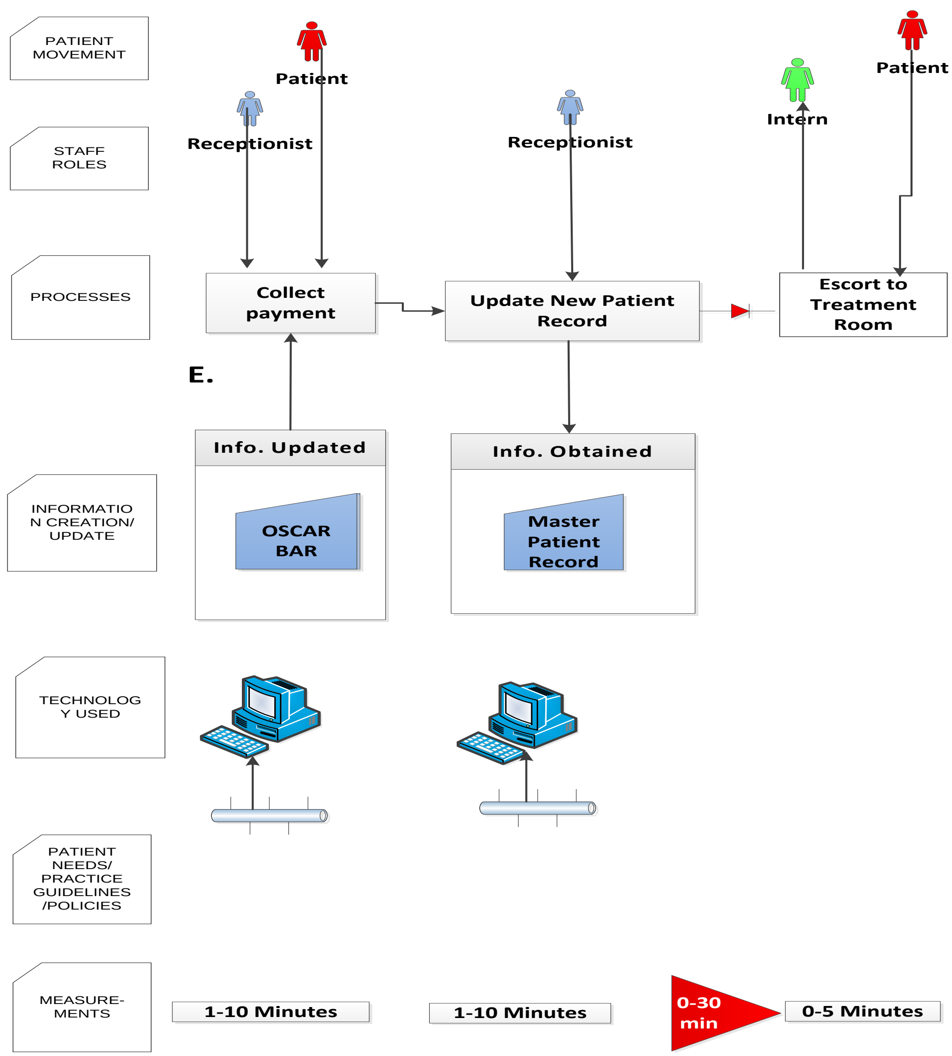
The different characteristics in modeling approaches further confirm the need to consider the project objectives and organizational environment when selecting a patient journey modeling methodology. The cost of holistic models can be easily off-set by the richness of the analysis conducted using the models but only if needed within the scope of the project. Therefore, as a recommendation to the organization, the goals, and context of the process improvement project must be clearly determined prior to construction of the models.

Section 5.2.2. Comparison between Clinical Sites

The next phase of analysis involves a comparison of the constructed patient journey PaJMA depictions between the two clinical sites. Process modeling and analysis allows for examination of the careflow from user-centric perspective. Lean perspective of analysis was applied to understand the value and non-value, and interdependencies of process elements and attributes as they apply to the continuum of the patient journey.

The models aid in the discovery of inconsistency in payment procedures between the clinical sites, as payment was collected before or after escorting the patient to the treatment room to medically assess the patient, as indicated by the letter E (Figure 27) and letter F (Figure 27). In addition to demonstrating a lack of standardization of process between clinical settings, this inconsistency warrants the investigation of the prospect of infringing on care coordination.

Figure 27. Comparison between clinical sites: PaJMA (B)



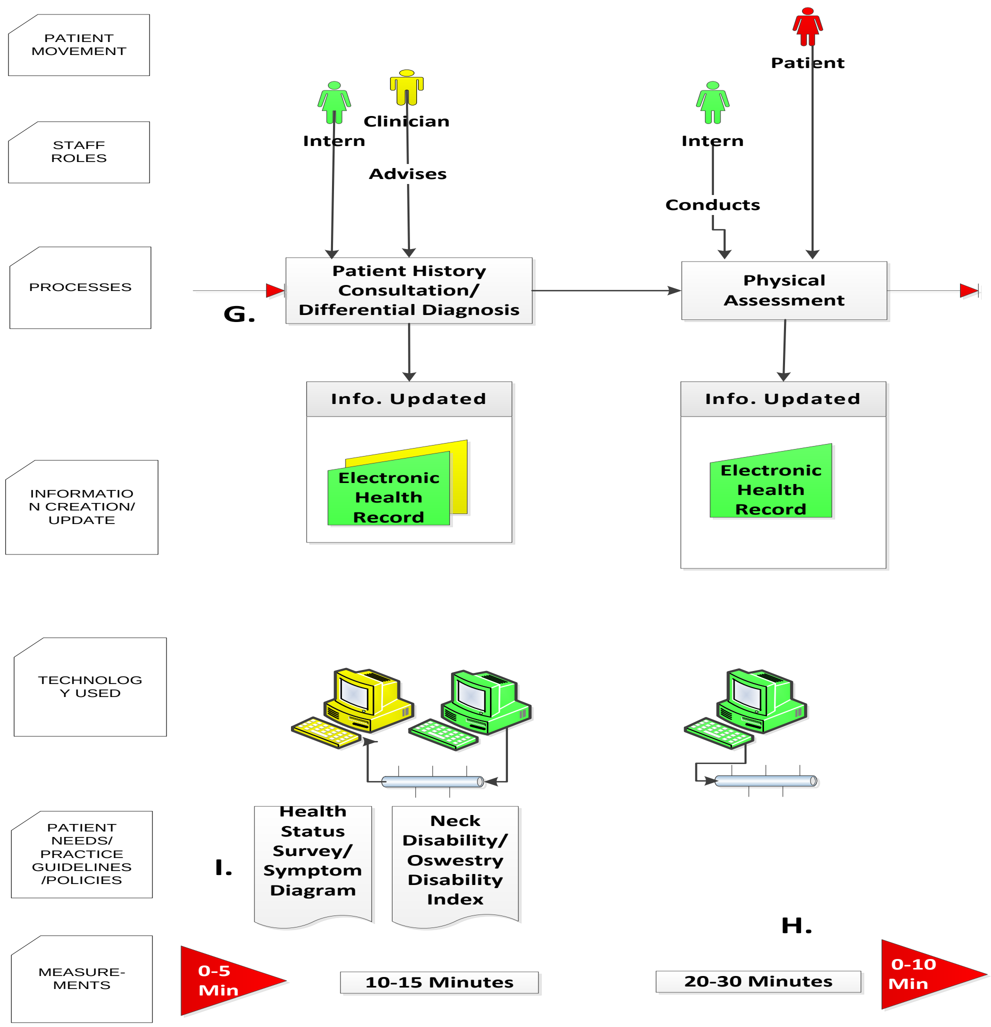
Moreover, when analyzing the metric layers of the PaJMA models between the two clinical sites, inefficiencies in the form of process flow delays were identified. An example of delays is indicated by letter G (Figure 28) & letter H (Figure 28). These instances of non-value added time varied in length due to the difference in amount of treatment rooms available at the examined clinical site. The delays are also attributed to the constraints of availability of attending clinicians for consultation and authorizing actions undertaken by interns. As these locations are teaching facilities, there is an opportunity to use the EHR to reduce through use of remote clinical consulting and authorization sign off by clinical By identifying a measure of artefacts related to patient needs, and practice guidelines/policies, as indicated by letter I (Figure 28), we establish an indicator of operational and information management compliance standards. Theoretically, if the two patient journeys are standardized, comparison of PaJMA process models should demonstrate both processes account for the identical practice guidelines and policies linked to the same process activity or decision. Variation in practice guidelines and policies could potentially present patient safety or health information risks. Therefore, the PaJMA models support service quality management and process improvement.

Consistent with TQM, PaJMA was flexible, and provided a comprehensive view of the process with focus on the patient's journey; the patient journeys at individual clinics could be analysed as part of larger system (clinical education department, entire organization, or healthcare industry), or an entire system unto itself, made up of various process elements, flow and entities. Therefore we were able to identify and relate the artefacts using a multi-dimensional perspective of the same process. In addition to

TQM, assuming different lenses of perspectives to analyze the patient journey process supports lean quality improvement; we were able to distinguish and associate the use, impact, and value or non-value of individual information units and artefacts.

Developing the process models required review of current clinical guidelines, policies, and consideration of patient demographics and clinical context. We employed a Lean bottom-up approach to process validation as all levels of staff were encouraged to participate and collaborate; we found model development and validation techniques serve as a method to organizational policy review, compliance documentation and training. The artefacts distinguish best practices, are explicitly identified using PaJMA, and linked to each clinical decision making step of the patient journey. Considering the linkage of the appropriate policy, guideline or patient need to the associated clinical decision or process activity, and the intuitive nature of PaJMA, the models can aid as an effective training tool for students to learn best practices.

Figure 28. Comparison between clinical sites: PaJMA (C)



Section 5.2.3. Summary of Analysis

This case study has presented a two part analysis. Process modeling tools PaJMA and BPMN were compared in context of: Model Construct, Representation of Metrics, and Integration of Technology. The PaJMA model of the patient journey at CMCC was compared between two clinical sites.

Examination of the process modeling tools revealed differing lenses of perspective and focus. BPMN was focused primarily as on staff-role functions as shown through the use of swim lanes, leading to limited isolation of individual subprocesses within the patient journey. The PaJMA tool however, maintained a customer-centric perspective, consistent with Lean principles and capability of simple vertically and horizontal segmentation. The models differed in capability to define and measure compliance to industry-specific clinical guidelines and patient needs. BPMN accounted for some compliance elements through inclusion of activities, artefacts and roles, but this account was significantly limited when compared to the explicit definition of clinical practice guidelines, information, and color-code scheme of staff accessibility and accountability. Similarly, the integration of the electronic health record system, including accessibility of information, and technological and communication infrastructure, was explicitly defined using the PaJMA tool. However the BPMN tool failed to clearly demonstrate implications of using the electronic record system or the systems infrastructure as related to the patient journey. The PaJMA tool was shown to be multifaceted with qualitative and quantitative metrics, while the BPMN tool focused solely on qualitative process flow. As complexity of the models increased, the effort and resource expenditures also increased. Therefore, the PaJMA model, although provided a more detailed, comprehensive depiction of the patient journey required more effort to create, compared to the BPMN model. However, this case study found the cost of creation of the PaJMA models to be offset by the benefits of more comprehensive data leading to the possibility of a more robust analysis. Therefore, a large-scale project, especially involving health information technologies would benefit from using the

PaJMA tool. The case study found that the benefits, cost and applicability of the process modeling tools were largely dependent on the scope of the process management initiative and project resources.

PaJMA models are constructed from the patient perspective of the process; the models are patient-centric, and identify patient movement relative to all process activities and decisions. In a healthcare context, the PaJMA tool explicitly allowed for the definition, measurement and analysis of the patient journey while inherently combining consideration of the significance of understanding the patient perspective, health information technology, and clinical practice accountability. The holistic view of the process allowed for comprehensive examination of the patient journey between two clinical sites within a single organization. This comparison reaffirmed the richness of data that can be extrapolated from using the PaJMA tool by the explicit account for information, accountability and quantitative time delays. Comparing the two sites using the PaJMA tool led to the identification of operational differences of the patient journey. It also served as an indicator of clinical compliance and means to create standardization of high quality patient care, and support organizational policy review and documentation.

Section 5.3. Case Study #3: Integrating Technology across the Organization

This section presents the results of this case study focus primarily on the work done by the researcher in the Human Resources Department at CMCC. Similar work was completed by 4th year Capstone students in CMCC's Accounting & Finance department as well as the Information Technology department. Administrative processes that were examined in the Human Resources Department included: Hiring and Recruitment for Faculty and Non-Faculty employees, Coordination of Benefits and Payroll. This case study was motivated by the aim of establishing a common platform for quality and process improvement across the organization. Considering CMCC is a chiropractic college and clinical practice setting, a holistic systems approach to quality and process improvement spans across the organization to include patient and student experiences based on clinical practice. A systems approach also includes the functional channels of the organization, such as administrative units, which can be overlooked in healthcare process literature.

As CMCC is a combined chiropractic college and clinical practice setting, faculty assume a dual role with teaching and supervising clinical practice. Non-faculty include CMCC support staff, and clinical students working as chiropractors at the CMCC clinical sites. This dual role structure can cause myopic vision on the clinical aspects of the organization. The process diagrams were evaluated for process improvement opportunities using a visual language similar to the clinical diagrams to support ease of communication and process improvement across the organization.

This case study analysis demonstrated a concern of collaboration and customer-centricity between the hiring managers and the HR recruiters. In the Hiring & Recruiting process, the human resources recruiter provides a service to the hiring manager in filling a vacant position for the targeted department. Therefore, the hiring manager is shown to be the customer of the process. The Hiring & Recruiting process model is illustrated in Appendix V. *Hiring & Recruiting Process Model, CCPIM*

In the Payroll and Benefits processes, the Payroll & Benefits Coordinator provides a service to the employees of CMCC. Therefore, the employee is shown to be the customer of these processes. The Payroll Process is illustrated in Appendix IV. *Payroll Process Model, CCPIM.*

Lean philosophies involve emphasis on the importance of the customer's perspective of a process, including determining the value from this perspective. All tasks within a process should contribute to adding this value and removing instances which provide no value or are unnecessary to the customer. The customer's perspective is therefore exceedingly significant in creating process perfection, and should be consistently monitored. The process models of CMCC's administrative units indicated no specified strategy or guidelines geared towards internal customer service provisions. Therefore, there was no explicit measure for continuous improvement to guide service interactions between employees, or a method to track customer needs and feedback.

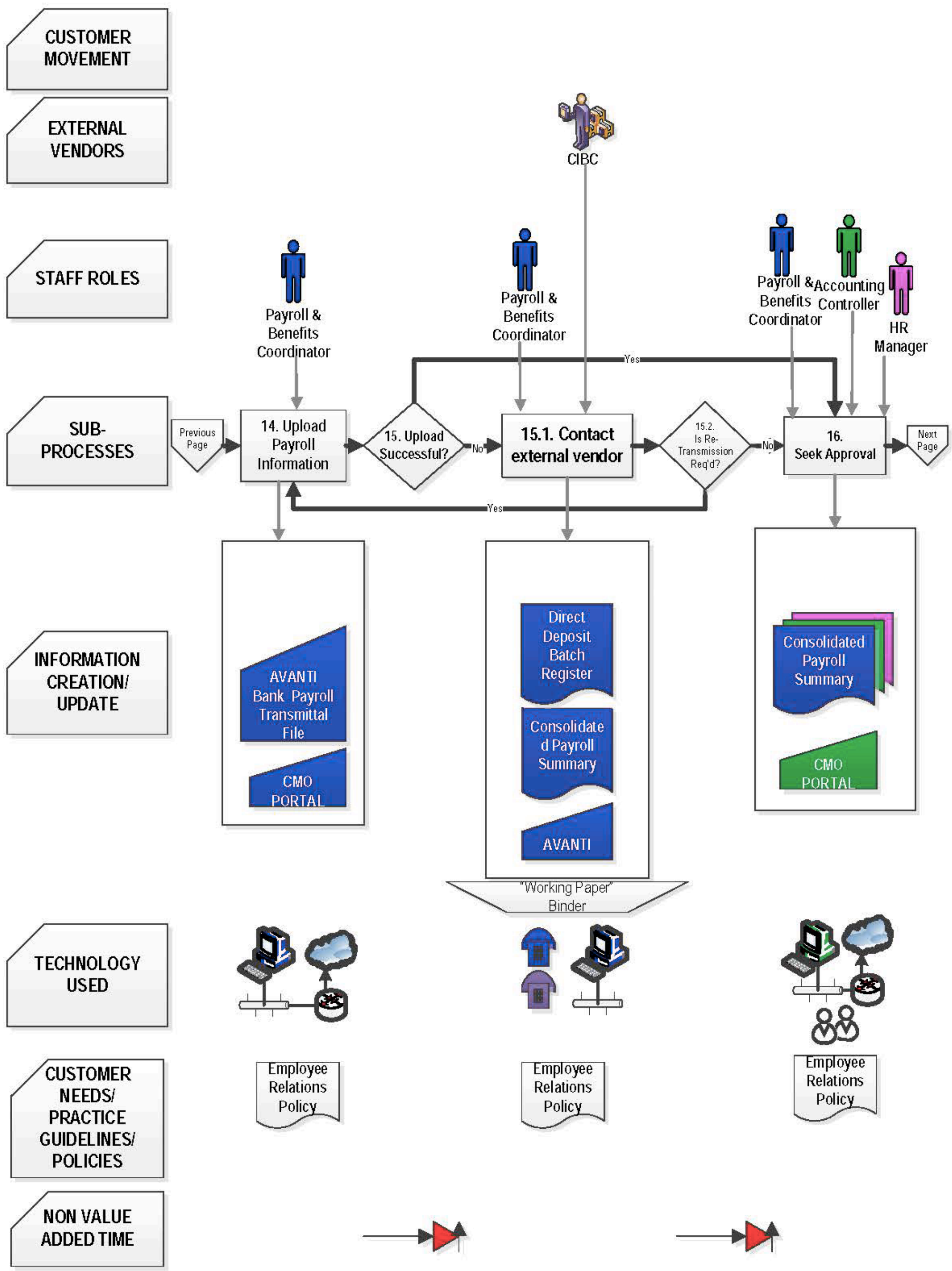
This section is divided into the areas of Quality Control (Section 5.3.1), Flexibility (Section 5.3.2), Technological Integration (Section 5.3.3). The final section (Section 5.3.4) outlines Recommendations, including change management, to CMCC and specifically the Human Resources Department. Similar recommendations were provided for the remaining two departments in specific documents but will not be reported in this thesis.

Section 5.3.1. Quality Control

This section presents the results of process analysis in context of Quality Control. For purpose of this case study, quality control involves the assurance of high quality service for the customer, by minimizing inefficiencies or risk within the process. To understand and improve the administrative functions at CMCC, process maps were developed and validated. The resultant comprehensive sets of maps were analyzed using

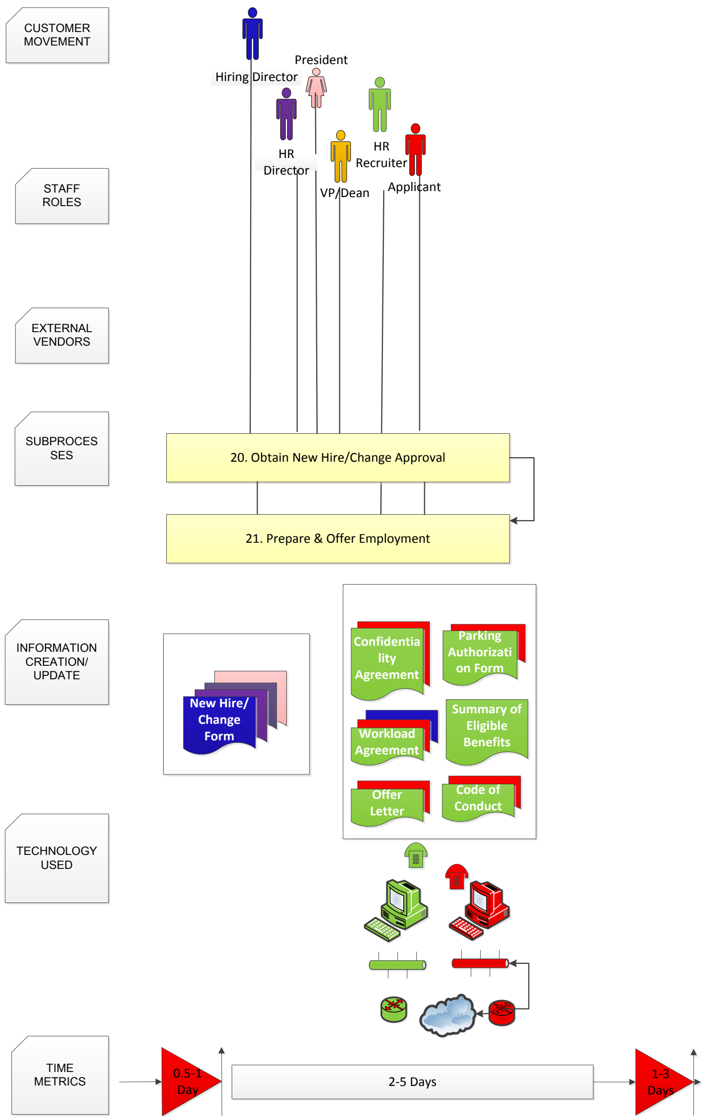
Lean principles to streamline process flow. For example, the processes were examined to determine opportunities to minimize touch points and handoffs. Both non-faculty and faculty models proved to be multifaceted with several touch points and intermediaries. Instances of redundant handovers, where documents were passed through multiple intermediaries for verification and approval, were discovered. The findings indicated this caused delays of excessive motion in physical handover of paper documents for approval, as well as the delay in waiting for the authorization of the documents. Similarly, referring to Figures 29 & 30, there is involvement of many staff roles in contributing to the steps of the process, excessive signatures, and long approval cycles (Refer to Appendix IV. *Payroll Process Model, CCPIM* (5, 16, 18, 24 & 27) & Appendix V. *Hiring & Recruiting Process Model, CCPIM* (4, 5, 16A, 18A, 18i). In these cases, handovers of documentation were primarily regarded as a method of asserting validation by senior staff roles. However, the excessive transportation and waiting for task completion increases the complexity of process flow, creating inherent inefficiencies of non-value added time delays, as well as the potential for errors or miscommunication between staff roles, leading to potential rework.

Figure 29. Segment of payroll process, CCPIM.



Subprocess: 14, 15, 15.1, 15.2,16

Figure 30. Segment of hiring & recruiting process, CCPIM

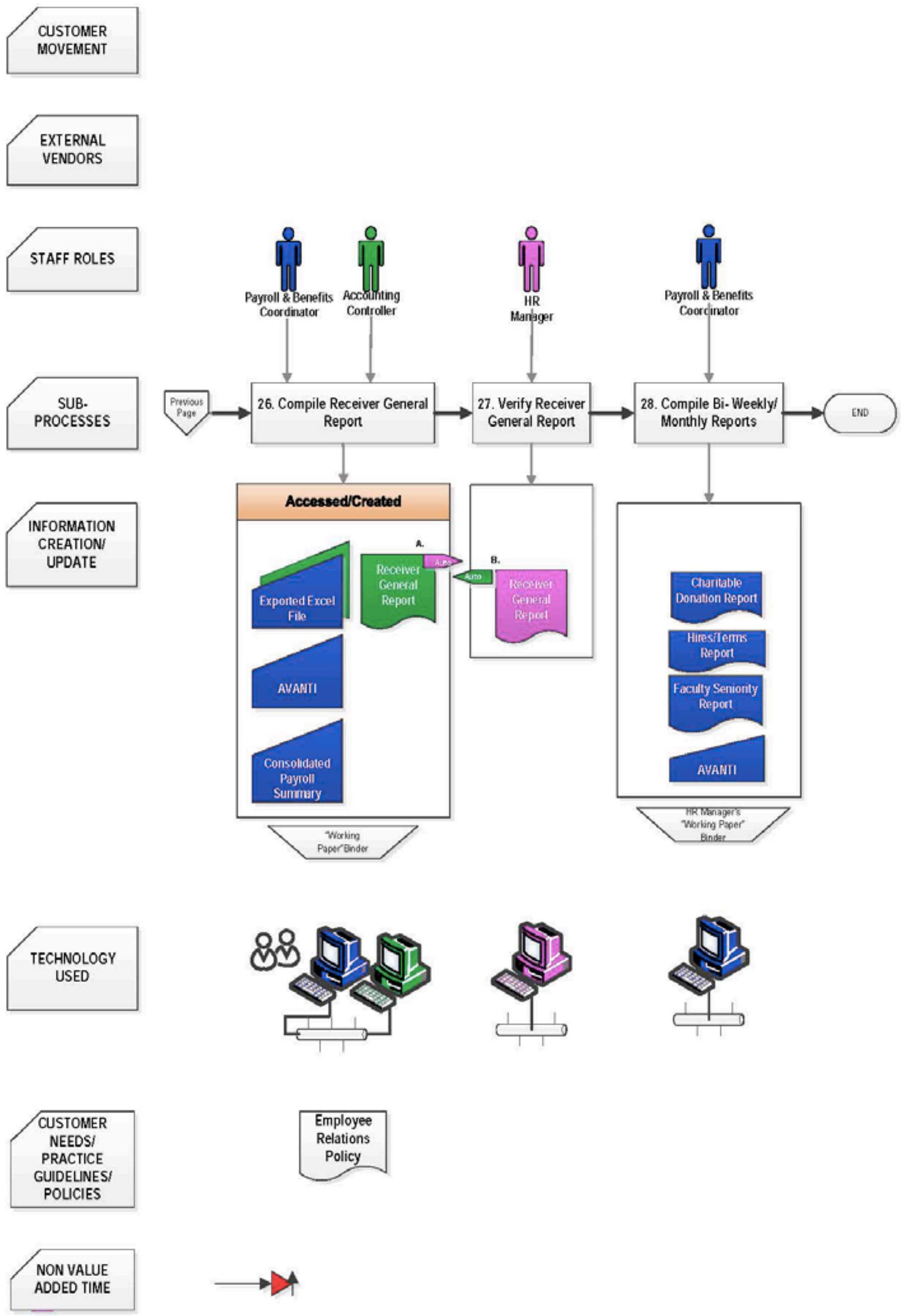


Subprocesses 20, 21

Another issue identified was of audit and compliance tracking. During the payroll process, both the Accounting Controller and Payroll & Benefits Coordinator access the same Excel file (Refer to Figure 29). In this case, the document is accessed by multiple touch points with no inclusion of audit functions or version controls. A similar issue presented for instances where paper documents are used to liaise for approval or collaboration efforts with other departments with no records of version control (Refer to Appendix IV. *Payroll Process Model, CCPIM* Subprocesses 13.1, 18, 16). Without these control and auditing capabilities, there is a concern for tracking changes to the documents, leading to potential large scale issues from the inability to detect misuse of information or fraud, as well as difficulties in monitoring adherence to internal compliance policies.

The previous paragraphs identify concerns of quality control for excessive motion, delays from waiting, auditing, and compliance issues. Further process analysis presented concern of faulty supplier information as an input of the process. Supplier input defects are minimized by collecting and providing efficient and effective supplier information. For example, the first steps of payroll process involved customer input of time slip information (Refer to Appendix IV. *Payroll Process Model, CCPIM* Subprocesses 1-4). The focus groups conducted in the data collection phases presented a common concern of non-faculty employees failing to submit timesheets correctly. Participants shared their issues of the non-faculty employees documenting the information on the time slips incorrectly, leading to follow-up communication by the Human Resources department to verify or recollect employee data.

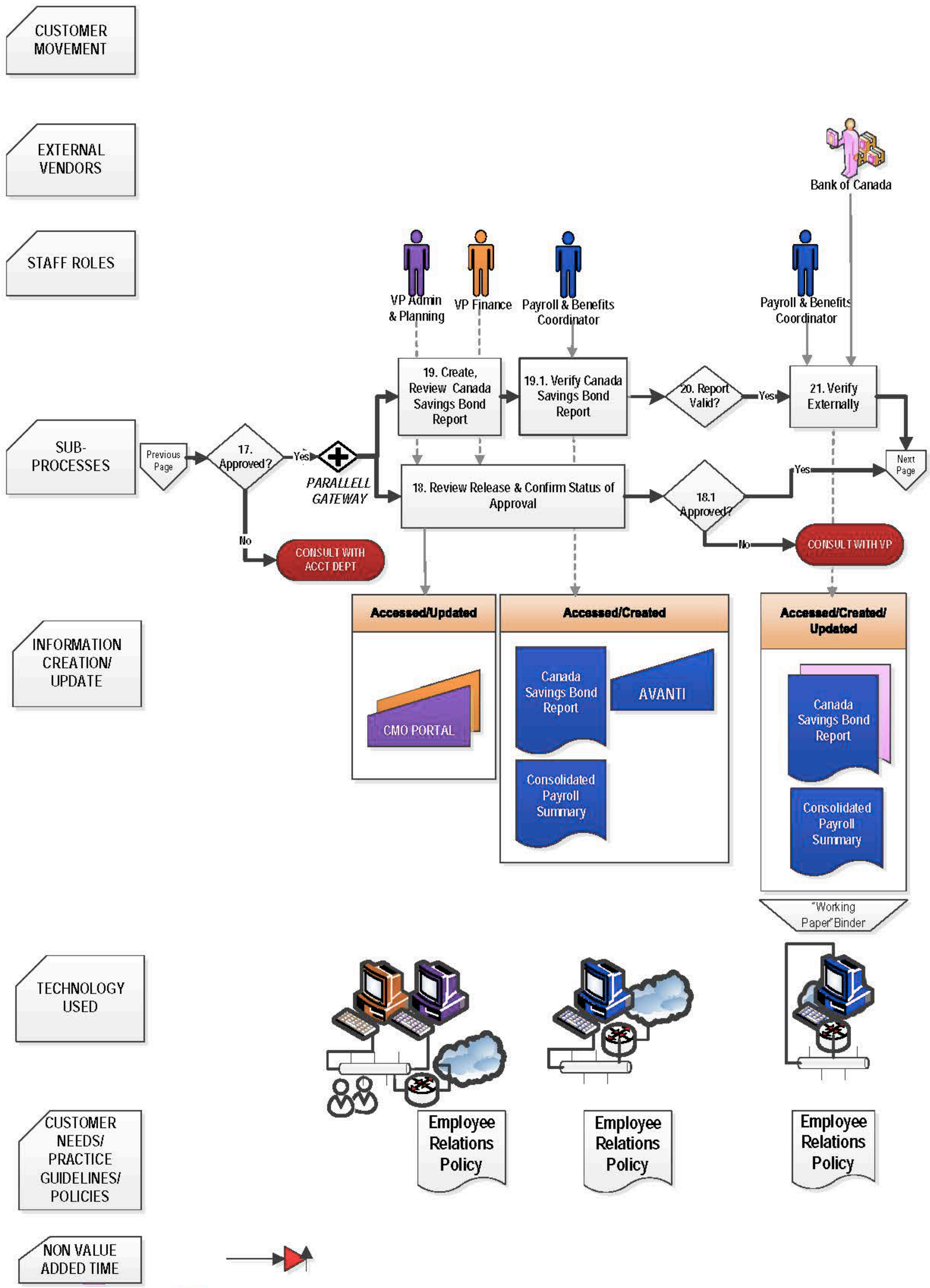
Figure 31. Segment of payroll process, CCPIM



Lean principles involve streamlining processes and minimizing waste, endorsing a process which emphasizes preventing incorrect information input rather than detecting errors following input. By avoiding detection following information input, the process is diverting instances of revisiting previous subprocesses or tasks for additional rework. Preventing incorrect information from the source is essentially ensuring the task has been completed at the first attempt without defect. This would lead to positive progression of sequential movement of process flow stipulating the specific conditions which make passing defects to the next process steps impossible.

Instances of possible rework scenarios with similar causes are also apparent in the payroll process (Refer to Appendix IV. *Payroll Process Model, CCPIM* Subprocesses 13, 15, 15.2, 17, 18.1 & 20). In these payroll examples, the effectiveness of the subprocess and the quality of the subprocess output was relying explicitly on the accuracy of supplier of information to determine the outcomes of the subsequent subprocess outputs. In Figure 32, Subprocess 21, the Payroll & Benefits Coordinator must verify a Canadian Savings Bond Report from the information supplier, Bank of Canada. If the supplier was unclear of the specific type of information required or provides incorrect data, defects were disclosed, eventually becoming rework. Therefore, these issues of rework and process flow are considered quality control issues, stemming from the supplier information errors.

Figure 32. Segment of payroll process, CCPIM



Section 5.3.2. Flexibility

The process maps were also evaluated based on the ability to respond to potential external changes which may affect the service outputs and quality of work. Considering the payroll process map (Figure 29), the overall process is inflexible in terms of scalability. There is an apparent limitation of skillset and resources, as the primary effort stems from a single point of reserve as a sole staff role, the Payroll & Benefits Coordinator, is responsible for the majority of the payroll process. This limitation and obvious dependency on a single staff role does not allow the process to handle a larger volume of input without significantly increasing stress on existing resources.

The results also indicated potential for delays or excessive time consumption resulting from breaks in process flow due to absence of immediate process triggers. Ideal state subprocesses are triggered by dependencies of previous process elements. This revealed opportunity for automation to be incorporated into areas of the current state. For example, a number of consecutive steps in the Payroll process involve assembling reports, manual compiling, verification of data and performing maintenance (Refer to Appendix IV. *Payroll Process Model, CCPIM* Subprocesses 2-4, 9-12, 28). These steps could be combined, or the existing software could be used, to link the steps to streamline the process flow and create automation. Finally, referring to the Hiring & Recruiting processes, the results indicate inflexibility in the form of dependency on approvals with significant time delays (Refer to Appendix V. *Hiring & Recruiting Process Model, CCPIM* Subprocesses 4 & 16A). In the current state, these approvals are necessary for progression of process flow. Although the approvals are a form of compliance and quality assurance, they result in significant delays. These delays could be minimized by removing or combining approval handoffs, limiting the number of dependent handoffs. Automation for triggers and notification could also be incorporated to minimize dependencies, delays and handoffs.

Section 5.3.4. Recommendations

This section presents recommendations for CMCC derived from Lean process analysis of the resultant CCPIM process models. Recommendations to support quality control include decreasing process complexity through automation, streamlining hand-offs, and minimizing data integrity risks through version control and audit trails. To increase process flexibility, CMCC is recommended to cross-train staff roles and evenly distribute workload across the process flow streams. For optimal technological integration, automation, data integrity and compliance should be considered. CMCC should consider the strategic benefits of all applications of the new information systems to leverage the technological capability, complementing the process and avoiding repeating old processes with new tools. Finally recommendations for change management include overcoming departmental silos for an "end-to-end" perspective of process management and improvement. Fostering an organizational culture that supports change is also essential for change management at CMCC.

Section 5.3.4.1. Quality Control

For each process map, documented intermediaries and touch points along the process flow were considered. It is recommended that the number of intermediaries be reduced to decrease delay and reduce overall complexity. Decreasing the complexity of the process flow will simultaneously minimize risks for errors in information transfer and potential rework. In cases where additional non-customer facing touch points cannot be eliminated, and the Subprocesses involve staff roles from varying functional departments, enabling increased communication strategies is recommended to streamline these efforts. By incorporating forms of automated indication, which will notify the appropriate staff roles of the state of the task relative to completion, those staff members from varying departments are able to monitor changes and keep consistent flow. This strategy can remain valid for any such condition of contribution from varying departments to a common task. An example of an indication method is embedding the current system with alerts using a simple color code to depict current status or task completion. Figure 29 shows an example of this automation as indicated by letters A. & B. In this example, the General Receiver Report is compiled by the Accounting Controller, and then automated to notify and send to the HR Manager for verification.

In addition to status notification, the administrative departments can use of version control to allow users to edit and track changes to electronic documents. Without version control, there is a significant risk that in the case of errors, users will be unable to the audit the document for compliance or security. Establishing transparency through version control would create a sense of accountability and ownership of the data and provide an audit trail which can be used to gauge compliance to departmental policies and guidelines. These are critical elements in ensuring compliance with government regulations for data privacy and security, and a strong control to support improved data integrity.

Another recommendation for streamlining process flow with handoffs, where information is passed from one role to another, is to apply strategic mistake proofing; a fundamental Lean attribute. In order to propagate items in continuous flow, without scenarios of rework, it is essential to generate an emphasis on the appropriate specification of the required supplier information and consolidating the flow of input data. To avoid unnecessary rework in process flow, the supplier of information must understand the type of input information needed to satisfy the process requirements and output expectations. For ideal process flow, the format or structure of input data should be immediately usable by roles involved in subsequent tasks. The Human Resources department could also apply a means of educational reinforcement using reference sheets or a conveniently accessible electronic resource page. This mode of specification for supplier input may reduce this concern. Likewise, there would be increased customer focus of the process by creating a customer-centric communication channel. This channel could also include forms of electronic reminders or an electronic medium of submission.

The recruitment and hiring process was depicted as service to other departments at CMCC, involving interaction across functional departments. To ensure successful collaboration of these varying department and roles, additional guidelines should be provided to the hiring managers. The guidelines should be relevant, and easily accessible to the departments acting as the customer of the process to promote consistent use. Explicitly providing reinforcing procedures would simplify the process requirements for the customer and clearly outline the expectations of all roles within the process. Another goal of establishing these guidelines and requirements prior to creating the job posting, is to strengthen communication with the customer for effective collaboration and act as an instrument of compliance on both ends. Creating a channel for feedback will contribute to the relationship with the customer and provide a means to measure and manage outcomes for improvement.

Section 5.3.4.2. Flexibility

The resultant process maps indicated process inflexibility. To overcome process inflexibility, similar roles should be cross trained to support other functions. For example, the Human Resources Assistant, a role seen assisting the Payroll & Benefits Coordinator, can be further trained in other areas of payroll to assist when necessary (Refer to Appendix IV. *Payroll Process Model, CCPIM* Subprocesses 3 & 4). The distribution of workload was also considered. Evenly distributing throughput, rather than concentrating more work on specific areas of the process flow would increase flexibility and efficiency. For instance, leveraging potential pay schedule flexibility and creating an alternate pay schedule with pay groups on opposing weeks may effectively distribute the payroll workload.

Section 5.3.4.3. Technological Integration

The process documentation and analysis revealed issues of technological integration such as information silos and information storage were identified. For instances of information silos due to inefficient technological integration, the input data should be structured in a format which optimizes the application and usability by the succeeding steps in the process in order to increase efficiency and leverage the acquired technological infrastructure. A consistent structured data format minimizes risks with data entry and supports data integrity. The input data could be further altered to automatically feed into Avanti thereby, incorporating further automation to the process. This exemplifies the advantage of using electronic based data as an input rather than manual entering from data forms, which is seen with the use of paper documents (Refer to Appendix IV. *Payroll Process Model, CCPIM* Subprocesses 1-4, 8 & 12). Once the input data is electronically formatted, its use can be maximized for efficiency and technological leverage through customer- facing portals. Considering the payroll and benefits processes, creating a portal for employees to validate and monitor their own information would create information in an electronic, usable format, and support the transparency principles presented in the previous sections. It would also shift the process focus to support customer relationship management and service.

The common theme found related to all of the resultant process maps in this case study involves the possibility for additional leveraging of technological solutions. Adopting the information system is only part of the solution. To increase the quality and efficiency of workflow and overall outcomes, the Human Resources department must ensure the system is operating in its full capacity. This means considering the strategic benefits of all of the software applications and avoiding replicating old processes with new tools. With additional training, the information system has the potential to enable further process control and flow. Additionally, the department could evaluate features of the new information system to allow management to analyze trends and use business intelligence for benchmarking, continuous improvement, and competitive advantage. Therefore, the features of the Avanti software should be evaluated with special attention to elements that are available but not already being used for process enhancement.

Similarly, Figures 26 & 27 presented information being used in silos. This was demonstrated by the occurrences of data in Avanti but re-entered into other electronic systems by other departments or entities. For example, although the Human Resources department and Accounting & Finance department collaborated on CMCC's payroll process, each department had their own information system which did not link information. A similar occurrence was seen during the Hiring & Recruiting process when information was electronically entered and stored separately in the Human & Resources department's information and Media Services information system. These examples of silo entry and storage of information demonstrate a lack of effective technological integration into process. Data integrity and storage risks can also cause threats to data security, As a private organization, CMCC is subjected to privacy information laws such as Personal Information Protection and Electronics Data Act, 2000 (PIPEDA) and Personal Health Information Protection Act, 2004 (PHIPA) that govern the collection, use and disclosure of personal information. According to the resultant process maps, the current hiring and recruiting, payroll and benefits processes do not leverage the new information system to explicitly track and monitor possible compliance issues based on these regulations. With these practices, CMCC was supporting a functional management focusing on individuals and departments, rather than Lean process oriented management spanning across functional areas.

Process analysis of the administrative process maps also indicated a need for improving the format and consistency of information and information storage. There are multiple instances of paper documents and binders used to store information. Figure 26 reveals an example of this storage as demonstrated by a "working paper" binder icon.

This storage binder is under the responsibility of the Payroll & Benefits Coordinator, even when the associated tasks of the subprocess are completed with the use of the computer based information (Refer to Appendix *Case Study 3. Payroll Process Model*, Subprocesses 9-11). This lack of consistency is inefficient as it further results in additional work with the need to maintain, secure, and store documents.

Section 5.3.5. Change Management

Analysis of the resultant process models presented opportunities for effective change management. The most significant identifiable result for change management was the need to overcome silos. The focus on process improvement should assume an "end-to-end" perspective with increased communication across departments. This would support of a process driven environment ideal for managing change rather than a functional management approach where staff tasks and information is concentrated solely towards their own function or department. The "end-to-end" design involves people, tasks and information and their implications on the process and creation of value for the customer. Senior management is encouraged to consider this holistic process perspective across the barriers of organizational structured departments at CMCC.

CMCC is recommended to create initiatives within individual departments to create an organizational culture which supports change (Masodi, 2013). For example, the administrative department should encourage employees to provide feedback regarding the use of the new information system to support the targeted processes through formal documentation. This documentation would aid in feedback analysis and could be used by the departmental managers to guide change management. Additionally, a program of frequent sessions for human resources employees to reinforce training and develop behaviours needed to sustain the change should be created. These approaches for employee involvement would create a sense of empowerment and ownership of action (Masodi, Ahmadi & Salavati, 2013). It would also minimize the risk of resistance to change by monitoring the current state outcomes from the perspective of the human resources employees. Assuming an alternative perspective is another strategy to aid in managing change (Masodi et al., 2013; Teubner, 2013). Change management theories and frameworks are further discussed in the conclusion of this thesis (Section 7.2).

Chapter 6. Limitations & Future Research

The purpose of this thesis was to apply a holistic perspective of systems-thinking and process modeling to examine processes across a single organization, following the adoption of new information technologies. The researcher aimed to create process models and analyze the targeted processes using Lean management approaches, ultimately providing the organization's departments with process improvement recommendations. The research was divided into three distinct case studies focusing quality, business process management and process modeling within context of each case. We suggest future studies to consider longitudinal analysis to examine the impact of recommendations presented in this thesis; this suggestion is based on the Lean principle of continuous improvement by monitoring outcomes, evaluating the impact of the changes, and ensuring sustainability of improvements (Bamford et al, 2015; Burgess & Radnor, 2013).

Although this research presented valuable findings for industry and academia, there were limitations to be considered. The research included small sample sizes. Processes from CMCC's Human Resources Department were directly analyzed,; business process cases constructed by UOIT Capstone students in the Accounting & Finance, and Information Technology departments supported our findings. Still, we recognize thatevery administrative department at CMCC was not included in this study. Therefore the conclusions drawn from this research are based on a total of three administrative units. Although few departments were included, the selected departments provided variation in functional area while still accounting for core processes at CMCC.

As a whole, the selected units were considered to provide an accurate representation of the state of the organizations overall administrative functions.

To examine patient journeys, samples from two of CMCC's clinical sites were considered.. The Campus clinic and Sherbourne clinic were selected because the research timeline had aligned with implementation of the EHR at these locations. A convenience sample matching our timelines ensured that process data could be captured pre- and post-adoption of the information system at the campus clinic, and post-adoption at the Sherbourne clinic. Fundamentals of the patient journey were inferred to be similar at all sites given the journeys were processes within a single organization. Therefore, the selection of two clinical sites, rather than every possible site, provided an inclusive representation of the general patient journey at CMCC.

Small quantitative data samples, related to patient observations were collected, due to time constraints and difficulties of scheduling. The researcher was limited to observing solely new patient and re-evaluations, as the remaining appointment type involved completing treatment for the patient, instead of the additional patient intake and clinician consultation procedures. Therefore, scheduling the patients observations were based on the availability of new patient or re- evaluations, the clinic schedule, as well as the willingness of participants. The observations were exceedingly time consuming and difficult to coordinate. Schedule changes due to the institution specific clinical education calendar were limiting factors as these had to be considered in coordinating effort. To overcome these limitations, the process models were rigorously cross-validated by seeking staff and student input. The administrative models were validated through multiple focus group sessions including the department's employees to support an accurate reflection of current processes. The clinical processes were validated through focus groups including employees and interns. The clinical process maps were enlarged and posted in the clinic hallway to openly solicit comments.

Although CMCC employees and students were invited to participate patients were not. Direct input from patients or customers was not collected. Considering the limitations of not including patient participation, the resultant process models may not be representative of individual experiences. To minimize the impact of this limitation, the research design incorporated customer and patient focused methods, such as specialized process modeling tools, to gain indirect patient or customer perspective. We identified opportunity for future studies to use this thesis as a starting point, and include a more broad range of perspectives by collecting data from patients, patient's families or caregivers and customers. Data could be collected using role-specific surveys, focus groups, or an invitation to participate in post-it note collaboration used in Case Study #1. Future research could emphasize collection of heterogeneous data and perspectives from all roles. The significance of the results may not be directly applicable to other clinical settings or healthcare applications. However, given the robustness of data and results, the researcher believes similar benefits will be possible.

Case Study #2: Process Modeling & Clinic Site Comparison, (Section 5.2.1) presented a comparison between the process modeling tools BPMN and PaJMA. We specifically examined model construct, representation of metrics and capability to integrate of technologies. There is opportunity for future research to expand this research to include other dimensions for comparators, such as the tool's use and effectiveness in different industries. Furthermore, future research can also use the evaluation of PaJMA and

BPMN presented in this thesis as a basis to compare additional process modeling tools such as VSM or UML. We suggest including additional comparators to add new dimensions to the research.

Case Study #1: CMCC Campus Clinic (Section 5.1.1) explores the method and challenges in developing a simulation based on static process models. Flexsim software was used to create the simulation. The researcher had novice level experience in the area of simulation and minimal experience with Flexsim software prior to this research. The researchers lack of expertise in the area of simulation and unfamiliarity with the software could have been a limitation in this study. There is possibility that a simulation expert may have extrapolated different data, such as scheduling data,. The expert could have used a different method and simulation software to develop the same dynamic models. We suggest researchers conducting future studies, with beginner or novice level experience with simulation should begin with thorough review of the software and practice application prior to developing the model to truly leverage all software features.

This chapter has summarized limitations of this research and provided suggestions for future research studies. We have used scientific reasoning and methods to investigate and present findings. With this research serving as initial groundwork, there is opportunity for future research to include broader scope and greater impact.. Using innovative and creative approaches, and precise, well-developed research methods will impact validity and reliability of results in process management research regardless of the type of industry.

Chapter 7. Conclusion

This research aims to determine how process mapping can support process improvement in a clinical organization following the adoption of new information technologies. The three case studies presented in the previous chapters applied specialized mapping methodologies and process analysis using Lean principles. The first case study presented a current and future state analysis of the clinical process at CMCC's campus clinic and process simulation. This was followed by a comparison between central and external clinical sites, and variations in applying process modeling tools: PaJMA and BPMN. The final case study complemented this research by evaluating processes modeling applications to organization-wide administrative support functions. This chapter will present a conclusion to this thesis. The significance of the results will be summarized and linked to the thesis research question: "*Can modeling processes enhance process improvement and technology integration across all areas of a clinical organization following the adoption of new information technologies?* This chapter will also address the individual subquestions identified in Chapter one.

Section 7.1. Research Sub-Questions

a) *How can process modeling provide a basis for in-depth simulation scenario analysis for strategic planning?*

We found that process modeling methods and the resultant tangible process models provide a basis for in-depth simulation scenario analysis which could be applied to improve strategic planning. Combining process model development and validation methods enable reflection of detailed, accurate accounts of process elements, variables and interdependencies. We observed process modeling to be a relevant means to identify opportunities for efficiencies and current and future state of an organization's: information management, technological infrastructure and capabilities, customer role and needs within the process, quality, compliance and practice standards.. These current and future state categorized concepts are vital to an organizations improvement, business management & strategy.

Supported by supplementary primary and secondary data collected from interviews, focus groups, observations, and EHR data, process models were easily translated to develop dynamic simulations using computer software. This thesis found that application of a specialized process modeling tool which captures detailed metrics, will effectively aid translation from the static process model to a dynamic simulated model. The PaJMA tool was especially effective to support translation due to high ease of use, inherent patient-centric focus in model construct, and ability to capture detailed metrics, including time, technologies, and information flow. Metrics were easily transferable to the patient track used in simulation computer software. Similarly the patientfocused model construct complemented the patient track and modules used in the simulation software. We found that using a process model which depicted a patient journey, centered on the premise of creating patient value and activities as the foundation of a simulation, will support Lean-thinking to analyze and conduct experiments for strategic planning. However, in developing the simulation, we were unable to provide enough scheduling information to complete a scheduling module in the software. This missing information is imperative in running tests and conducting statistical experiments. Therefore, future research should use the PaJMA tool; however flexible metric layers should be adapted to reflect scheduling requirements to aid in in-depth strategic planning.

b) *Can strengths and weaknesses of process modeling approaches for technology enabled processes be identified through comparison of methodologies?*

This research was designed to incorporate TQM . TQM is not an industry-specific philosophy. The case studies presented in this thesis involved clinical patient journey processes and administrative processes from Human Resources department; therefore it was appropriate to apply TQM.TQM inherently combines Systems-thinking, process management and human behaviours to support continuous improvement (Hackman & Wageman, 1995; Bryan, 1996; Richards 2012). A basic tenet of TQM assumes that costs of poor quality are greater than the costs of managing or creating processes that yield outcomes of greater quality, therefore greater value (Hackman & Wageman, 1995).

Consistent with TQM, we applied holistic Systems-thinking to modeling and analyzing processes in technology-enabled environments. Each case study involved acquisition of a new information system in opposing subject areas: clinical and administrative. Systems-thinking approach views the processes as a whole, going beyond compartmentalizing aspects, to consider the process environment and interdependencies of the system. Therefore, without creating silos by isolating individual parts of organization, Systems-thinking supported comprehensive definition of processes to include context, impact and purpose.

In addition, to TQM, each case study incorporated Lean principles. Process models were constructed using user-centric process modeling tools, namely PaJMA and CCPIM. We found the user-centric nature of the tools distinguished the role of customer or patient in the process. Combination of process modeling approaches TQM and Lean, enabled process definition, and measures of patient or customer value and non-value; these variables were linked back to business context and organizational strategy for complete analysis.

Similar to TQM, Lean principles, consider human behaviour to be a fundamental aspect of process improvement and quality management (King, 1997; Shirazi & Pintelon, 2012). This thesis considered the influence of human behaviour on process modeling and analysis as it relates to TQM and Lean. We strategically incorporated multidisciplinary collaboration efforts and emphasized participant engagement in our research methods with the notion that every staff member's contribution significantly impacts the organizations processes and outcomes. We found that this strategy supported staff empowerment, active communication, and accountability. Participants openly or anonymously communicated feedback, opinions and concerns through interview, focus groups, and post-it notes. Participants were given autonomy to choose to a contribution method, how much information they wanted to provide, and level of personal information disclosure. Staff was given a means to contribute their own perspective to define processes and determine customer value and non-value.

Engaging multidisciplinary participants in process modeling approaches supported accounts of diverse perspectives which may not have been included if the process modeling technique had solely engaged a single specific staff role. Multidisciplinary collaboration promoted discussion between roles and within roles, with the purpose of establishing clarity of the process elements, responsibilities and accountabilities. Collaboration and engagement required staff to consider their own contributions to the processes and their impact on the system. Similarly, participants were required to consider others' roles in the same context. Since some participants were not initially aware of the contribution of other roles, this often involved further discussion and reflection. The multidisciplinary participants gained new information and understanding of the process and system. Diverse perspectives sustain validity of the results and application of the models.

Each case study in this thesis applied a bottom-up approach to process modeling and validation. The bottom-up approach relied on engagement and collaboration of stakeholders at all levels of the system, including key stakeholders who directly interact with the customers. Engaging various roles with no restrictions on organizational hierarchies enhanced robustness and reliability of data due to the required inclusion of comprehensive, heterogeneous participant population and sample data. Furthermore, the bottom-up approach was strategically inclusive to foster buy-in from various roles, and support change acceptance and management. Change management analysis and recommendations are discussed in Section 7.2.

This thesis recognizes limitations of TQM approaches to process modeling. Data collection and analysis was evidently time-consuming, resource-intensive and required high degree of effort. To develop and validate the process models, we needed to gain access to, and effectively engage many stakeholders from various areas of the organization. Therefore, we needed to consider possible costs, scheduling restrictions, and efforts of communicating with these study participants. Because the research was conducted in technology enabled environments, we integrated EHR data to corroborate results of the process models. We found challenges in drawing absolute concrete conclusions from the analysis and discovered limits of inadequate data sample size and insufficient level of detail in the datasets. We suggest that future studies include larger, diverse data samples size to support sophisticated process modeling and analysis. Moreover, intrinsic complexities of process modeling that uses Systems-thinking and Lean were recognized in this research. This level of complexity suggests possibility for difficulties in interpreting and truly comprehending the entire process, beyond a compartmentalized silo. Therefore, complexities may hinder transformation from theoretical notion to a tangible model that can be manipulated for experimentation and applied to the real world. Additionally, we confirmed the significance of selecting an appropriate methodology and tool for process modeling in a technology enabled environment. The selected approach and tool should flexibly account for information management factors and technological infrastructure to accurately reflect all process elements, constraints and interdependencies.

e) *Will process modeling enhance consistency of operational practices and service quality across multiple clinical locations?*

We found that process modeling can enhance consistency of practice across multiple locations by producing careflow models, and comparing the results between clinic locations. *Case Study #2: Process Modeling & Clinic Site Comparison* specifically addresses this research sub question. The second case study in this thesis presented the methods and outcomes of comparing two process models. The patient journey process model from Case Study #1: CMCC Campus Clinic was compared to a second, newly developed patient journey process model. The second process model derived from a different dataset, which was collected to reflect the patient journey at an external clinic site. Both models used the same process modeling methodology and tools. Therefore, *Case Study #2: Process Modeling & Clinic Site Comparison* demonstrated a means of gauging consistency of operational and information management practices across multiple locations within a single healthcare organization. Theoretically the two models would be similar, if not identical to ensure the same standard care is provided across the organization, regardless of where the patient seeks treatment.

Using PaJMA process modeling tool to construct, analyze and compare the two models, aided in explicit identification of variations in the process. Process variations or inconsistencies can theoretically present potential risk. . Evidently, process modeling served as an indicator of compliance standards and vehicle to enhance service quality.

The claim that process modeling enhances quality is based on the Donabedian's (1990) definition of service quality, namely the conjunction between service provision and patient perspective (Campbell et al., 2000; Donabedian, 1990). Donabedian's definition recognizes the complexities individual patient circumstances. He suggests service quality is achieved through alignment of the healthcare professional's objective and the needs and expectations of the patient (Campbell, et al.; 2000; Donabedian, 2009). We found that process modeling and analysis using PaJMA enables a comprehensive, systems perspective to the patient journey. PaJMA process models define multiple internal and external roles as related to the patient journey.

We assume that the healthcare professional's objective is to provide ideal medical practices for the patient, based on Donabedian's quality categories: efficacy, effectiveness, optimality, acceptability, legitimacy, and equity (Donabedian, 1990). These categories were described in section 2.1. The PaJMA models included clinical process activites and decisions, information management, technological capacities, patient needs, practice guidelines, policies and time. The metric layers directly or indirectly affect provision of medical care. Therefore, process modeling using PaJMA incorporated the healthcare professional's objective of providing high quality care.

PaJMA process models are constructed with all activities relative to the patient's role. The models are patient-centric, specifically designed to understand the patient's role and patient perspective. The models include a specific metric layer to define patient needs; yet if patient needs are not explicitly defined in the patient-centric model can be interpreted to indirectly suggest patient needs and expectations. Since the PaJMA process model construct clearly combines clinical objectives with patient needs and expectations, process modeling supports enhanced service quality.

Moreover, process modeling presents a systematic method to define and analyze careflow processes to identify opportunities for improvement and efficiencies . According to the Donabedian's quality categories defined earlier in this section, efficiency is a healthcare professionals objective, and logically efficient care is what the patient expects and needs. Therefore process modeling is a means to enhance service quality.

Process modeling was found to support organizational policy review. Process modeling using PaJMA explicitly documents significance of standards of best practices to be used for organization-wide consistency. For example, artefacts distinguish policy and clinical guideline documents related to best practices; these artefacts are explicitly identified using PaJMA and linked to each appropriate process activity or clinical decision. Considering the linkage, and the inherent intuitive nature of PaJMA, the models can potentially aid as an effective training tool for students from all clinic locations to learn best practices.

c) *Will process modeling improve communication, operational efficiency, and technological adoption within functional administrative units?*

Process modeling can enhance understanding and practices between functional units. *Case Study #3: Integrating Technology across the Organization* directly addresses this sub question. This case involved developing a series of process models to represent processes from various administrative departments.

These administrative departments are essential to the function of the healthcare organization. Each process model in the series used the CCPIM tool, thereby incorporating the viewpoint of customers; customers were internal or external to the organization. The process models were analyzed to understand the current state and role of stakeholders. In addition, we aimed to identify opportunities for streamlining the processes and provide recommendations for process improvement to the healthcare organization.

The administrative processes often involved contribution from multiple roles from varying departments across the organization. Methods for creating and validating the process models clarified details of the multifaceted nature of the processes. Ultimately the functional departments were given the resultant process models. These models presented clear, detailed, end-to-end representations of the entire process, in a medium which accounted for the various process complexities and interdependencies.

Besides supporting a clear understanding of complex details, process modeling encouraged interactive collaboration and communication. Staff roles were encouraged to provide their own perspectives of the process. Therefore, process modeling required staff to reflect on the function of their own roles and tasks, as well as the purpose of the others' roles and tasks. Given the CCPIM process models, Staff were able to visualize from a systems-thinking perspective, how individual roles contributed to the overall process.

The case studies in this thesis primarily used the customer-centric tool, CCPIM to model functional departments, and patient focused tool, PaJMA, to model clinical processes. We found that employing a consistent methodology to developing and validating process models, including consistently using customer-centric or patient-centric tool, supported ease of use and common language of process improvement across the organization.

Process modeling provided a valid account of information management and technological capabilities of the system. We were able to identify opportunities for departments to leverage these capabilities to avoid replicating old processes with their new information systems. In addition to technological integration, process modeling was found to support quality control and flexibility. Process modeling aided identification of inefficiencies and risk. We identified touch points, transfer of information between departments, and delays within the process. Finding these inefficiencies presented opportunity to enhance communication in specific areas of the process, between departments to mitigate risk.

Section 7.2. Continuous Quality Improvement & Sustaining Process Change

This thesis has used a series of case studies to examine the applications of process modeling as a means to enhance service quality, information management practices and technology integration following adoption of new information systems. Clinical and administrative processes at CMCC were modeled and analyzed, and process improvement recommendations were provided to the organization.

Although we have provided process improvement recommendations to CMCC, we acknowledge that the process improvement initiative is not complete. At this stage we probe, "How can CMCC effectively implement the recommendations and sustain the process changes for Continuous Quality Improvement?" To address process change, implementation and sustainability, and Continuous Quality Improvement, this section explores change management theories and frameworks.

Change management commonly fails when there is a lack of employee engagement at all levels of the organization, insufficient time allotted to adapt to the change, and insufficient understanding of what drives the nature of the change (Stanleigh, 2008). Barriers to successful change are attributed to resistance. Resistance to change in various forms is natural. Human anxieties are typically exhibited during unfamiliarity or change that was not agreed with (Pãun, 2014). Nonetheless, the degree of resistance is dependent on whether or not the people that need to adopt the change agree with the proposed change (Luo et al., 2006). Therefore we suggest for CMCC to proactively anticipate and prepare for change resistance.

To overcome resistance to change, socio-technical systems and organizational strategy should be objectively considered (Carter, 2008; Hines et al., 2004; Pãun, 2014). Application of change theories that include consideration of socio-technical factors and strategic-thinking, is a widely accepted approach for managing change (Hines et al., 2004; Joosten et al., 2009). Chapter Two (Section 2.5) discussed change theories: Lewin (1947), Kotter (1996), and Learn and Engage (Worley & Mohrman, 2014). We combine these change theories with Lean principles in our analysis.

Change should consider humanistic dimensions such as organization culture and well-being of staff (Shirazi & Pintelon, 2012). Similarly, complex aspects of human behaviour and psychology, such as motivation, respect, and empowerment, should also be considered (Hines et al., 2004). Initiating change should incite a sense of urgency through early motivation, and learning and engagement between staff roles (Burnes, 2004; Lewin, 1947). Moreover, it is essential to include modes of stakeholder communication, collaboration and leadership. Change management strategies should be inclusive, and viewed from a bottom-up approach to engage and empower staff from all levels of the organization (Mannon, 2014; Worley & Mohrman, 2014).

Staff leading the change must be transparent and open to gain trust from other staff members. Staff members should feel safe to express their concerns and freely express ideas. Effective change management shifts blaming staff members to focusing on the process. Metrics should be openly displayed in departments to strategically link departmental objectives to the organizations objectives, and demonstrate openness (Mannon, 2014).

Furthermore, senior management's buy-in and support is essential to effective change management. In clinical context, Joosten et al. (2009) suggest successful change management requires the managers to understand their role is to improve and develop their own team members; their role is not to improve clinical care processes. The manager's objective is to enrich their team members and environment to develop a system where communication and collaboration between staff results in the highest possible level of performance and quality Therefore, ownership and improvement of clinical processes rests with the healthcare professionals within the clinic (Joosten et al. ; 2009).

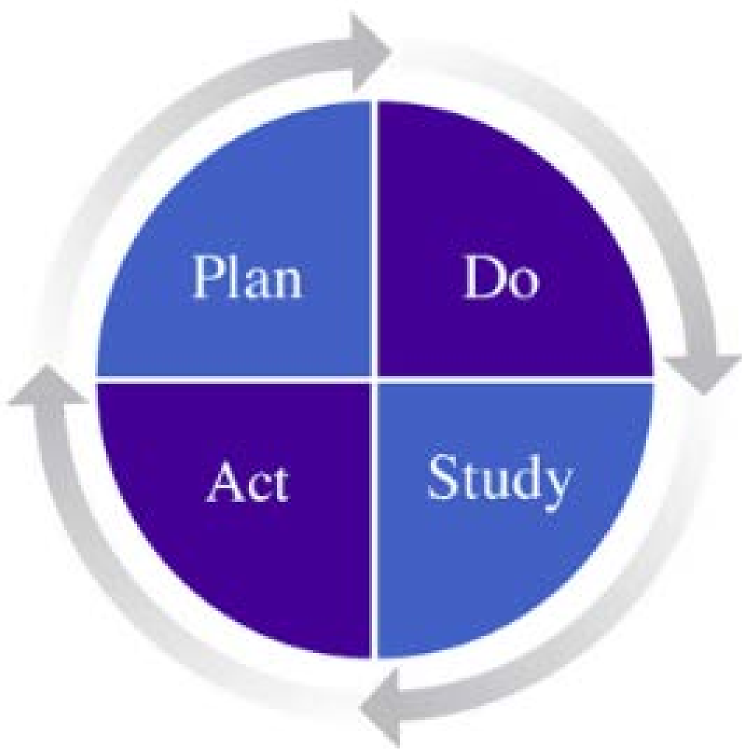
Change theories explain the need for a mechanism to monitor effects of change, and detect errors for successful implementation and sustainability (Kotter, 1996; Pãun, 2014; Worley & Mohrman, 2014). We suggest CMCC use Edward Deming's Plan-Do-Study-Act (PDSA) change management framework to implement and sustain process changes. Using a formal framework to provides a vehicle to clearly explain process change concepts and promote buy-in (Donnelly & Kirk, 2015). PDSA is an iterative scientific method that incorporates Continuous Quality Improvement to monitor changes in complex systems (Ward et al., 2017). It is commonly used in healthcare for quality improvement; wherein quality improvement refers to better healthcare safety, efficiency, timeliness, effectiveness, equitability, and patient centeredness (Broman et al., 2016; Donnelley & Kirk, 2015)

The first step to PDSA is called "Plan". At this step, the inefficiency is clearly defined. It is verified to be a concern data because has been collected and a baseline measure exists. Additionally, the aim and impact of the change has been identified, and a detailed implementation plan has been recorded. The implementation plan includes identification of specific key roles and accountabilities relative to the change (Donnelly & Kirk, 2015; "PDSA cycle", 2017).

Interestingly, this thesis and case studies aligns with "Plan" of PDSA. In each case study, process data were collected and modelled using user-centric process modeling tools. The process models were analyzed to clearly identify inefficiencies and propose solutions for the respective departments. Furthermore, the process models in each case study serve as a baseline measures. We suggest CMCC use this thesis as a starting point to create a detailed implementation plan for the process changes, completing the first stage of PDSA.

The second phase, "Do", is the implementation stage; the change is carried out as a test. Detailed is data collected, and results from the test are recorded. The next step is "Study"; results are analysed. Validity of the plan is tested since the analysis yields successes, and opportunities for improvement ("PDSA cycle", 2017). The fourth step is "Act"; at this stage we determine what measures and procedures exist that ensure the solution is effective and sustainable. If modifications to the goal, change method are required to ensure viability and sustainability, the required adjustments are identified at this point. PDSA is cyclical; therefore the cycle begins again at "Plan". A key characteristic of PDSA is the significance of a cyclical design. Iteration of the four steps shows a cycle of Continuous Quality Improvement (Donnelly & Kirk, 2015; "PDSA cycle", 2017). Figure 33 is a visual representation of the PDSA cycle.

Figure 33. Deming Plan-Do-Study-Act (PSDA) Cycle



Source: PDSA cycle. (2017). *Deming.org*. Retrieved 16 April 2017, from https://deming.org/management-system/pdsacycle

This thesis has used a series of case studies to examine the applications of process modeling as a means to enhance process improvement and technology integration following adoption of new information systems. Clinical and administrative processes at CMCC were modeled and analyzed, and process improvement recommendations were provided to the organization.

Section 7.3. Application for CMCC and Overall Recommendations

Synchronizing processes, people, information and technology with the organization's strategic vision and business goals will help CMCC deliver maximum value to its customers. Customer satisfaction is linked to the value of an organization's products or services. These products and services are, in turn, the result of an organization's processes. An ideal process is a process in which the creation of value is optimized from "end-to-end". Components of a process are activities, people and tools. These components have to integrate as a holistic TQM system to effectively and efficiently create value for the customers. Integration can be supported by proper management. Effective management relies on a thorough understanding of the customer's view of the process through comprehensive documentation and measurement. The organization is encouraged to leverage their technologies and information systems to align with processes; technologies and information systems should be integrated within the process.. Processes across departments should be aligned to avoid duplication of efforts, mismanagement of resources and information silos. The clinical case studies can be replicated to include all CMCC clinical settings to support complete clinical process alignment and standardization.

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Appendices

I. Research Ethics Board Approval (UOIT)

UNIVERSITY OF ONTARIO INSTITUTE OF TECHNOLOGY

RESEARCH ETHICS BOARD
OFFICE OF RESEARCH SERVICES

Date: October 10th, 2013

To: Saira Sukhera (PI), Jennifer Percival (Supervisor)

From: Bill Goodman, REB Chair

REB File #: 13-001

Project Title: Understanding Processes to Improve Patient Care

DECISION: APPROVED

START DATE: October 10th, 2013 EXPIRY: October 10th, 2014

The University of Ontario, Institute of Technology Research Ethics Board (REB) has reviewed and approved the above research proposal. This application has been reviewed to ensure compliance with the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS2) and the UOIT Research Ethics Policy and Procedures.

Please note that the (REB) requires that you adhere to the protocol as last reviewed and approved by the REB.

Always quote your REB file number on all future correspondence.

Please familiarize yourself with the following forms as they may become of use to you.

- **Change Request Form:** any changes or modifications (i.e. adding a Co-PI or a change in methodology) must be approved by the REB through the completion of a change request form before implemented.
- **Adverse or unexpected Events Form:** events must be reported to the REB within 72 hours after the event occurred with an indication of how these events affect (in the view of the Principal Investigator) the safety of the participants and the continuation of the protocol. (I.e. un-anticipated or un-mitigated physical, social or psychological harm to a participant).
- **Research Project Completion Form:** must be completed when the research study has completed.
- **Renewal Request Form:** any project that exceeds the original approval period must receive approval by the REB through the completion of a Renewal Request Form before the expiry date has passed.

All Forms can be found at http://research.uoit.ca/faculty/policies-procedures-forms.php.

REB Chair Dr. Bill Goodman, Faculty of Health Sciences bill.goodman@uoit.ca	Ethics and Compliance Officer compliance@uoit.ca

University of Ontario, Institute of Technology
2000 Simcoe Street North, Oshawa ON, L1H 7K4
PHONE: (905) 721-8668, ext. 3693

II. Research Ethics Board Approval (CMCC)

Certificate of REB Approval

CMCC

Project Number 132020 **REB Approval** 1307X10

Principal Investigator Sukhera, Saira Aaima

Faculty Supervisor Faculty Project

The project entitled Understanding Processes to Improve Patient Care.

has received CMCC REB Approval as of: 23-Jul-13

This approval expires in one year. The status of the project must be reported as of: 23-Jul-14

The investigator, or in the case where this pertains to a Student Investigative Project, the faculty supervisor, is responsible for ensuring that the work is conducted in accordance with the CMCC's Research Policy and the Research Procedure manual.

The investigator/faculty supervisor is responsible for notifying the ORA when this study is completed.

July 23, 2013

Mark Fillery, BA, CCRP
Research Administrator, Office of Research Administration

III. Interview Guide

<u>Interview Guide (REB # 13-001)</u>

June 1, 2013

The purpose of this interview guide is to gather information pertaining to the processes related to the functional centres of the organization. The research is being supervised by Dr. Jennifer Percival and Dr. Silvano Mior, with Saira Sukhera as the principal investigator. The goal of this guide is to gain greater understanding of the elements of individual sub-processes to allow for the construction of a detailed graphical representation of information flow, and an enhanced analysis of the outcomes in terms of efficiency and quality.

The interview will be conducted upon the participant's signed consent. The interview will be digitally recorded and then transcribed. Although the information gathered will be confidential, individual staff roles may serve as identifiers in the completed study. The following questions have been approved by the UOIT Research Ethics Board.

Interview Questions

1. What is your title role in this department?

2. What are your department's main functions as part of this organization?

    a. Describe your daily tasks and responsibilities.

3. I would like to understand the individual steps involved in completing your departments main functional processes. Using as much detail as possible, describe the procedure to complete these processes.

[*Ask the following follow-up questions for each of the procedural points listed by the interviewee(s) in the previous question*]

a. Who is involved in this process?
    i) What other staff roles are involved? Probe: how are they involved?
    ii) Is the employee/patient/customer present, or involved during this process?
b. Can you explain any instances where special attention must be paid to specific needs of the patient or customer during completing this step in the process?
    i) Can you explain these patient/customer needs? Probe: Do these patient/customer needs effect the task process? If yes, how?
c. Is information being updated, created, or recorded in each of these processes?
    i) If yes, by whom?
    ii) What type of technology is being used?

iii) Who has access to this information?

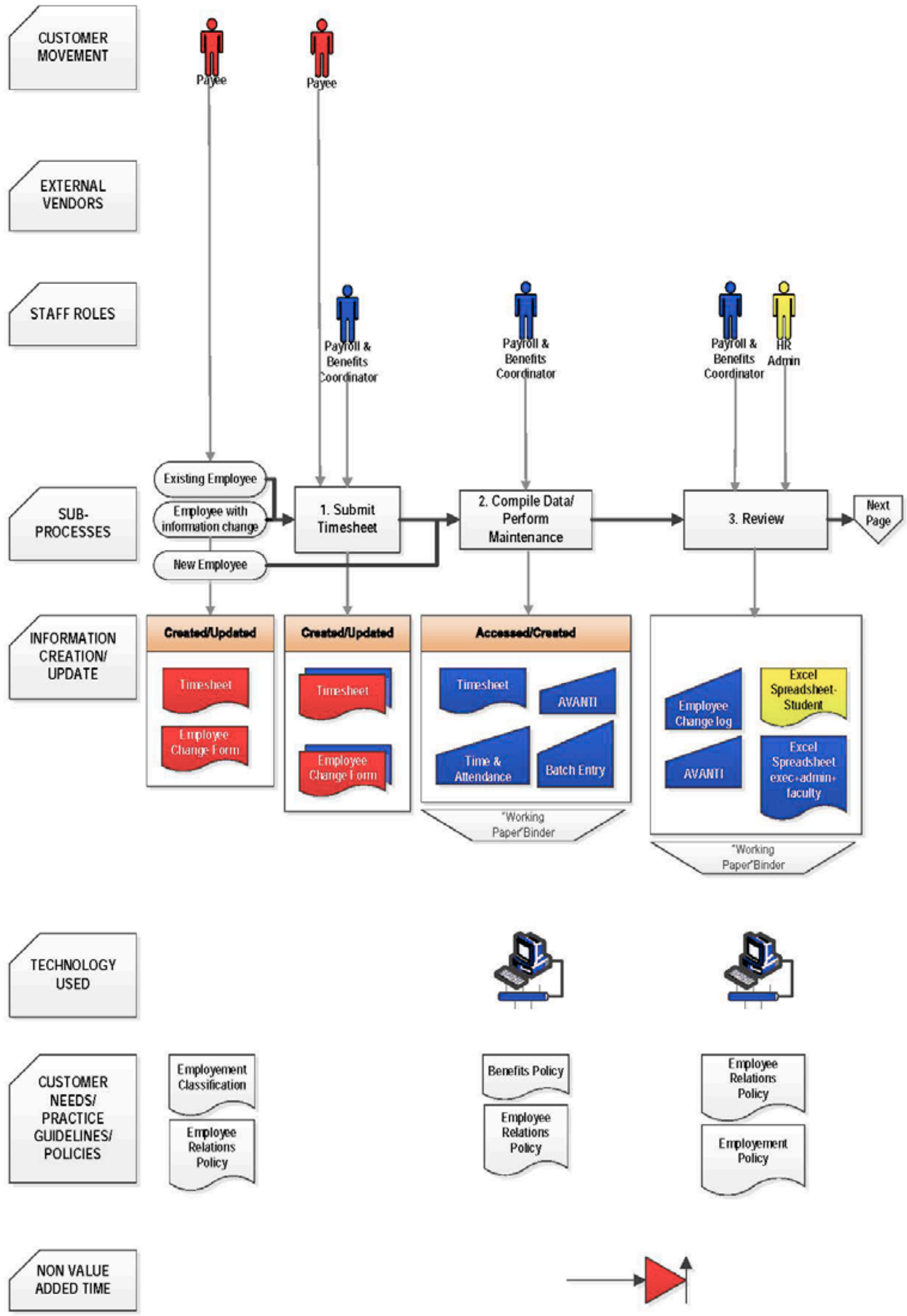
d. Is there a specific standardized protocol, policy or guideline being followed at this stage?

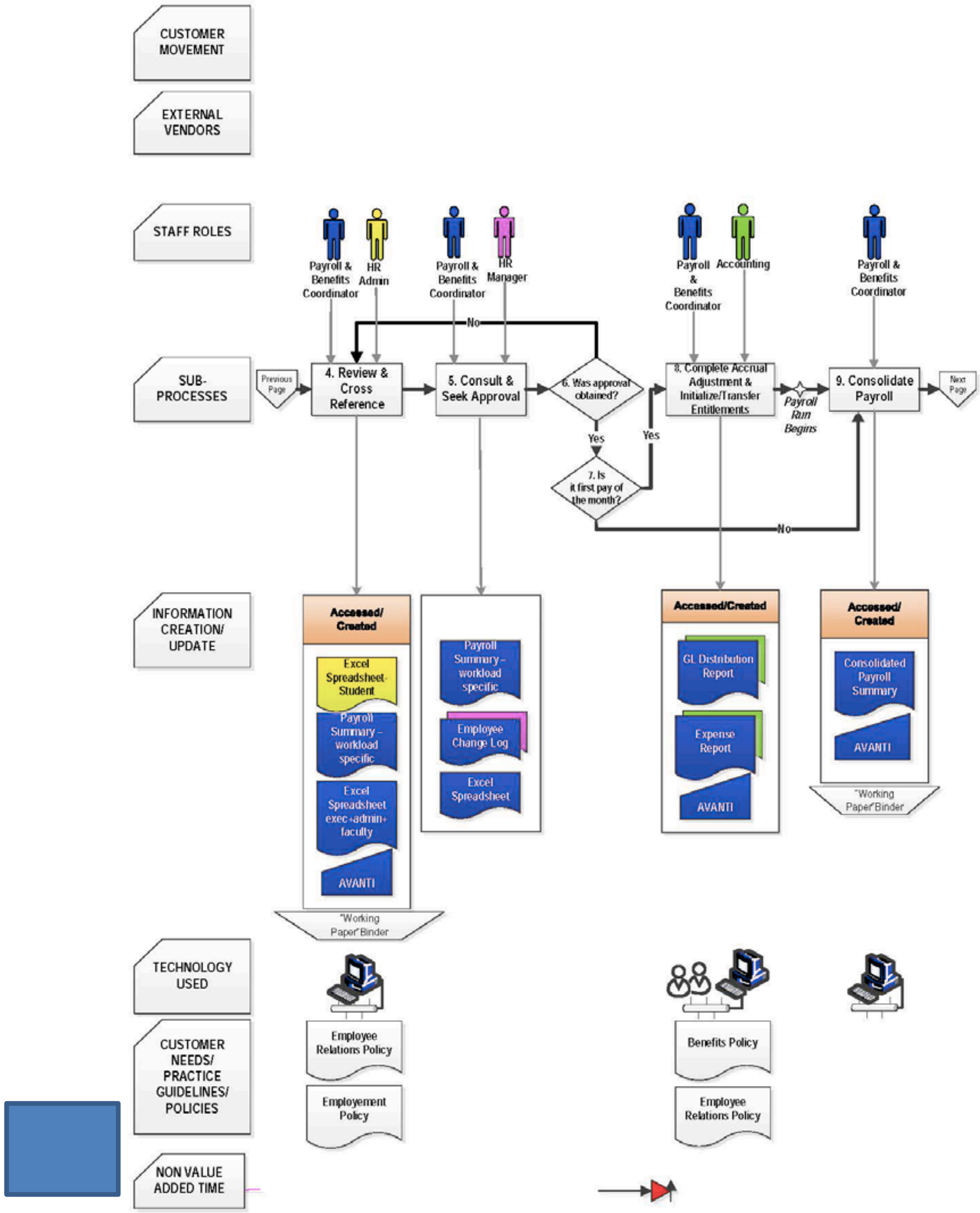
e. How long does this stage of the procedure take to complete?

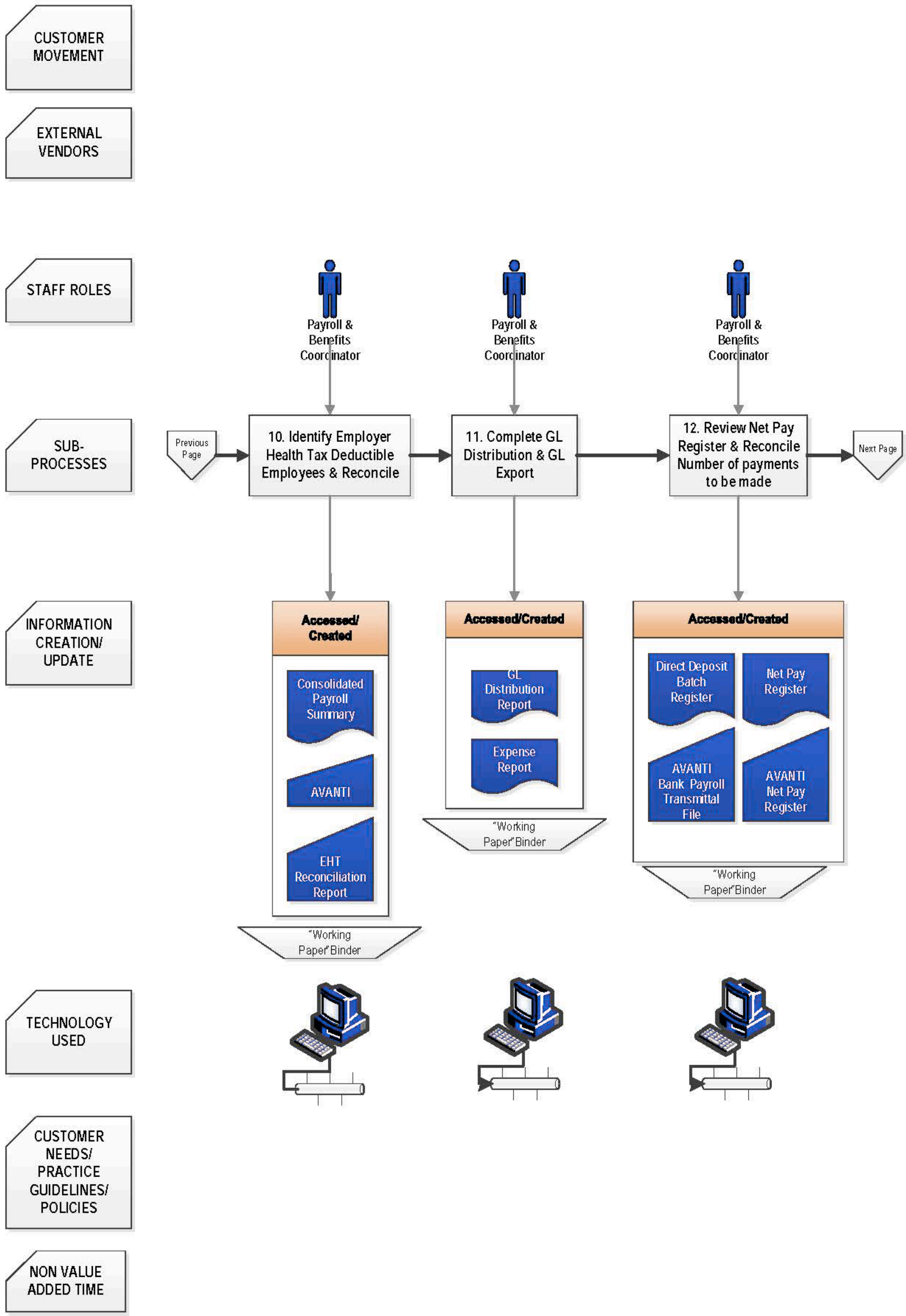
4. Is there any segment of the current process that you feel is ineffective?
   i) If yes, explain.
   ii) Are there any suggestions you have to improve the current processes?

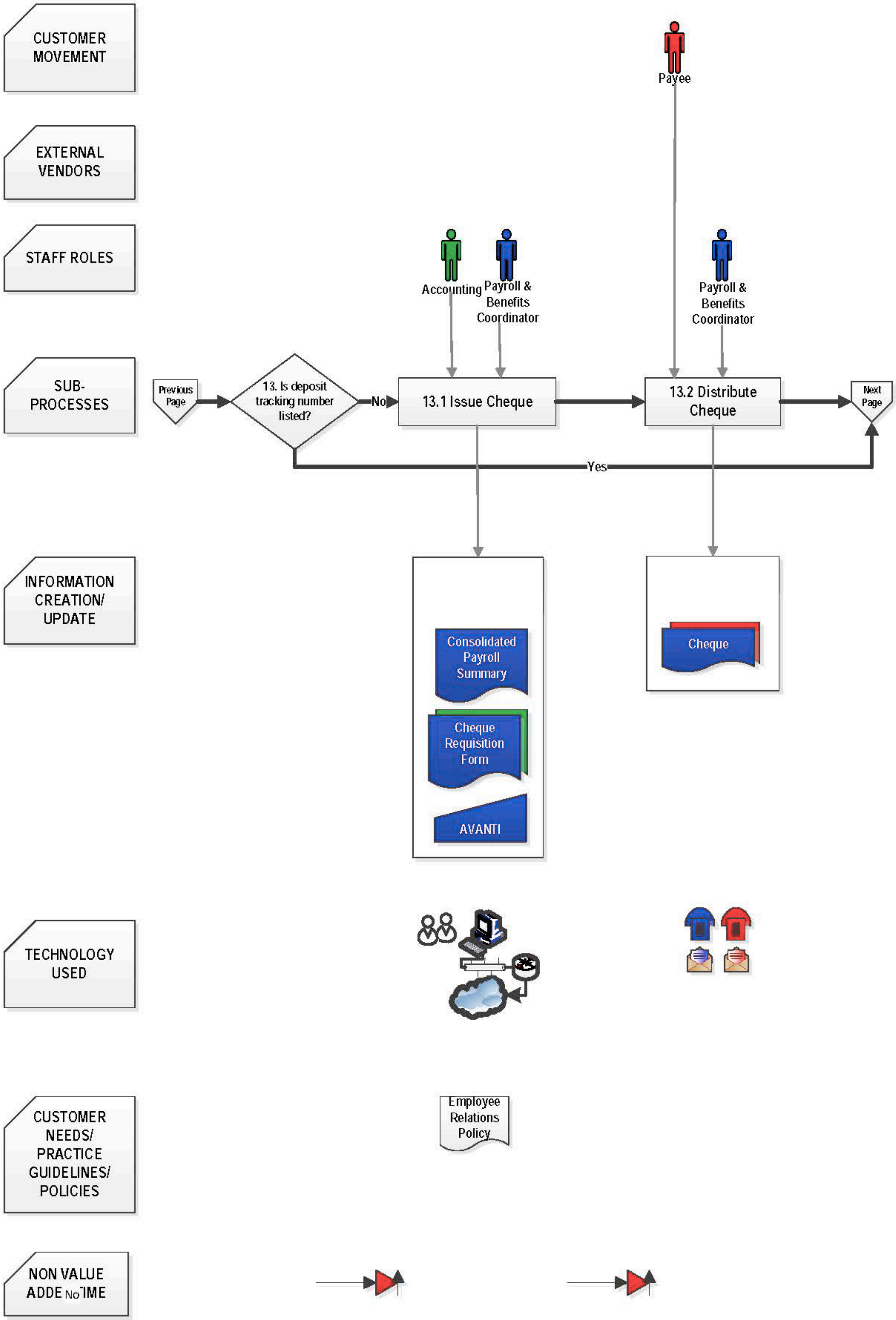
End of Interview

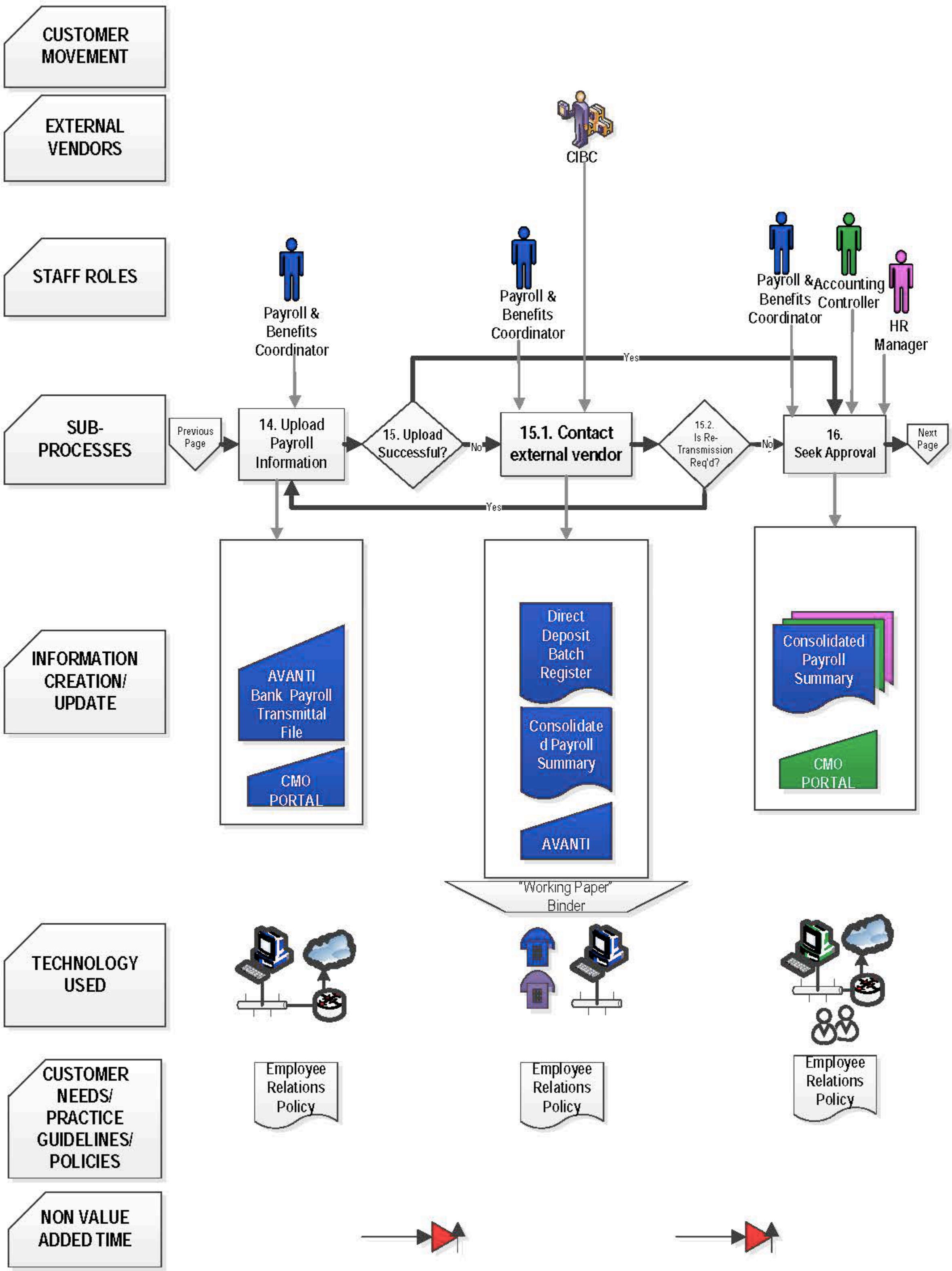
IV. Payroll Process Model, CCPIM

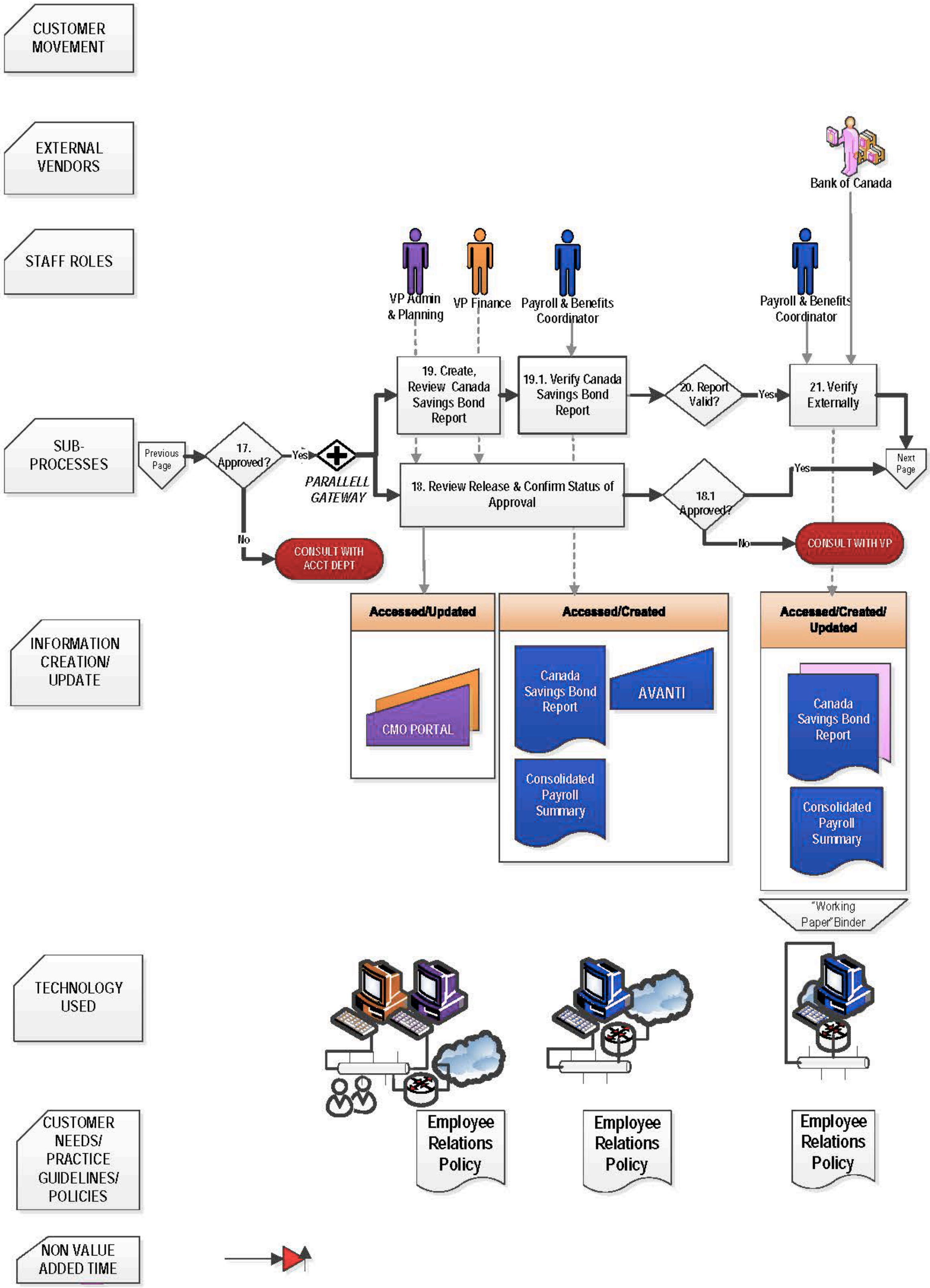


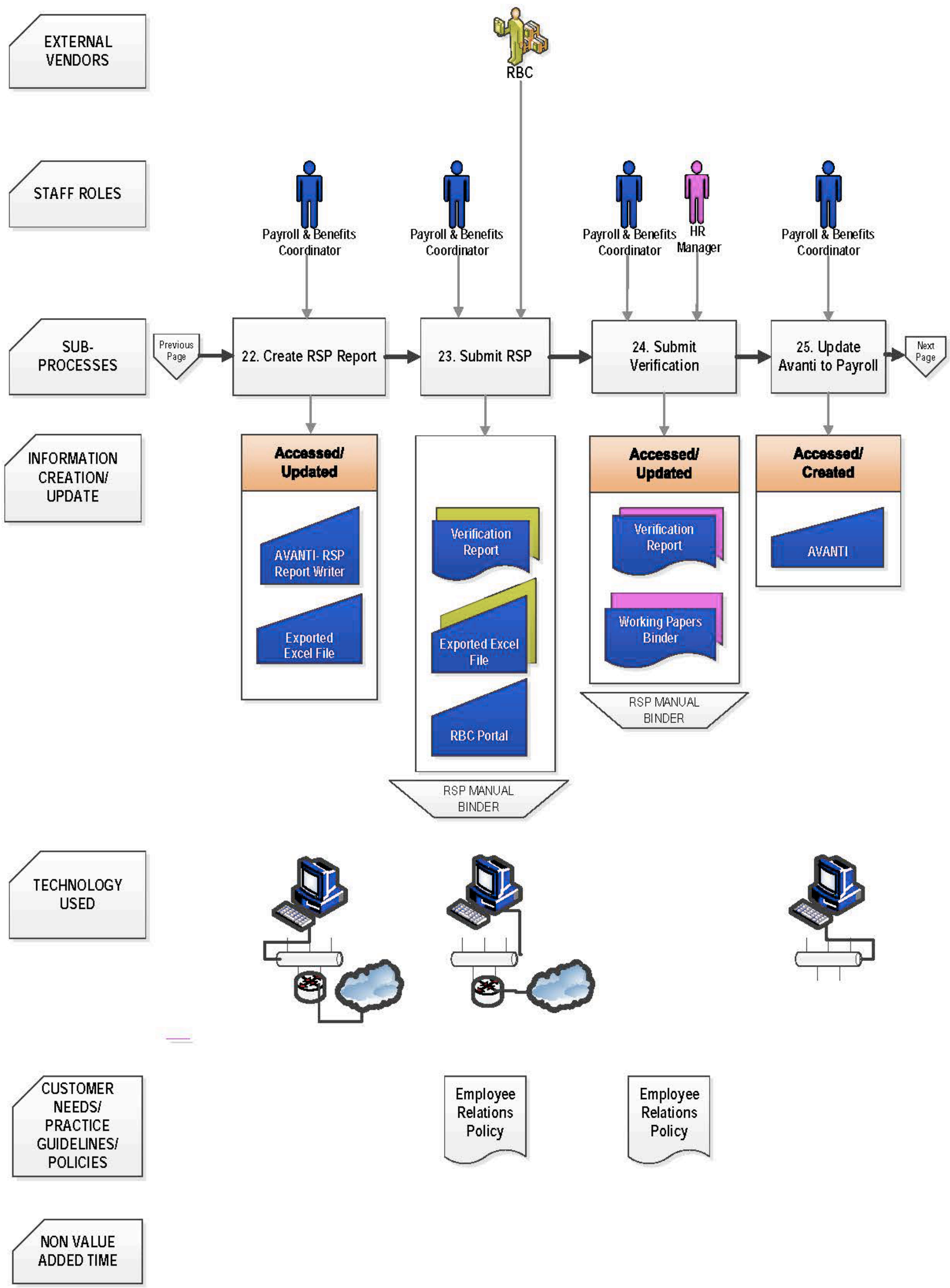

CUSTOMER MOVEMENT
EXTERNAL VENDORS
STAFF ROLES
Payroll & Benefits Coordinator
HR Admin
Payroll & Benefits Coordinator
HR Manager
Payroll & Benefits Coordinator
Accounting
Payroll & Benefits Coordinator
SUB-PROCESSES
Previous Page
4. Review & Cross Reference
5. Consult & Seek Approval
6. Was approval obtained?
No
Yes
7. Is it first pay of the month?
Yes
No
8. Complete Accrual Adjustment & Initialize/Transfer Entitlements
Payroll Run Begins
9. Consolidate Payroll
Next Page
INFORMATION CREATION/ UPDATE
Accessed/ Created
Excel Spreadsheet-Student
Payroll Summary – workload specific
Excel Spreadsheet exec+admin+ faculty
AVANTI
"Working Paper" Binder
Payroll Summary – workload specific
Employee Change Log
Excel Spreadsheet
Accessed/Created
GL Distribution Report
Expense Report
AVANTI
Accessed/ Created
Consolidated Payroll Summary
AVANTI
"Working Paper" Binder
TECHNOLOGY USED
CUSTOMER NEEDS/ PRACTICE GUIDELINES/ POLICIES
Employee Relations Policy
Employement Policy
Benefits Policy
Employee Relations Policy
NON VALUE ADDED TIME

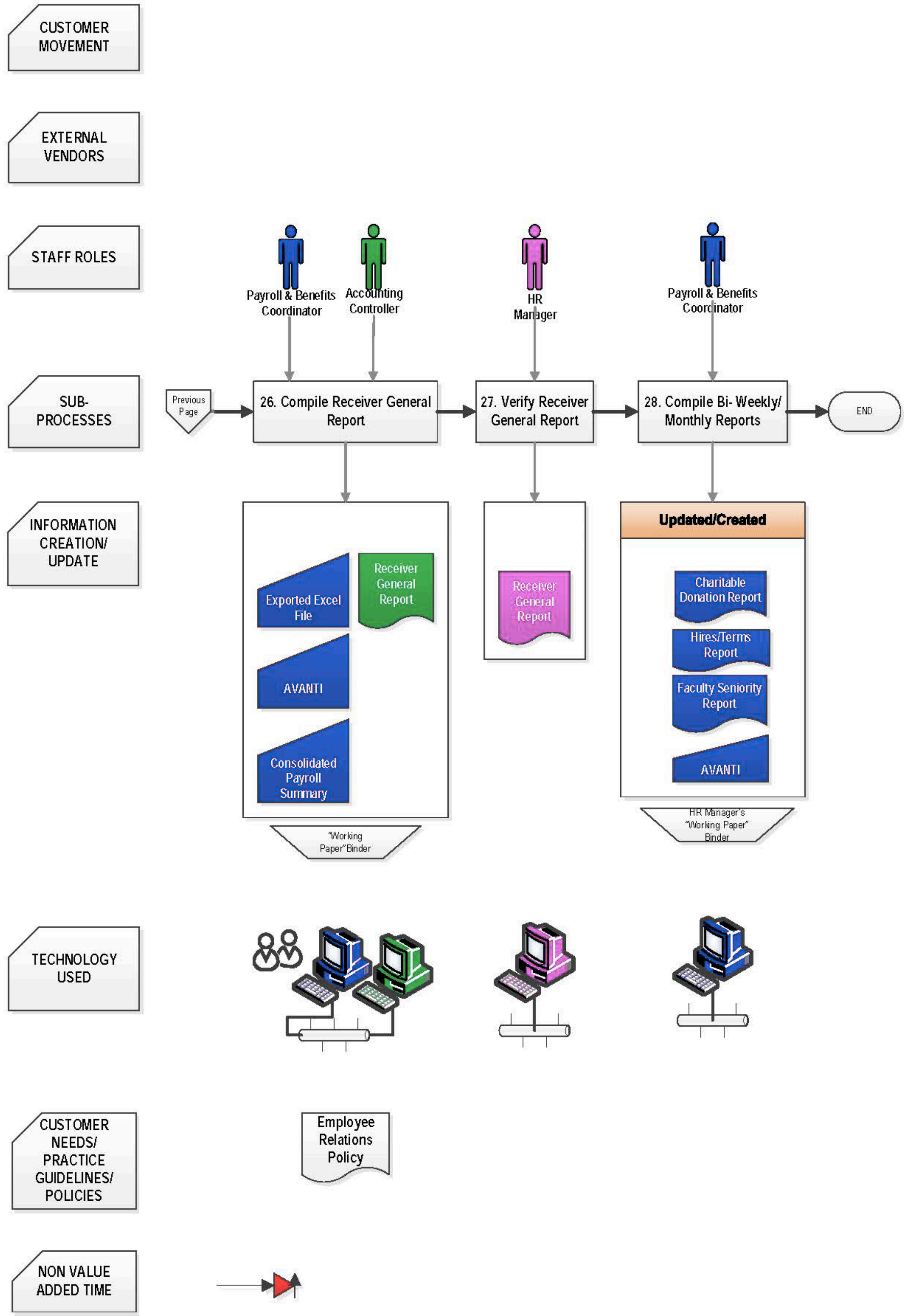

CUSTOMER MOVEMENT
EXTERNAL VENDORS
STAFF ROLES
SUB-PROCESSES
INFORMATION CREATION/ UPDATE
TECHNOLOGY USED
CUSTOMER NEEDS/ PRACTICE GUIDELINES/ POLICIES
NON VALUE ADDED TIME
Payroll & Benefits Coordinator
Payroll & Benefits Coordinator
Payroll & Benefits Coordinator
Previous Page
10. Identify Employer Health Tax Deductible Employees & Reconcile
11. Complete GL Distribution & GL Export
12. Review Net Pay Register & Reconcile Number of payments to be made
Next Page
Accessed/ Created
Consolidated Payroll Summary
AVANTI
EHT Reconciliation Report
"Working Paper" Binder
Accessed/Created
GL Distribution Report
Expense Report
"Working Paper" Binder
Accessed/Created
Direct Deposit Batch Register
Net Pay Register
AVANTI Bank Payroll Transmittal File
AVANTI Net Pay Register
"Working Paper" Binder


CUSTOMER MOVEMENT
EXTERNAL VENDORS
STAFF ROLES
SUB-PROCESSES
INFORMATION CREATION/ UPDATE
TECHNOLOGY USED
CUSTOMER NEEDS/ PRACTICE GUIDELINES/ POLICIES
NON VALUE ADDE No TIME
Payee
Accounting
Payroll & Benefits Coordinator
Payroll & Benefits Coordinator
Previous Page
13. Is deposit tracking number listed?
No
Yes
13.1 Issue Cheque
13.2 Distribute Cheque
Next Page
Consolidated Payroll Summary
Cheque Requisition Form
AVANTI
Cheque
Employee Relations Policy

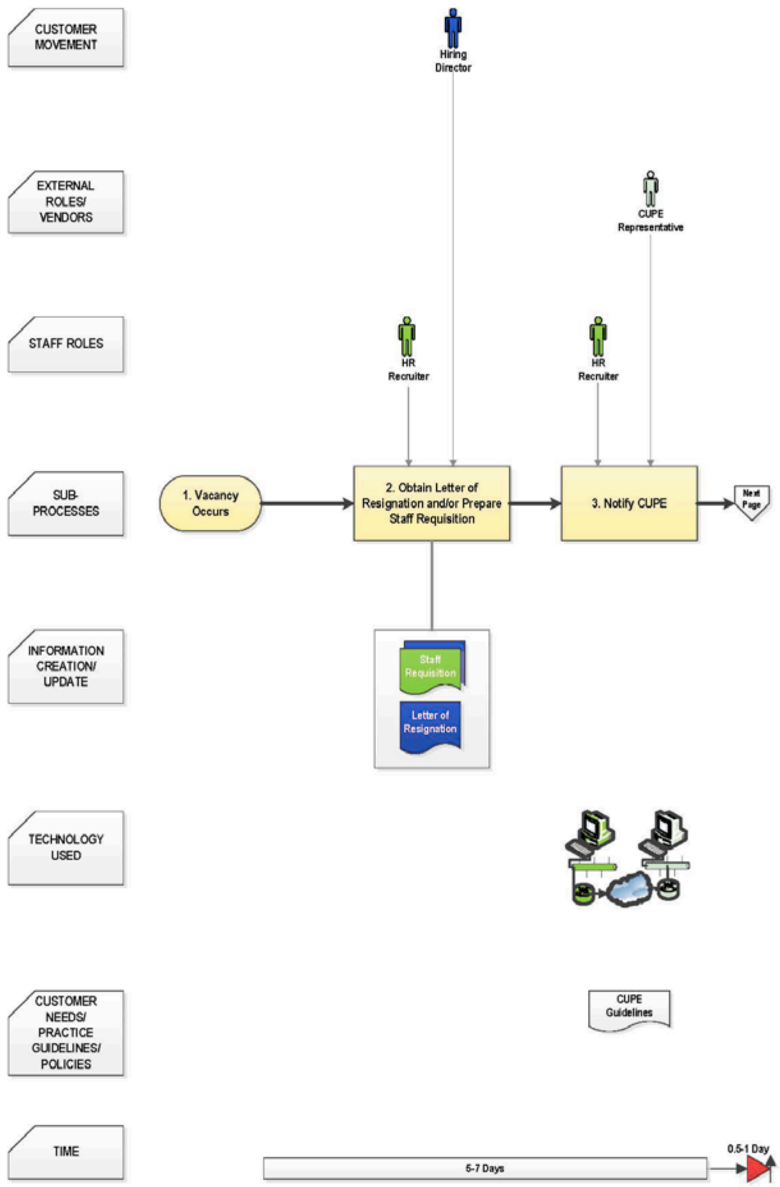

CUSTOMER MOVEMENT
EXTERNAL VENDORS
STAFF ROLES
SUB-PROCESSES
INFORMATION CREATION/ UPDATE
TECHNOLOGY USED
CUSTOMER NEEDS/ PRACTICE GUIDELINES/ POLICIES
NON VALUE ADDED TIME
CIBC
Payroll & Benefits Coordinator
Payroll & Benefits Coordinator
Payroll & Benefits Coordinator
Accounting Controller
HR Manager
Previous Page
14. Upload Payroll Information
15. Upload Successful?
No
Yes
15.1. Contact external vendor
15.2. Is Re-Transmission Req'd?
No
Yes
16. Seek Approval
Next Page
AVANTI Bank Payroll Transmittal File
CMO PORTAL
Direct Deposit Batch Register
Consolidated Payroll Summary
AVANTI
"Working Paper" Binder
Consolidated Payroll Summary
CMO PORTAL
Employee Relations Policy
Employee Relations Policy
Employee Relations Policy

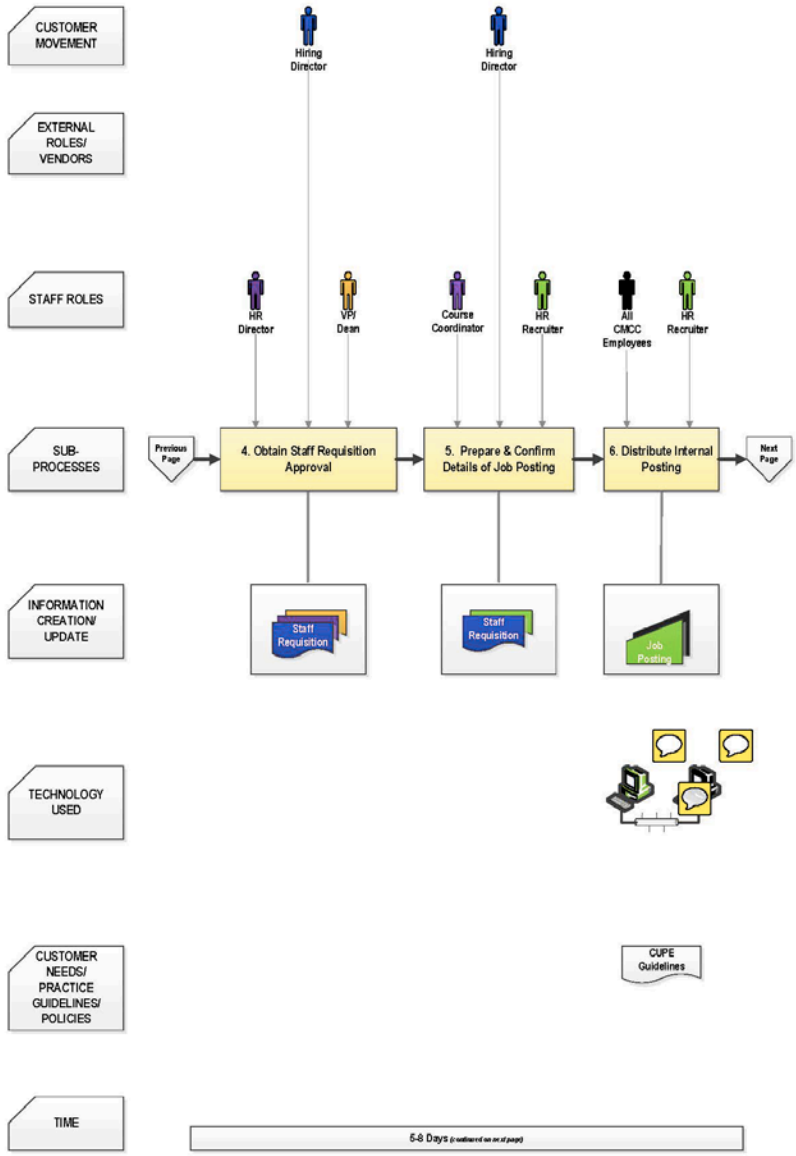

CUSTOMER MOVEMENT
EXTERNAL VENDORS
STAFF ROLES
SUB-PROCESSES
INFORMATION CREATION/ UPDATE
TECHNOLOGY USED
CUSTOMER NEEDS/ PRACTICE GUIDELINES/ POLICIES
NON VALUE ADDED TIME
Bank of Canada
VP Admin & Planning
VP Finance
Payroll & Benefits Coordinator
Payroll & Benefits Coordinator
Previous Page
17. Approved?
Yes
No
PARALLELL GATEWAY
CONSULT WITH ACCT DEPT
19. Create, Review Canada Savings Bond Report
19.1. Verify Canada Savings Bond Report
20. Report Valid?
Yes
21. Verify Externally
Next Page
18. Review Release & Confirm Status of Approval
18.1 Approved?
Yes
No
CONSULT WITH VP
Accessed/Updated
CMO PORTAL
Accessed/Created
Canada Savings Bond Report
AVANTI
Consolidated Payroll Summary
Accessed/Created/ Updated
Canada Savings Bond Report
Consolidated Payroll Summary
"Working Paper" Binder
Employee Relations Policy
Employee Relations Policy
Employee Relations Policy


CUSTOMER MOVEMENT
EXTERNAL VENDORS
RBC
STAFF ROLES
Payroll & Benefits Coordinator
Payroll & Benefits Coordinator
Payroll & Benefits Coordinator
HR Manager
Payroll & Benefits Coordinator
SUB-PROCESSES
Previous Page
22. Create RSP Report
23. Submit RSP
24. Submit Verification
25. Update Avanti to Payroll
Next Page
INFORMATION CREATION/ UPDATE
Accessed/ Updated
AVANTI- RSP Report Writer
Exported Excel File
Verification Report
Exported Excel File
RBC Portal
RSP MANUAL BINDER
Accessed/ Updated
Verification Report
Working Papers Binder
RSP MANUAL BINDER
Accessed/ Created
AVANTI
TECHNOLOGY USED
CUSTOMER NEEDS/ PRACTICE GUIDELINES/ POLICIES
Employee Relations Policy
Employee Relations Policy
NON VALUE ADDED TIME

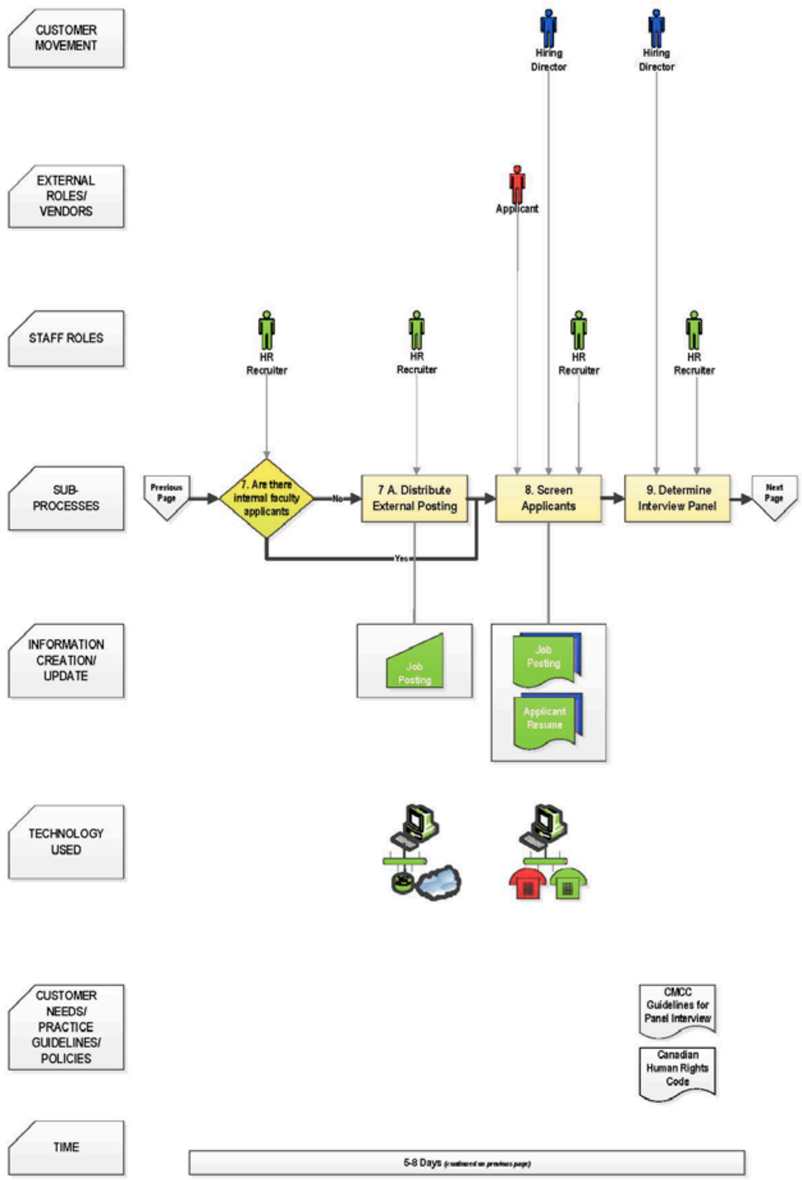

CUSTOMER MOVEMENT
EXTERNAL VENDORS
STAFF ROLES
SUB-PROCESSES
INFORMATION CREATION/ UPDATE
TECHNOLOGY USED
CUSTOMER NEEDS/ PRACTICE GUIDELINES/ POLICIES
NON VALUE ADDED TIME
Payroll & Benefits Coordinator
Accounting Controller
HR Manager
Payroll & Benefits Coordinator
Previous Page
26. Compile Receiver General Report
27. Verify Receiver General Report
28. Compile Bi- Weekly/ Monthly Reports
END
Exported Excel File
Receiver General Report
AVANTI
Consolidated Payroll Summary
"Working Paper" Binder
Receiver General Report
Updated/Created
Charitable Donation Report
Hires/Terms Report
Faculty Seniority Report
AVANTI
HR Manager's "Working Paper" Binder
Employee Relations Policy

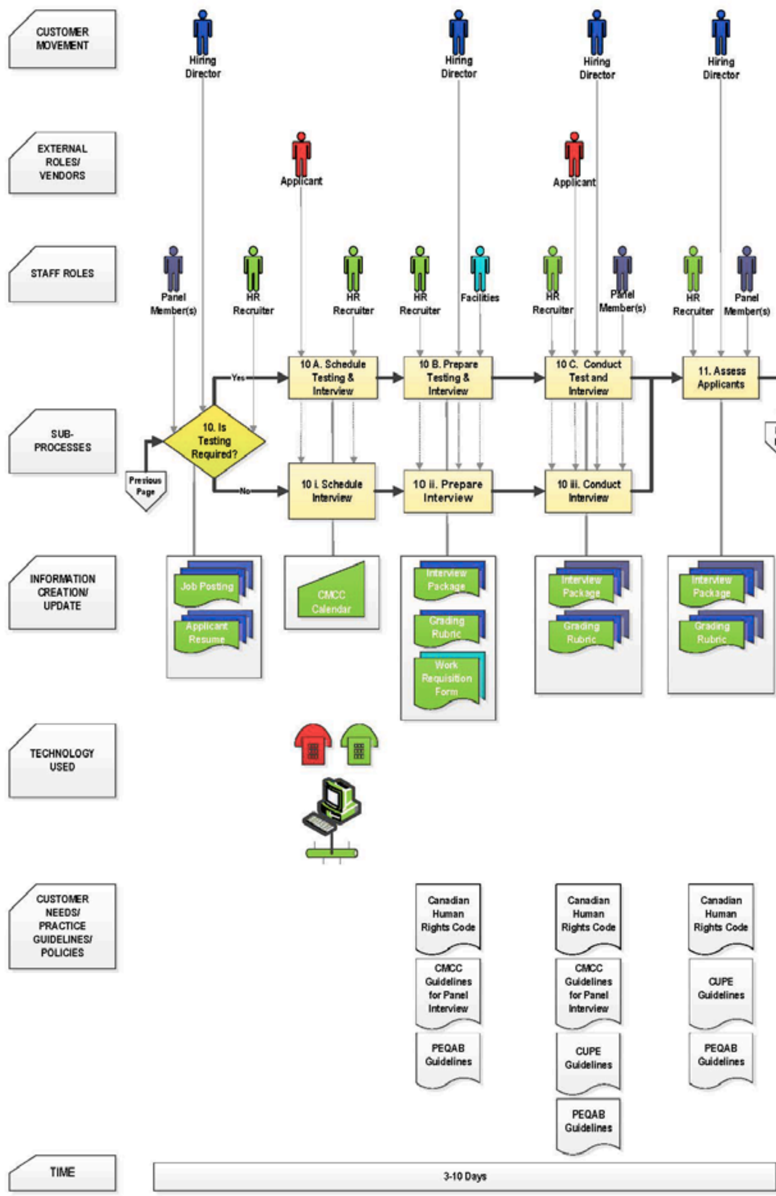
V. Hiring & Recruitng Process Model, CCPIM

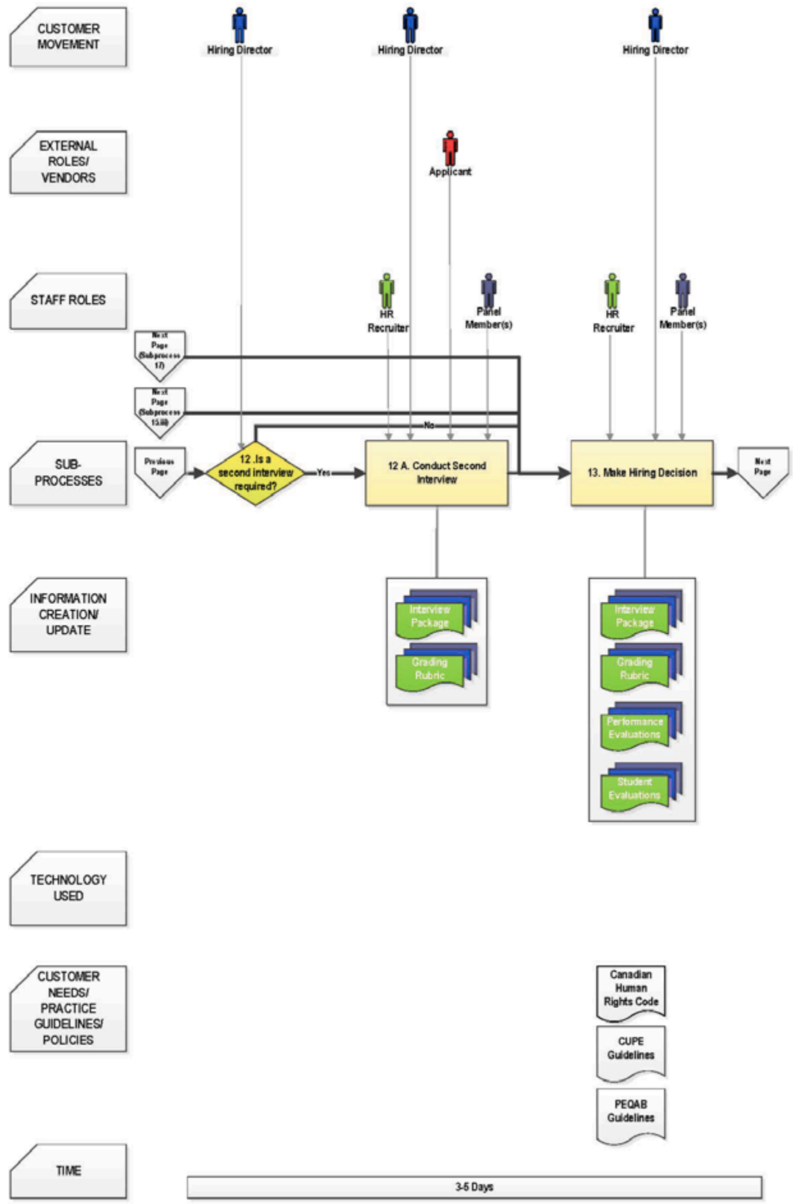


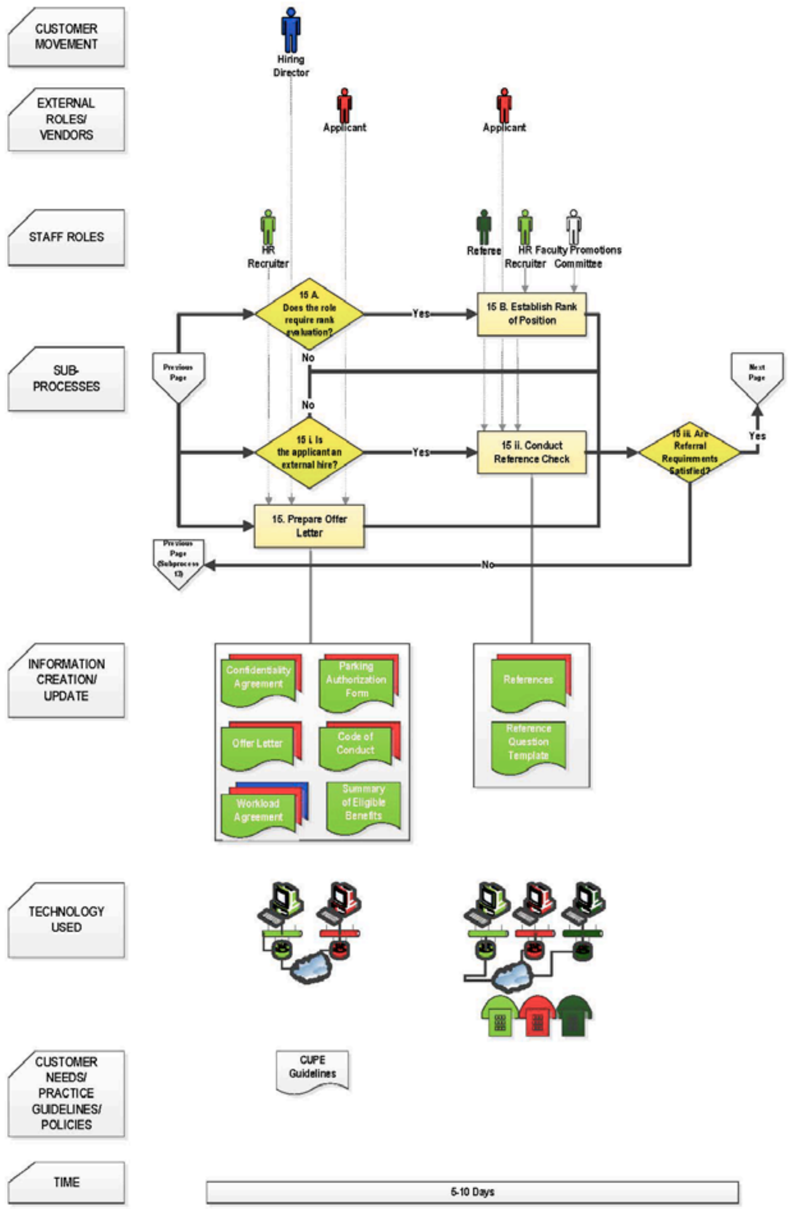


CUSTOMER MOVEMENT
EXTERNAL ROLES/ VENDORS
STAFF ROLES
SUB-PROCESSES
INFORMATION CREATION/ UPDATE
TECHNOLOGY USED
CUSTOMER NEEDS/ PRACTICE GUIDELINES/ POLICIES
TIME
Hiring Director
Hiring Director
HR Director
VP/ Dean
Course Coordinator
HR Recruiter
All CMCC Employees
HR Recruiter
Previous Page
4. Obtain Staff Requisition Approval
5. Prepare & Confirm Details of Job Posting
6. Distribute Internal Posting
Next Page
Staff Requisition
Staff Requisition
Job Posting
CUPE Guidelines
5-8 Days

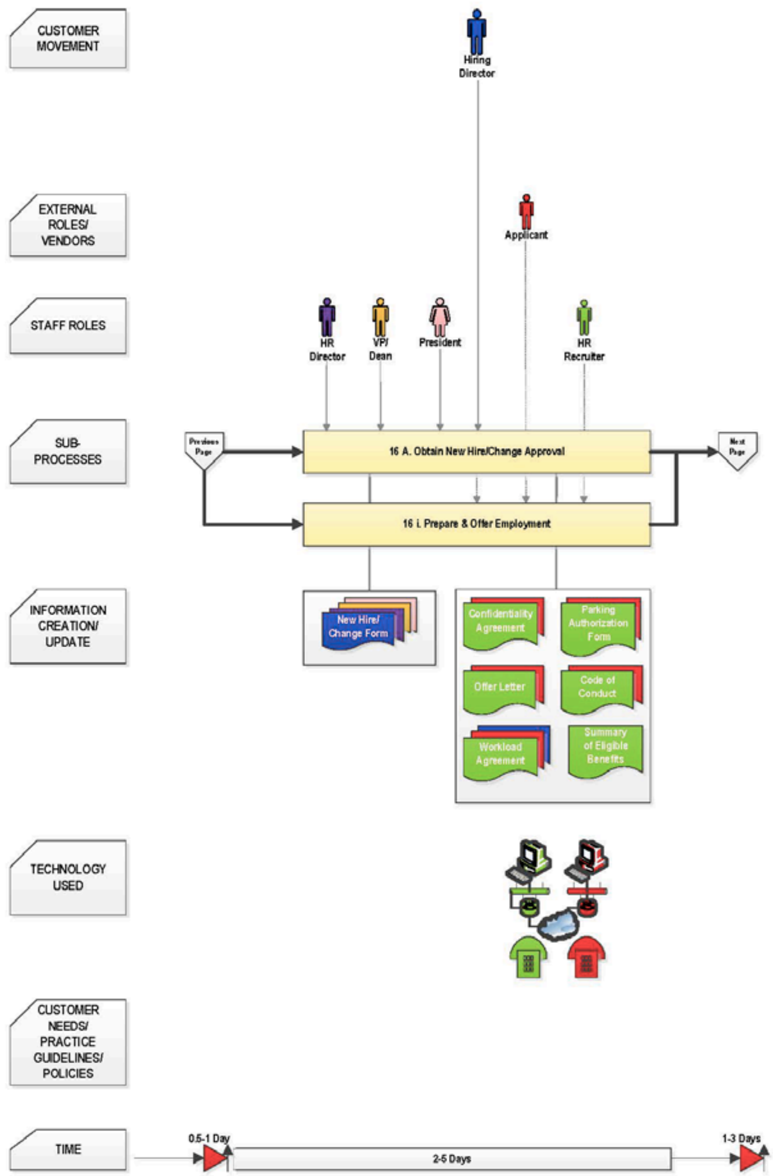

CUSTOMER MOVEMENT
EXTERNAL ROLES/ VENDORS
STAFF ROLES
SUB-PROCESSES
INFORMATION CREATION/ UPDATE
TECHNOLOGY USED
CUSTOMER NEEDS/ PRACTICE GUIDELINES/ POLICIES
TIME
Hiring Director
Hiring Director
Applicant
HR Recruiter
HR Recruiter
HR Recruiter
HR Recruiter
Previous Page
7. Are there internal faculty applicants
No
Yes
7 A. Distribute External Posting
8. Screen Applicants
9. Determine Interview Panel
Next Page
Job Posting
Job Posting
Applicant Resume
CMCC Guidelines for Panel Interview
Canadian Human Rights Code
6-8 Days

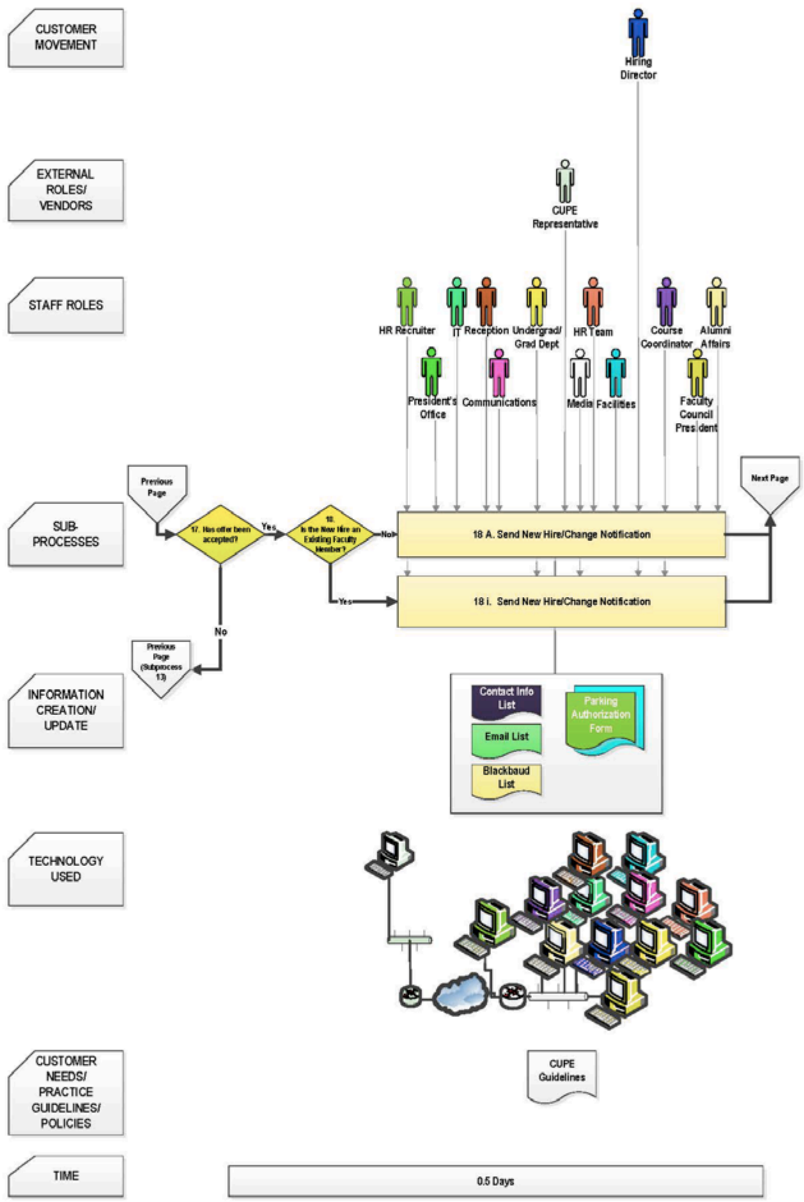

CUSTOMER MOVEMENT
EXTERNAL ROLES/ VENDORS
STAFF ROLES
SUB-PROCESSES
INFORMATION CREATION/ UPDATE
TECHNOLOGY USED
CUSTOMER NEEDS/ PRACTICE GUIDELINES/ POLICIES
TIME
Hiring Director
Applicant
Panel Member(s)
HR Recruiter
Facilities
Previous Page
10. Is Testing Required?
Yes
No
10 A. Schedule Testing & Interview
10 B. Prepare Testing & Interview
10 C. Conduct Test and Interview
11. Assess Applicants
Next Page
10 i. Schedule Interview
10 ii. Prepare Interview
10 iii. Conduct Interview
Job Posting
Applicant Resume
CMCC Calendar
Interview Package
Grading Rubric
Work Requisition Form
Canadian Human Rights Code
CMCC Guidelines for Panel Interview
PEQAB Guidelines
CUPE Guidelines
3-10 Days


CUSTOMER MOVEMENT
Hiring Director
Hiring Director
Hiring Director
EXTERNAL ROLES/ VENDORS
Applicant
STAFF ROLES
HR Recruiter
Panel Member(s)
HR Recruiter
Panel Member(s)
Next Page (Subprocess 17)
Next Page (Subprocess 13.III)
No
SUB-PROCESSES
Previous Page
12 .Is a second interview required?
Yes
12 A. Conduct Second Interview
13. Make Hiring Decision
Next Page
INFORMATION CREATION/ UPDATE
Interview Package
Grading Rubric
Interview Package
Grading Rubric
Performance Evaluations
Student Evaluations
TECHNOLOGY USED
CUSTOMER NEEDS/ PRACTICE GUIDELINES/ POLICIES
Canadian Human Rights Code
CUPE Guidelines
PEQAB Guidelines
TIME
3-5 Days



CUSTOMER MOVEMENT
EXTERNAL ROLES/ VENDORS
STAFF ROLES
SUB-PROCESSES
INFORMATION CREATION/ UPDATE
TECHNOLOGY USED
CUSTOMER NEEDS/ PRACTICE GUIDELINES/ POLICIES
TIME
Hiring Director
Applicant
Applicant
HR Recruiter
Referee
HR Recruiter
Faculty Promotions Committee
15 A. Does the role require rank evaluation?
Yes
15 B. Establish Rank of Position
No
Previous Page
No
15 i. Is the applicant an external hire?
Yes
15 ii. Conduct Reference Check
15 iii. Are Referral Requirements Satisfied?
Yes
Next Page
15. Prepare Offer Letter
Previous Page (Subprocess 13)
No
Confidentiality Agreement
Parking Authorization Form
Offer Letter
Code of Conduct
Workload Agreement
Summary of Eligible Benefits
References
Reference Question Template
CUPE Guidelines
5-10 Days

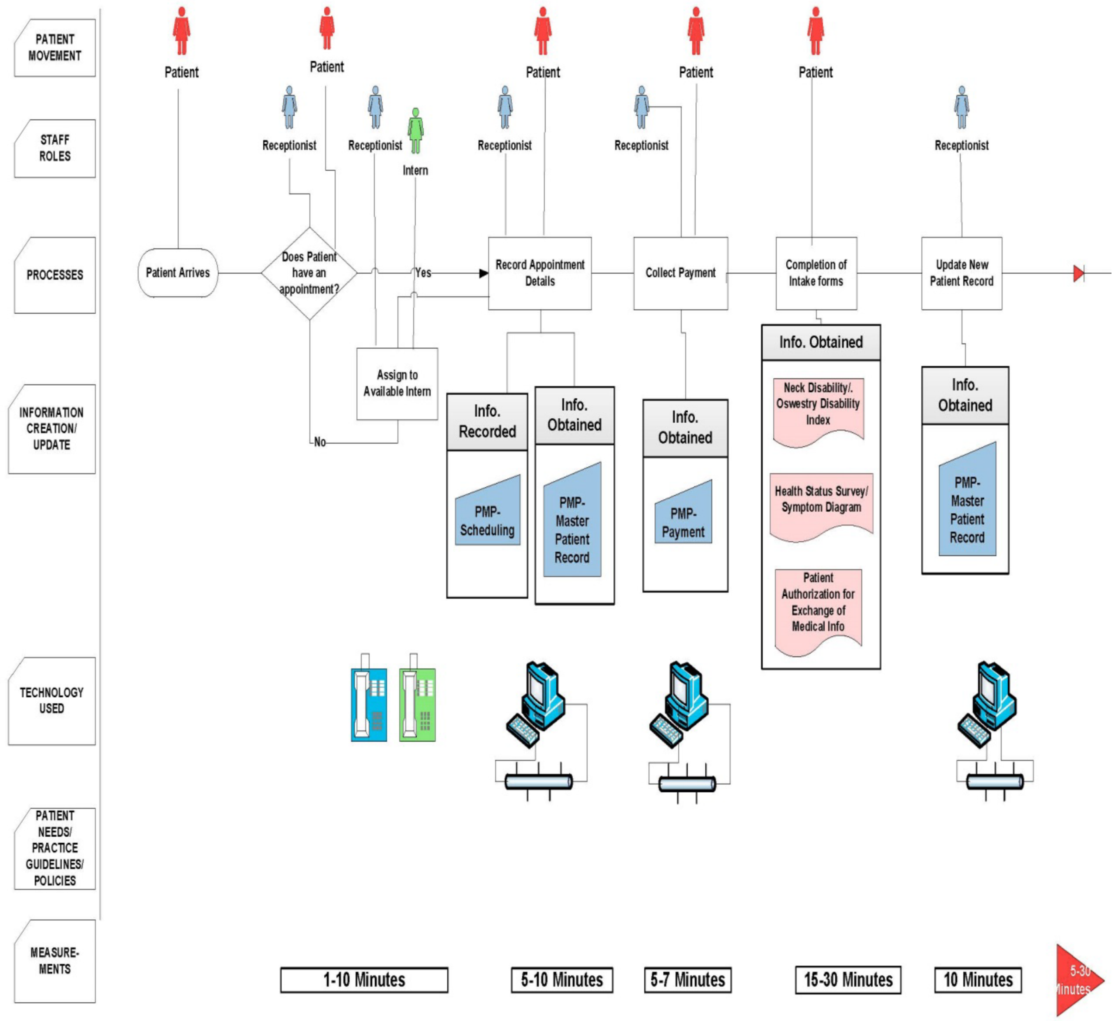

CUSTOMER MOVEMENT
EXTERNAL ROLES/ VENDORS
STAFF ROLES
SUB-PROCESSES
INFORMATION CREATION/ UPDATE
TECHNOLOGY USED
CUSTOMER NEEDS/ PRACTICE GUIDELINES/ POLICIES
TIME
Hiring Director
Applicant
HR Director
VP/ Dean
President
HR Recruiter
Previous Page
16 A. Obtain New Hire/Change Approval
16 i. Prepare & Offer Employment
Next Page
New Hire/ Change Form
Confidentiality Agreement
Parking Authorization Form
Offer Letter
Code of Conduct
Workload Agreement
Summary of Eligible Benefits
0.5-1 Day
2-5 Days
1-3 Days

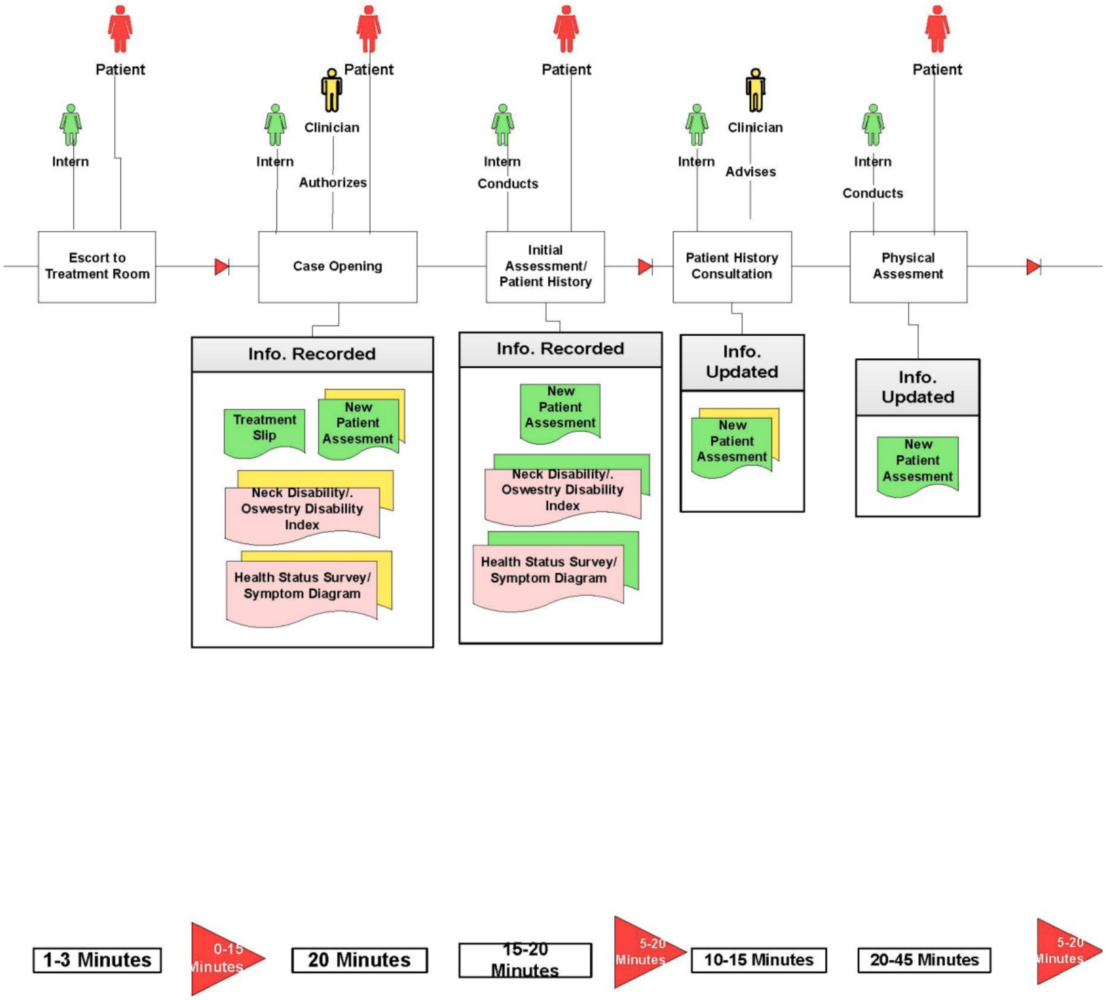


CUSTOMER MOVEMENT
Hiring Director
EXTERNAL ROLES/ VENDORS
CUPE Representative
STAFF ROLES
HR Recruiter
IT
Reception
Undergrad/ Grad Dept
HR Team
Course Coordinator
Alumni Affairs
President's Office
Communications
Media
Facilities
Faculty Council President
SUB-PROCESSES
Previous Page
17. Has offer been accepted?
Yes
No
Is the New Hire an Existing Faculty Member?
No
Yes
18 A. Send New Hire/Change Notification
18 i. Send New Hire/Change Notification
Next Page
Previous Page (Subprocess 13)
INFORMATION CREATION/ UPDATE
Contact Info List
Email List
Blackbaud List
Parking Authorization Form
TECHNOLOGY USED
CUSTOMER NEEDS/ PRACTICE GUIDELINES/ POLICIES
CUPE Guidelines
TIME
0.5 Days

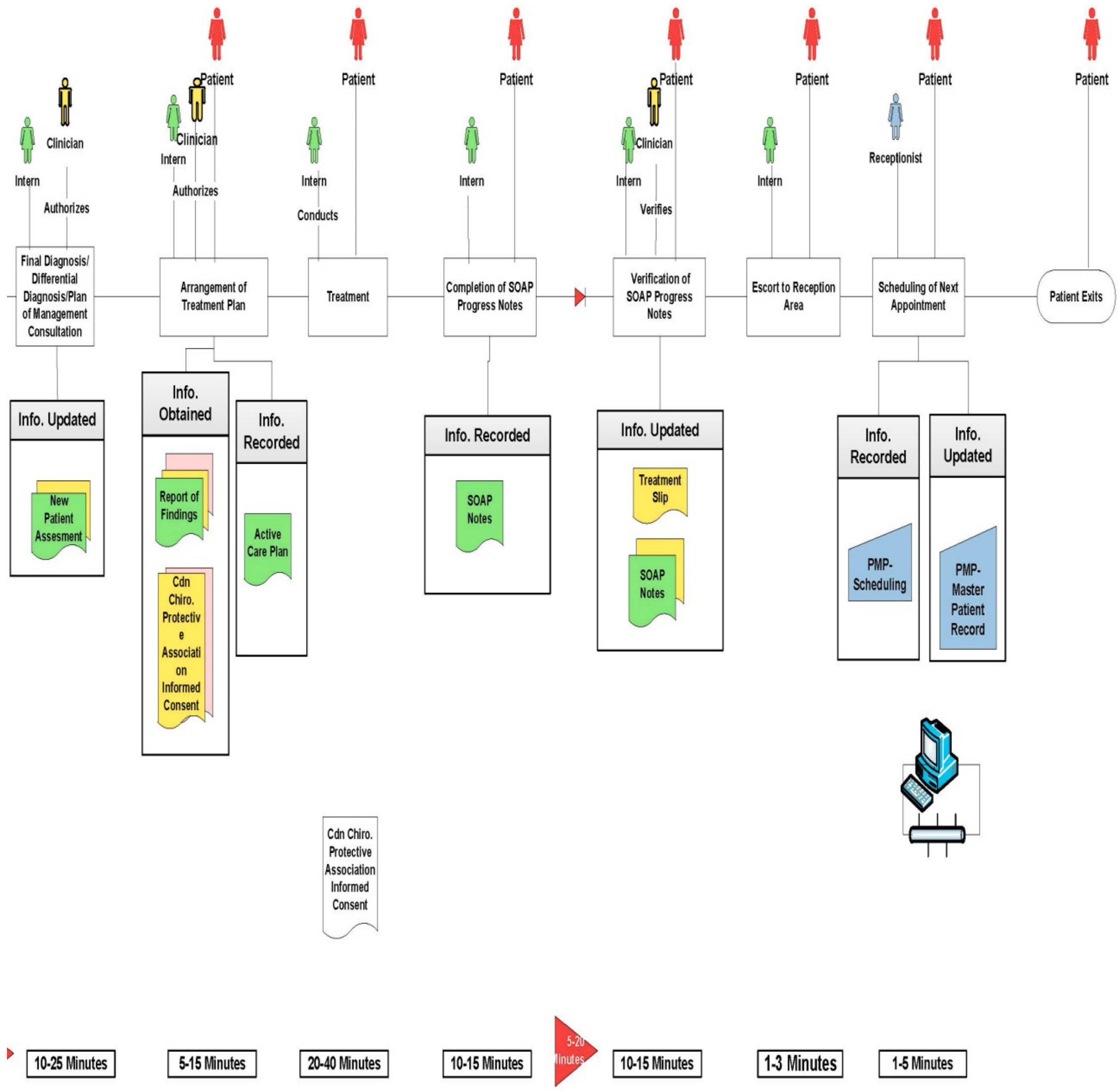

CUSTOMER MOVEMENT
EXTERNAL ROLES/ VENDORS
STAFF ROLES
SUB-PROCESSES
INFORMATION CREATION/ UPDATE
TECHNOLOGY USED
CUSTOMER NEEDS/ PRACTICE GUIDELINES/ POLICIES
TIME
Hiring Director
Applicant
HR Recruiter
Undergrad/ Grad Dept
IT
Course Coordinator
Media
Finance/ Accounts Receivable
Previous Page
19. Orientation & Training
20. End
Fed/Prov. Tax Form
Payroll Form/ Void Cheque
HR Policies
Access to KIRO
Personal/ Emergency Information
Social Club
Payroll Schedule
Headshots Employee Information
Offer Letter
Health & Safety Package
Part-Time Parking Procedure
Manager's Checklist
1 Day

VI. Patient Journey: Paper Records, PaJMA



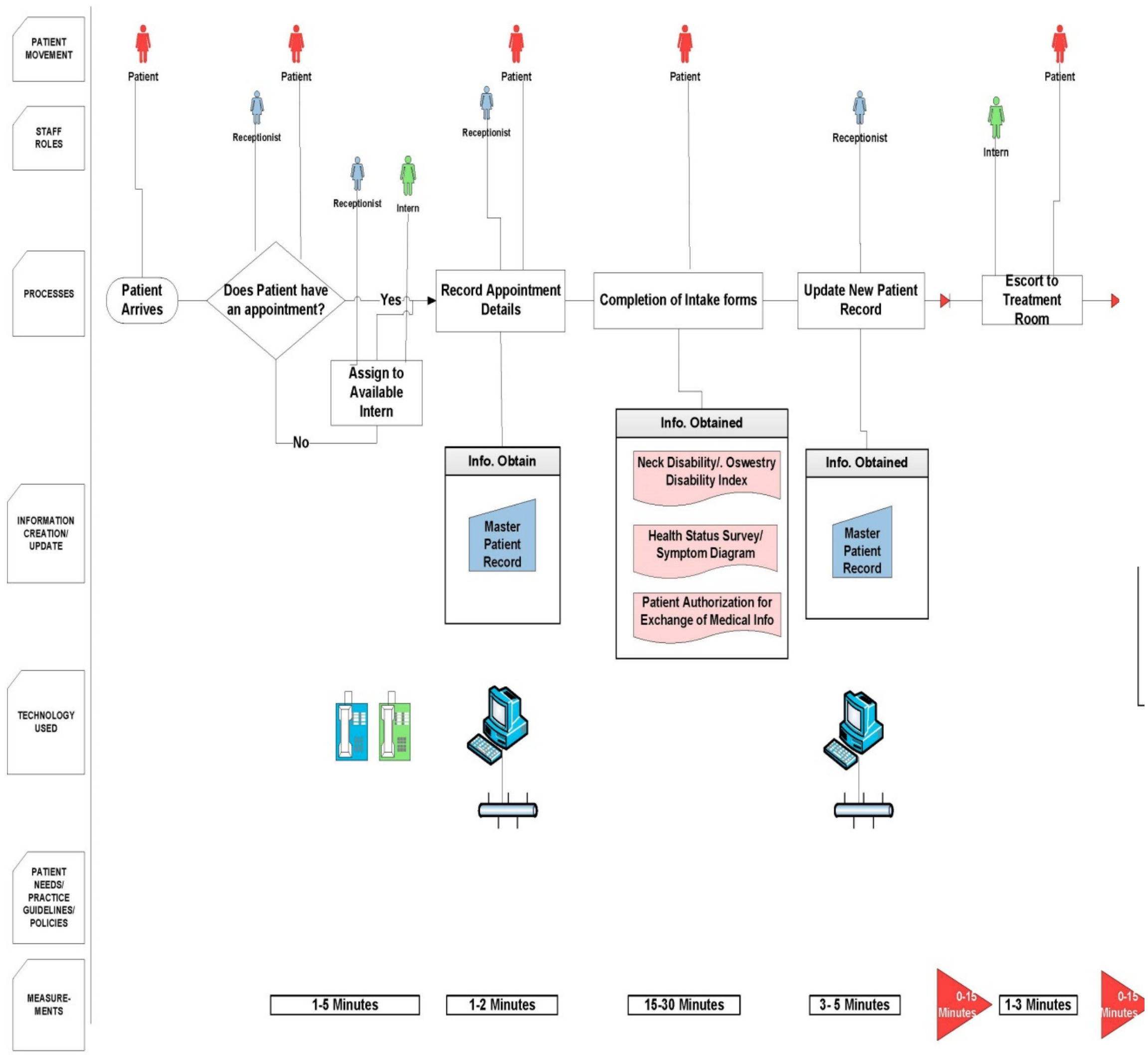


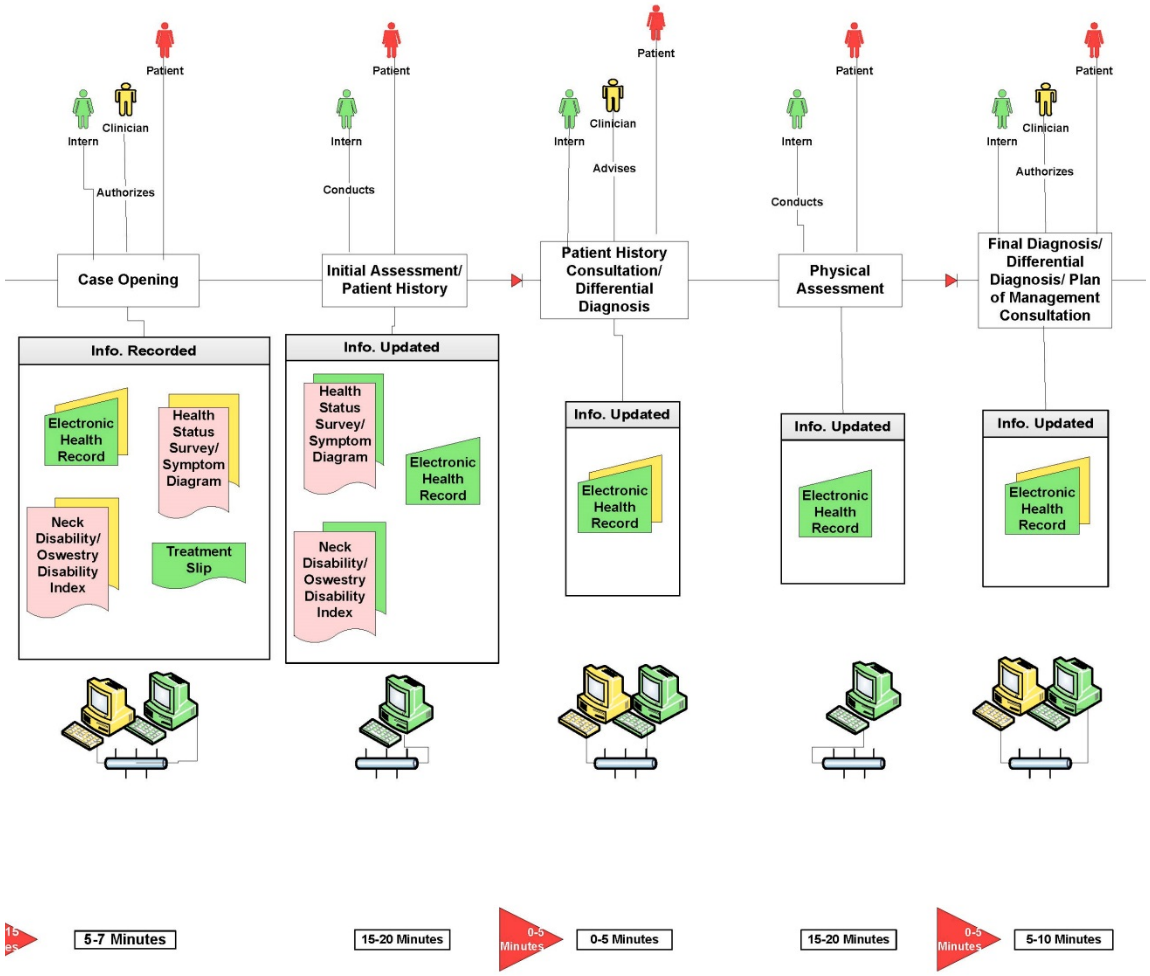
Patient
Intern
Escort to Treatment Room
Patient
Clinician
Intern
Authorizes
Case Opening
Info. Recorded
Treatment Slip
New Patient Assesment
Neck Disability/. Oswestry Disability Index
Health Status Survey/ Symptom Diagram
Patient
Intern
Conducts
Initial Assessment/ Patient History
Info. Recorded
New Patient Assesment
Neck Disability/. Oswestry Disability Index
Health Status Survey/ Symptom Diagram
Clinician
Intern
Advises
Patient History Consultation
Info. Updated
New Patient Assesment
Patient
Intern
Conducts
Physical Assesment
Info. Updated
New Patient Assesment
1-3 Minutes
0-15 Minutes
20 Minutes
15-20 Minutes
5-20 Minutes
10-15 Minutes
20-45 Minutes
5-20 Minutes



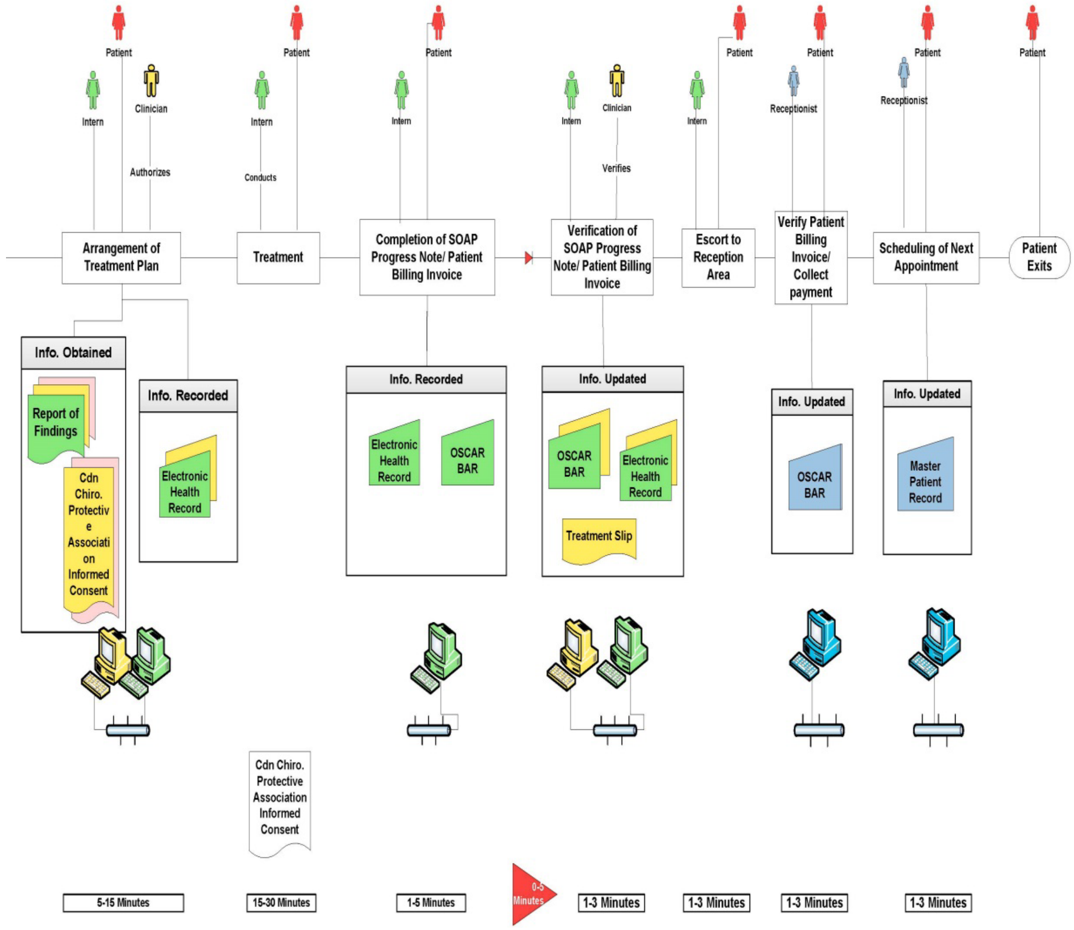
Patient
Clinician
Intern
Authorizes
Conducts
Verifies
Receptionist
Final Diagnosis/ Differential Diagnosis/Plan of Management Consultation
Arrangement of Treatment Plan
Treatment
Completion of SOAP Progress Notes
Verification of SOAP Progress Notes
Escort to Reception Area
Scheduling of Next Appointment
Patient Exits
Info. Updated
New Patient Assesment
Info. Obtained
Report of Findings
Cdn Chiro. Protective Association Informed Consent
Info. Recorded
Active Care Plan
Info. Recorded
SOAP Notes
Info. Updated
Treatment Slip
SOAP Notes
Info. Recorded
PMP-Scheduling
Info. Updated
PMP-Master Patient Record
Cdn Chiro. Protective Association Informed Consent
10-25 Minutes
5-15 Minutes
20-40 Minutes
10-15 Minutes
5-20 Minutes
10-15 Minutes
1-3 Minutes
1-5 Minutes

VII. Patient Journey: Electronic Health Record (EHR), PaJMA





Patient
Intern
Clinician
Authorizes
Case Opening
Info. Recorded
Electronic Health Record
Health Status Survey/ Symptom Diagram
Neck Disability/ Oswestry Disability Index
Treatment Slip
5-7 Minutes
Patient
Intern
Conducts
Initial Assessment/ Patient History
Info. Updated
Health Status Survey/ Symptom Diagram
Electronic Health Record
Neck Disability/ Oswestry Disability Index
15-20 Minutes
0-5 Minutes
Patient
Intern
Clinician
Advises
Patient History Consultation/ Differential Diagnosis
Info. Updated
Electronic Health Record
0-5 Minutes
Patient
Intern
Conducts
Physical Assessment
Info. Updated
Electronic Health Record
15-20 Minutes
0-5 Minutes
Patient
Intern
Clinician
Authorizes
Final Diagnosis/ Differential Diagnosis/ Plan of Management Consultation
Info. Updated
Electronic Health Record
5-10 Minutes



Patient
Intern
Clinician
Authorizes
Conducts
Verifies
Receptionist
Arrangement of Treatment Plan
Treatment
Completion of SOAP Progress Note/ Patient Billing Invoice
Verification of SOAP Progress Note/ Patient Billing Invoice
Escort to Reception Area
Verify Patient Billing Invoice/ Collect payment
Scheduling of Next Appointment
Patient Exits
Info. Obtained
Report of Findings
Cdn Chiro. Protectiv e Associati on Informed Consent
Info. Recorded
Electronic Health Record
OSCAR BAR
Info. Updated
Treatment Slip
Master Patient Record
Cdn Chiro. Protective Association Informed Consent
5-15 Minutes
15-30 Minutes
1-5 Minutes
0-5 Minutes
1-3 Minutes
1-3 Minutes
1-3 Minutes
1-3 Minutes