A STRATEGIC ANALYSIS OF SYNAPSE AND CANADA HEALTH INFOWAY’S ELECTRONIC HEALTH RECORD SOLUTION BLUEPRINT

by

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Bachelor of Science, Simon Fraser University, 1993

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ABSTRACT

Synapse is a currently deployed software application that collects and presents clinical and administrative information about Mental Health & Addictions patients, in the form of an Electronic Health Record (EHR). Synapse was jointly developed by regional health authorities, federal and provincial governments and research institutions. While Synapse has enjoyed limited regional success in British Columbia, the Synapse Project Steering Committee seeks to expand its adoption with clinicians and position it as a pan-Canadian solution. The key to national adoption of Synapse is further compliance with industry standards and the integration with emerging EHR architecture initiatives.

This analysis examines Synapse within the context of the burgeoning architecture initiatives outlined in Canada Health Infoway’s Blueprint document. Widespread adoption of the Blueprint is considered with respect to two theoretical adoption frameworks: the Diffusion of Innovations and Economics of Technology Standards. Additionally, what are the ramifications to Synapse if the Blueprint principles were adopted?

Keywords: Electronic Health Record, Mental Health & Addictions, Synapse.
DEDICATION

For every long day and night I spent locked in my office working, you had my back. For every weekend when I missed family activities to work on my studies, you stood by me. In every instance when my study groups invaded our home, you were cordial and understanding. You have proof read and edited more MBA papers than you likely ever dreamed of, yet rarely complained and always offered me your best work. I have never before witnessed such a degree of prolonged self-sacrifice and there are not enough ways to fully thank you. This is for you Kristen.
ACKNOWLEDGEMENTS

I have such appreciation and admiration for Dr. Elliot Goldner for his unabashed willingness to help me prior to and throughout my graduate studies. Despite seemingly dormant periods of our friendship, when called upon he always responds. What else can a friend ask for?

I would like to acknowledge my parents and how they instilled in me a love of life-long learning. I don’t know exactly how they did it, but I hope to reproduce the magic with my children.

My heartfelt thanks for the support from my in-laws, Dr. Bruce and Penny Gallaway, who treated me as their own flesh and blood. I always got the sense that they “got it” and understood why the sacrifices Kristen and I make will eventually pay dividends.
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## GLOSSARY

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Adverse Event</td>
<td>An adverse event is an unintended injury or complication which results in disability, death or prolonged hospital stay, and is caused by healthcare management.</td>
</tr>
<tr>
<td>Diffusion Of Innovations (DOI)</td>
<td>Diffusion of Innovations theory was formalized by Everett Rogers in a 1962 book called Diffusion of Innovations. Rogers stated that adopters of any new innovation or idea could be categorized as innovators (2.5%), early adopters (13.5%), early majority (34%), late majority (34%) and laggards (16%), based on a bell curve.</td>
</tr>
<tr>
<td>Digital Imaging and Communications in Medicine (DICOM)</td>
<td>A standard developed by the American College of Radiology and the National Equipment Manufacturers Association to define the connectivity and communication protocols of medical imaging devices.</td>
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<tr>
<td>Electronic Health Record (EHR)</td>
<td>The central component that stores, maintains and manages clinical information about patients/persons. An EHR provides each individual in Canada with a secure and private lifetime record of his or her key health history and care within the health system. The record is available electronically to authorized healthcare providers and the individual anywhere, anytime in support of high quality care. The extent of the clinical information sustained by the EHR may vary based mainly on the presence or absence of Domain Repositories in any given jurisdiction.</td>
</tr>
<tr>
<td>EHR Infostructure (EHRI)</td>
<td>A collection of common and reusable components in support of a diverse set of health information management applications. It consists of software solutions, data definitions and messaging standards for the EHR.</td>
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<tr>
<td>Infostructure</td>
<td>A shared foundation of hardware, software, and</td>
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<td>Term</td>
<td>Description</td>
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<tr>
<td>Interoperability Profile (IP) or EHR IP</td>
<td>A description of the types of business functions/service requests a Point of Service (PoS) system requires the EHRi system to provide in order to support the EHR clinical activity business (use case) requirements.</td>
</tr>
<tr>
<td>Picture Archiving and Communication System (PACS)</td>
<td>Computers or networks dedicated to the storage, retrieval, distribution and presentation of images.</td>
</tr>
<tr>
<td>Point of Service (PoS)</td>
<td>These are the software programs or information systems being used at the points of service, providing critical healthcare information to inform clinical decision making. This may be the program to access the EHR in a physician’s office or primary care clinic, the information system in a hospital emergency department, or the system in the local pharmacy - among many others.</td>
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<tr>
<td>Service Oriented Architecture (SOA)</td>
<td>An infrastructure where many N-tier applications are deployed, sharing common software services that are accessible from any user interface. In this environment, any application can access any service, provided the application has the proper security permissions. The greatest strength of a service-oriented architecture is the potential for repeatable rapid development of new applications. It depends on interoperable services for the provision of high-value business logic processing.</td>
</tr>
<tr>
<td>SNOMED CT</td>
<td>Systematized Nomenclature of Medicine--Clinical Terms. A standardized vocabulary system for medical databases. Current modules contain more than 144,000 terms and are available in at least 12 languages.</td>
</tr>
<tr>
<td>SOAP</td>
<td>SOAP is a protocol for exchanging XML-based messages over computer networks, normally using HTTP. SOAP originally stood for Simple Object Access Protocol, and lately also Service Oriented Architecture Protocol, but is now simply SOAP. The original acronym was dropped with Version 1.2 of the standard, which became a W3C Recommendation on June 24, 2003, as it was</td>
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Service Event

The act of providing a health related service.

XML - eXtensible Mark-up Language

XML is a mark-up language for structuring arbitrary data based on element tags and attributes. It describes a class of data objects called XML documents and partially describes the behaviour of computer programs which process them. XML is an application profile or restricted form of SGML, the Standard Generalized Mark-up Language [ISO 8879]. By construction, XML documents are conforming SGML documents.
1: INTRODUCTION

Access to universal healthcare is an integral part of being Canadian. In fact, a 2002 Healthcare Report found that Canadians strongly support national principles in health care and look to the federal government to play an important role in maintaining these principles.\(^1\) Yet despite Canadians’ support for the government and its initiatives in the healthcare domain, the government faces many issues with regard to funding during this especially critical time of reform and renewal. The growing and aging population base in Canada places an increasing strain on the existing healthcare system. Additionally, health service delivery costs take up ever larger proportions of provincial budgets due to the costs associated with managing a myriad of services, providers, care locations and resources.

An effective healthcare system, one that is both responsive and sustainable, will require efficient management of shared information. That shared information will become the critical enabler and the lifeblood of the system. Further, the information must be accurate, up-to-date, and accessible whenever and wherever healthcare providers need it. Information communication technologies facilitate the sharing of patient-centered, care-focused information and there is a growing consensus around the value of shareable health information using electronic processes. In 2001 the Canadian

\(^1\) (The Standing Senate Committee on Social Affairs, Science and Technology, 2002)
Government requested an inquiry into the future of Canada’s public health care system. The intent of the inquiry was also to recommend policies and measures to ensure the long-term sustainability of a universally accessible, publicly funded health system. The fulfilment of the Government mandate was the Romanow Commission Final Report. The report states: “Electronic health records are one of the keys to modernizing the health systems and improving access and outcomes for Canadians.” Additionally, the Kirby Senate Committee finds that “Not only can an Electronic Health Record (EHR) greatly improve quality and timeliness in healthcare delivery; it can also enhance healthcare system management, efficiency and accountability.”

The use of computers to support all aspects of healthcare service delivery is nothing new. The large number of clinical applications in operation today in hospitals, clinics and physicians’ offices are a testament to the sector’s embrace of technology. In some sense, we already have EHRs in Canada, however the current state is far from ideal. Currently, a person’s clinical information is located in various systems, many of which are not interoperable. This requires additional time and expense to collect the needed information at critical moments. This unavailability of electronic healthcare information at the point of care presents one of the greatest challenges going forward. It is also the motivation for the creation of an interoperable EHR (iEHR) that contains a host of information on the healthcare services patients

---

2 (Romanow, 2002)
3 (Romanow, 2002)
have received such as their medical history, diagnostic tests, medications, care plans and their current health status.

Canada Health Infoway has published an Electronic Health Record Solution (EHRS) Blueprint to provide the foundation for a conceptual model for pan-Canadian interoperability. The Blueprint creates a common vision and defines the core solution components such as privacy and security, deployment models, and common standards for semantic interoperability.

This analysis illuminates the various components of the EHRS Blueprint and explores how the architecture principles may be adopted by Synapse as a catalyst to further the adoption of the EHR in Mental Health & Addictions. Various methods of augmenting Synapse could lead to further development (supported by additional funding), raised awareness and a heightened profile of the issues surrounding Mental Health & Addictions and EHRs, ultimately providing improved patient care. Because of the nascent state of the Blueprint, Synapse’s adoption is not a foregone conclusion. To help decide if the Blueprint’s adoption is appropriate for Synapse, this analysis will attempt to gauge the likelihood of the Blueprint’s widespread adoption through two theoretical adoption frameworks, Diffusion of Innovation (DOI) and the Economics of Technology Standards (EoTS), before making recommendations with regard to Synapse.

Assuming the Synapse Project Steering Committee accepts this report’s conclusions, the next logical step would be implementation of the recommendations. Undertaking any sizeable new project requires meticulous
management of all phases of the system development lifecycle. Analysis, planning, design, implementation, testing, and maintenance all represent substantial bodies of work. The scope of this report is anchored in the analysis phase, and as such will not consider the details of implementation.

1.1 Background on Synapse

Synapse is a software application that collects and presents clinical and administrative information about Mental Health & Addictions clients/patients, in the form of an EHR. The EHR tracks care episodes and interventions across the full continuum of Mental Health & Addictions services, including inpatient psychiatry, emergency department, outpatient, community, and residential programs. While an EHR typically contains many facets, Synapse is focused on a thin slice of the EHR that pertains to Mental Health & Addictions.

Synapse is the collaborative effort of health authorities, federal and provincial governments, research and data institutes, and countless individuals and organizations representing an array of content and technical expertise. Synapse was developed with the following partners and contributors:

<table>
<thead>
<tr>
<th>Vancouver Coastal Health Authority (BC) Jurisdictions</th>
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<tr>
<td>- North Shore Health Services Delivery Area</td>
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<tr>
<td>- Coast-Garibaldi</td>
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<td>- Sea to Sky</td>
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<td>- Powell River</td>
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<th>Northern Interior Health Services Delivery Area</th>
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The tasks of ongoing management, funding, product enhancements, and the promotion of Synapse are the responsibility of the partners. The partners’ goals are to:

1. Facilitate the highest quality of care to clients and patients through the provision of accurate, relevant and timely clinical information at every point of care throughout the mental health continuum.

2. Support regional, provincial and national health information management strategies through multi-jurisdictional implementation of a client-centered, standards-based EHR.  

It is the intent of the partners of Synapse to make the software available to all interested health authorities in Canada. The hope is that by releasing Synapse into the public domain, they will be able to attract additional partners from multiple jurisdictions and ultimately advance the project’s vision of improved patient care through widespread adoption of Synapse. Additional

---

5 (Governed SYNAPE Collaborative, 2002b)
partners will then contribute to supporting the vision of creating a comprehensive, standards-based EHR for mental health that supports pan-Canadian information management needs.

1.2 Analysis Scope

Because Synapse is focused on a thin slice of the EHR that pertains to Mental Health & Addictions, this analysis will not directly consider other areas such as Pharmacy or Radiology. Additionally, although Synapse has many interfaces to other systems within the regional health authorities, this analysis will not detail external systems unless the interfaces to those systems are pertinent to the analysis.
2: PROFILE OF SYNAPSE

2.1 Overview

Synapse is a client centred, standards-based, clinically focused software application that captures and presents clinical and administrative information about Mental Health & Addictions patients in the form of an EHR. Synapse is designed around the industry standard service event model, in which interventions are captured as service events. Service events have been specifically designed to support mental health care across the continuum, and to record all input resources and outcome measures attached to each specific event. Notification of required further interventions or follow ups are supported in Synapse by the automatic creation of trigger events generated at specific points throughout the care episode.

2.2 Synapse Team

Due to the collaborative nature of the Synapse project, the management structure reflects the various stakeholder interests. There are many distinct interests that must be served due to the breadth of representation on the Synapse Project Steering Committee. Stakeholders from the regional health authorities, provincial ministries, and federal offices must collaborate to build on the initiatives that serve the collective good. At the same time, contention for scarce resources can place the various factions at odds with each other as
they strive to pursue what is in their own best interest. Ultimately, this
collaborative nature with representation from all levels of government and
industry, is likely to provide the best opportunity to produce a truly pan-
Canadian healthcare solution.

Figure 2-1 Synapse Team

![Synapse Team Diagram](http://www.synapse-ehr.com/about_us/managementteam.htm)
2.3 Privacy in Synapse

As a repository for sensitive patient information, Synapse is required to comply with stringent security and privacy standards. Synapse complies with the following legislation and policy:

- Freedom of Information and Protection of Privacy Act of British Columbia
- Regional Health Authority & Hospital Acts
- Professional Ethics
- Health Net/BC

Access to Synapse is granted to clinical and clerical staff employed by the NS/CG Mental Health & Addictions Services. General practitioners involved with NS/CG Collaborative Care Program are granted restricted access to information on patients under their care.

Synapse tracks a myriad of privacy information during every usage. It tracks the opening of client files, the specific screens that practitioners view, the length of time files are open and changes to data. Synapse managers frequently review this audit information to ensure appropriate information access. Currently, managers must manually initiate such a review. A future enhancement to Synapse security mechanisms would be to include automated reports sent to all program managers when violations occur. A “management by exception” model would make better use of resources as program managers would not be forced to review audit logs looking for exceptions. Instead, the system would notify via email or report if an exception had occurred.

6 (Governing SYNAPSE Collaborative, 2006)
Synapse uses the standard username and password method to grant access to the system. Synapse forces the users to change their passwords every 42 days and does not allow a user to reuse their passwords. Additionally, after five unsuccessful login attempts the system locks out a user account, requiring the intervention of a Synapse system administrator. Finally, Synapse disables user accounts that have not been active for 90 days.

Because Synapse displays confidential patient information, the onscreen contents of a Synapse session must be safeguarded. If users leave their workstation unattended, Synapse automatically minimizes itself to hide the displayed information after three minutes of non-activity. To return to a Synapse session, the authorized user must enter their valid password.

Given the sensitivity of the information contained within Synapse, and the information retrieved by Synapse from other repositories, stringent security mechanisms have been put in place. Synapse has taken the appropriate steps to ensure the privacy and protection of patient data, and has established clear usage guidelines for practitioners using Synapse.

### 2.4 Functionality Within Synapse

This section provides an overview of the clinical functionality available within Synapse. It is not intended to provide detailed knowledge of how to perform activities within Synapse, but rather a bird’s eye view of the features Synapse provides. This high level overview also serves to illuminate the type of information a shared EHR must contain.
2.4.1 Client Related

Synapse clinicians refer to Mental Health & Addictions patients as clients. This section details how to locate existing clients or add new ones to Synapse.

2.4.1.1 Searching

Synapse provides three distinct mechanisms to locate clients:

1. Search by Client Info - using client specific attributes such as name, gender, date of birth, or Provincial Healthcare Number.
2. Search by Staff Assignment - provides clinicians a quick way to locate their client case load. Additional search criteria such as Active Enrolments, Active Staff Assignments, and Current Coordinators help reduce the size of the result set.
3. View History - provides the clinician with a list of recently viewed client names and service events for easy access to active clients.

2.4.1.2 Adding

To ensure duplicate records are not introduced into Synapse, Clinicians only create a new client record if no existing records are found. The addition of a new client record allows the clinician to capture additional information such as Child & Youth Information, Financial Assistance, Medical Service Plan (MSP) Coverage, Cautions and Allergies, Physician Name and History, and Additional Contact Information.

2.4.1.3 Client Browser

The Client Browser provides a top level view into the client file. It lists all Mental Health & Addictions programs a client has had contact with and all
service events linked to each program. The clinician can sort the Service Events by any of the fields such as Event Date, Author or Location. Clinicians can open a located summary record to view the details.

2.4.1.4 Client Profile

The Client Profile screen includes vital client information such as Cautions which may include history of violent behaviour, suicidal, homicidal, and other noteworthy mental conditions. Also included in the Client Profile are the following information groups: Demographics, Allergies, Name/Identifier History, Previous Addresses, Contact Information, Physician Information and Revision History.

2.4.2 Health Net

Synapse clinicians may be granted access to Health Net, the Provincial Health Care database for British Columbia. Health Net allows clinicians to view a clients Medication Profile, including a record of prescription medications that the client has filled and their medication history.

2.4.3 Intake / Screening

Intake / Screening is intended to record all service events in order to determine which Mental Health Program or Programs, if any, are most appropriate to meet the clients current needs. That is, this functionality is used to capture service events which occur prior to enrolment in a program.
2.4.4 Waitlisted Enrolments

Given that there is limited space in programs for clients awaiting treatment, a patient may be waitlisted until they can be actually enrolled in a program. A waitlisted enrolment is automatically created when a client is referred to a Program from Synapse’s Intake, Assessment, or Discharge screens. Waitlisted enrolments can have assigned priorities and are generally managed by the program that is receiving the patient. Once a client is actually enrolled in a program, the waitlisted enrolment is transitioned into an actual enrolment.

2.4.5 Enrolment

Enrolment is the process of assigning a client to a specific program or programs. Enrolments can come from a previously waitlisted client or the client can be enrolled directly from the client browser. An enrolment event captures such information as the program to enrol the client into, the effective dates, the source of the referral, the guardian if applicable, and the staff assignment.

2.4.6 Assessment

Assessment are evaluations of the patient conducted by trained clinicians. Synapse captures many pieces of data such as assessment stage (consult, initial, review, etc.), duration, whether or not the patient was present during the assessment, location, and the assessment author. Once the high level details of the assessment are captured the clinician can enter multiple assessment headings and associated details.
2.4.7 Assessment Instrument

Synapse can capture multiple assessment instruments and the associated outcome such as the numeric score and additional narrative. For example, the selection of a “Beck Anxiety” assessment instrument may be entered with the associated numeric score of 24 and narrative comment mentioning the client was able to successfully complete this test on one sitting. Beck Anxiety instruments are designed to assess the severity of patient anxiety. It was specifically designed to reduce the overlap between depression and anxiety scales by measuring anxiety symptoms shared minimally with those of depression.\(^7\)

2.4.8 Diagnosis

The Diagnosis functionality within Synapse was designed to record the multiaxial diagnostic assessment defined by the American Psychiatric Association’s Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR). The DSM-IV-TR states that, because it is produced for mental health specialists, its use by people without clinical training can lead to inappropriate application of its contents.\(^8\) Therefore the use of this functionality within Synapse should be limited to clinicians with specific training in the use of DSM-IV-TR and those users entering information in behalf of a physician.

\(^7\) (University of Pennsylvania Health System, 2007)

\(^8\) (American Psychiatric Association, 2006)
2.4.9 Activity

Synapse’s activity screens are used to capture various types of contact with clients, family members, and other service providers. These activities include, but are not limited to, progress notes, nurses notes, family therapy, and treatment plans.

2.4.10 Groups

Synapse supports grouping functionality to help manage common activities across a collection of clients and clinicians.

2.4.10.1 Group Template

A group template is a convenient way to aggregate activities across multiple clients and clinicians for a given program. Groups can be named and have its membership defined to include both clients and staff.

2.4.10.2 Group Activity

Once a group has been defined, multiple activities can be created for the group, which implies the activity pertains to all or some of the group members. Each group activity can track those group members in attendance and additional notes for the group in general, as well as individual members of the group in attendance. Synapse also provides the functionality to search for group activities from within the client browser for a specific client, or from the “top level” of the application.
2.4.11 Discharge

Discharge Summaries are created when a client is released from a program enrolment. A subset of the information captured about a discharge event includes the date, location the discharge took place, and the attendees. Much like an Assessment, Discharge information can contain multiple Discharge Summary Headings with associated information captured in a text field. Additionally the Discharge screens provide the clinician the opportunity to refer the client to another program. There is currently a limitation within Synapse that the act of referring a client to another program does not actually alert the receiving program. That is, individuals are required to manually contact the receiving program by phone to initiate the referral.

2.4.12 Drafts

Synapse provides Draft functionality to allow clinicians to save interim work with regard to a client. This information is deemed as not yet ready for general clinical consumption. Only the author and his designates can view “Draft” information stored within Synapse.

2.4.13 Addendums

Addendums provide the ability to edit or add information to a client file after it has been closed. An addendum added to a client file will show up in the revision history section of a report.
2.4.14 Reports

Synapse offers various reports to provide detailed information about clients. There are multiple report categories ranging from Audit Reports to Management and Operational Reports. Within each category are multiple report instances. Many of the reports support the specification of report parameters to enable the clinician to retrieve the desired information. Synapse supports on-screen viewing of reports and the printing of hard copies.

2.5 Summary

Synapse is a feature rich, client centred, clinically focused software application that supports mental health care across a continuum. It assists practitioners with almost all aspects of patient care from identification and intake to diagnosis and discharge. The implementation of Synapse’s security and privacy features are some of the most stringent in the industry and in full compliance with multiple legislation and policy mandates in this area.

Like all evolving software applications, Synapse could be improved in certain areas and the number of defects (bugs) reduced. For example, altering the usage audit procedures to have Synapse automatically flag inappropriate data access operations, instead of current manual methods, would be a welcome change.

Today’s applications’ Graphical User Interfaces (GUI) are much more visually appealing than GUIs in Synapse. The graphical components of modern applications are built with the help of dedicated user interface specialists and
design professionals. Synapse’s GUI is very cluttered, often deviates from common interface standards and is dated. These interface limitations lead to a steeper learning curve and a slowed rate of adoption.

The workflow enhancements and usability improvements suggested here amount to a few relatively minor tactical changes, but likely will not drastically alter Synapse’s adoption path. Synapse faces a larger more strategic hurdle in its quest for widespread adoption. The more pressing strategic issue is aligning Synapse with other initiatives underway in the rest of the Canadian Healthcare industry. Interoperability of EHRs is the driving force behind many of the initiatives, rooted in the need to reduce the costs and complexity of maintaining multiple independent healthcare applications. To become a national player in the Mental Health & Addictions space, Synapse needs to get aligned with the burgeoning national interoperability standards.

The next chapter introduces two theoretical technology adoption frameworks used as the basis for analyzing the likelihood of widespread acceptance of the Electronic Health Record Solution (EHRS) proposed by Canada Health Infoway. Chapter 4: “Canada Health Infoway’s Electronic Health Record Solution (EHRS) Blueprint” discusses the EHRS in greater detail.
3: FRAMEWORK FOR ANALYSIS

3.1 Introduction

The analysis of Synapse’s potential adoption of the proposed blueprint from Health Canada Infoway (See Chapter 4: Canada Health Infoway’s Electronic Health Record Solution (EHRS) Blueprint for a detailed discussion) is anchored within two frameworks. The frameworks are based on tested theories about organizational technology adoption. The first theoretical framework is the Diffusion of Innovation (DOI), broadly defined as the study of how innovations spread through a population of potential adopters over time.\(^9\) While valuable, a strict DOI approach is incomplete because of the phenomenon known as increasing returns to adoption (the advantages of adopting a given innovation depends primarily on the size of the community of other adopters, in the past, present and future).\(^10\) Therefore I introduce a second framework component, the Economics of Technology Standards (EoTS).

I describe each of the frameworks in turn, and then discuss Canada Health Infoway’s Blueprint. I then go back and use the frameworks together to analyse the proposal for Synapse to adopt the Canada Health Infoway’s EHRS Blueprint.

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\(^9\) (Rogers, 2003)  
\(^10\) (Arthur, 1988)
Finally, a point of clarification is needed with regard to the use of the terms “innovation” and “technology” used within the theoretical frameworks. The technologies outlined in the EHRS Blueprint are “tried and true” industry standards, each of which have been proven across many industries. So while individually the recommended technologies do not represent significant innovation, taken collectively in conjunction with the sizeable changes required for Synapse to be in complete conformance with the Blueprint, the proposal to adopt the Blueprint does represent a significant innovation.

3.2 Diffusion of Innovations (DOI)

Fichman and Kemerer note that from the DOI perspective, diffusion is predominantly a process of communication; when and how a potential adopter learns about an innovation are important determinants of whether that individual will adopt. In his seminal work on innovation, Everett Rogers has identified five generic innovation attributes that influence rates of adoption, outlined in Table 3-1 DOI Attributes of Innovations below.

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Definition</th>
<th>Desired Scale Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative Advantage</td>
<td>The innovation is technically superior (in terms of cost, functionality, etc.) than the technology it supersedes.</td>
<td>High</td>
</tr>
<tr>
<td>Compatibility</td>
<td>The innovation is compatible with existing values, skills, and work practices of</td>
<td>High</td>
</tr>
</tbody>
</table>

(Fichman & Kemerer, 1993)
The definition of Relative Advantage is simply that the new technology offers clear advantages over the incumbent. If the new technology does not drastically interfere with existing practices it is said to be high on the Compatibility scale. A favorable “Low” value is assigned to the Complexity attribute when a technology is easy to understand. The two risk related attributes, Trialability and Observability, indicate that potential adopters look unfavorably on innovations that are difficult to “try out” and hard to “see or describe.” Trialability and/or Observability attributes with “Low” scores signal increased risk of adoption and reduce the certainty of the innovations true value.

### 3.3 Economics of Technology Standards (EoTS)

As mentioned in the introduction, the Economics of Technology Standards is a nice complement to the DOI model because it includes the
phenomenon of increasing returns to adoption. While economists identify many increasing returns to adoption, the three most applicable to this analysis are:

1. Learning by Using - as the community of adopters accumulates experience with the technology, its price performance ratio improves.

2. Positive Network Externalities - often called “network benefits.” Additional value to all comes as each new adopter embraces the technology. For example, your FAX machine becomes more valuable with each FAX machine sold, as you have more people to FAX to.

3. Technology Interrelatedness - a large base of compatible products, and thus a large base of possible adopters, is needed to make the technology worthwhile as a whole. For example, the ecosystem of related accessories that complement Apple’s iPod make the choice of purchasing an iPod (rather than a competing music player without related technologies) much easier for the consumer.

Economists have identified several factors which help in determining whether or not a technology will achieve critical mass. Table 3-2 below outlines those factors followed by a brief discussion of each of the factors.
Table 3-2 Economic Factors Affecting Technology Adoption

<table>
<thead>
<tr>
<th>Factor</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior Technology Drag</td>
<td>A prior technology provides significant network benefits because of a large and mature installed base.</td>
</tr>
<tr>
<td>Irreversibility of Investments</td>
<td>Adoption of the technology requires irreversible investment in areas such as products, training, and accumulated project experience.</td>
</tr>
<tr>
<td>Sponsorship</td>
<td>A single entity (person, organization, consortium) exists to define the technology, set standards, subsidize early adopters, and otherwise promote adoption of the new technology.</td>
</tr>
<tr>
<td>Expectations</td>
<td>The technology benefits from an extended period of widespread expectations that it will be pervasively adopted in the future.</td>
</tr>
</tbody>
</table>

Table created by author; data from Fichman & Kemerer. Adoption of Software Engineering Process Innovations: The Case of Object Orientation. Table 2.

Prior Technology Drag is present when there is an existing mature technology with a sizeable installed base which causes a large disparity in the short-term benefits between the old and new systems. Despite the new technology holding long-term promise, the existence of an incumbent represents a “drag” on the movement towards the new technology. This reluctance to move is understandable as it presents transition costs associated with joining a nascent network. Additionally, and even more importantly, it could mean large irreversible investment requirements for the potential adopter. These additional costs represent a risk premium to potential adopters as they must consider the possibility of being stranded should the new technology fail to take hold.
The news is not all doom and gloom for new technologies, strong sponsorship and positive expectations can help to displace incumbent technologies. Strong sponsorship can help tip the scales in favor of the newer technology by subsidizing early adopters. Further, a strong sponsor can make large and credible commitments to develop the technology despite a slow initial adoption rate. Finally, a sponsor can help set standards to ensure that a single integrated network will emerge around the newer technology, avoiding a fragmented technology ecosystem.

Another crucial dimension in a technology’s quest for dominance is expectations. If industry players hold positive expectations that the new technology will eventually enjoy widespread adoption, a prolonged “honeymoon” period can develop. If this honeymoon period is cut short by a perception of a weak scientific basis or publicized “horror stories” the new technology is less likely to catch on.

3.4 A Complementary Framework Approach

The coupling of the DOI framework and the Economics of Technology Standards approach provides three key benefits when investigating Synapse’s adoption of the EHRS Blueprint. The benefits are:

1. It defines a special class of innovation, that of increasing returns to adoption, to which integrated Electronic Health Records (EHR) clearly belong. The more health care providers that adopt EHRs the better the level of service provided to clients as clinical
decisions are based on a more holistic client profile backed by shared data.

2. It identifies several widespread factors, such as Prior Technology Drag, that are not included in the DOI model yet have a profound impact on technology adoption. Synapse is a currently deployed production system, any strategic decision regarding its future must consider the currently installed base.

3. It predicts differing patterns of adoption for those technologies that are subject to increasing returns. Whereas the DOI model predicts a standard “S-curve” adoption path, the Technology Standards approach views things in more “black and white” terms. If the new technology succeeds in establishing itself during the honeymoon period it will likely ultimately succeed. Otherwise, the negative tide of expectations will turn on a new technology and its adoption will plateau.

The combination of the two technology adoption frameworks ultimately strengthens the analysis and adds value to the discussion.

3.5 Summary

This chapter introduced the two theoretical frameworks to be used in this analysis, namely, Diffusion of Innovation (DOI) and the Economics of Technology Standards (EoTS). These complementary frameworks are particularly relevant to the analysis of Synapse’s potential adoption of the
Blueprint because they help us understand and predict how innovations spread through a population of potential adopters over time. Additionally, by considering increasing returns to adoption we get a clearer picture of the likelihood of acceptance given the size of the community of other adopters.

The next chapter introduces the Canada Health Infoway organization, its mandate, and its Electronic Health Record Solution (EHRS) Blueprint. The EHRS Blueprint is the key architecture document that describes a model for a truly pan-Canadian EHR.

Chapter 5: entitled “Application of the Framework to Synapse and the EHRS Blueprint” will apply the theoretical adoption frameworks introduced in this chapter to the EHRS Blueprint initiatives proposed in Chapter 4: , with the intent of gaining some insight into the probability that the EHRS Blueprint becomes widely adopted.
4: CANADA HEALTH INFOWAY’S ELECTRONIC HEALTH RECORD SOLUTION (EHRS) BLUEPRINT

4.1 About Canada Health Infoway

Canada Health Infoway Inc. invests with public sector partners across Canada to implement and utilize existing compatible health information systems that support a safer, more efficient healthcare system. Infoway is an independent, not-for-profit organization whose Members are Canada’s 14 federal, provincial and territorial Deputy Ministers of Health. Launched in 2001, Infoway and its public sector partners have over 100 projects, either completed or underway, delivering Electronic Health Record (EHR) solutions to Canadians. The solutions are designed to bring tangible value to patients, providers and the healthcare system.¹²

4.1.1 Mission

- To foster and accelerate the development and adoption of electronic health information systems with compatible standards and communications technologies on a pan-Canadian basis, with tangible benefits to Canadians.
- To build on existing initiatives and pursue collaborative relationships in pursuit of its mission.

¹² (Canada Health Infoway, 2007a)
4.1.2 Vision

- A high-quality, sustainable and effective Canadian healthcare system supported by an infostructure that provides residents of Canada and their healthcare providers with timely, appropriate and secure access to the right information when and where they enter into the healthcare system. Respect for privacy is fundamental to this vision.

4.1.3 Goal

- To have an interoperable EHR in place across 50 per cent of Canada (by population) by the end of 2009.

4.1.4 Core Business

Infoway is a strategic investor that works in partnership with health ministries, regional authorities, other healthcare organizations and information system vendors to best align Infoway's investments with jurisdictional plans and to leverage existing solutions. Once investment decisions are made, the public sector partners lead the development, implementation and use of EHR solutions. Infoway provides leadership by establishing a strategic direction for EHR implementation in Canada in collaboration with the provinces and territories.

As a strategic investor, Infoway is currently working with its public sector partners on projects in nine targeted program areas: Registries, Diagnostic Imaging Systems, Drug Information Systems, Laboratory Information Systems, Telehealth, Public Health Surveillance, Interoperable EHR, Innovation and Adoption, and Infostructure.
4.1.5 Structure

Infoway is a unique organization by virtue of its membership - the 14 Deputy Ministers of Health of the federal, provincial and territorial governments of Canada. Infoway is equally accountable to all its Members who represent their jurisdictions, report to their Ministers, and may make available any report or plan to their Minister. This ensures that all Ministers are informed of Infoway's plans, progress and issues. Members also endorse Infoway's annual Corporate Business Plan which is approved by the Board.

Infoway is neither an agent of the Crown, nor a Crown Corporation nor a foundation. It is an independent not-for-profit corporation.

Infoway's structure allows for up to 13 Board Directors: two are appointed by the federal Deputy Minister of Health, five are appointed on a regional basis by the provincial and territorial Deputy Ministers of Health, and six are elected by the members of the Corporation.

4.1.6 Infoway's Privacy Mandate

Respect for Privacy is fundamental to the vision of an interoperable Electronic Health Record system.

Infoway's funding agreement requires it to:

- “incorporate the protection of personal health information in its activities in accordance with applicable laws and privacy principles.”

These applicable laws refer to the provincial and territorial laws and policies that dictate how personal health information is handled.

Infoway achieves this by:
o Ensuring that privacy and security are addressed in the projects it funds. For example, every project is required to conduct a Privacy Impact Assessment (PIA) that describes how the system will function and how it will address privacy rules in place in the jurisdiction.

o Working to identify and leverage best practices for re-use across the country. For example, Infoway’s pan-Canadian view means that if a project in one province is looking at technical solutions for guaranteeing that only those authorized can view data, Infoway can support that work and ensure it is available for another jurisdiction to consider.

o Working to ensure that jurisdictions adopt an interoperable approach. For example, Infoway has worked with clinicians, business, technology and privacy experts across the country to develop a privacy and security architecture that can be used to build secure and privacy enhancing interoperable EHRs. The architecture is flexible in that jurisdictions can implement the privacy protective features that are consistent with their local legislative requirements and allows consensual access to personal health records by authorized users.

4.2 Overview

Canadians view universally accessible healthcare as a key part of the national fabric. Besides people, information is the most valued resource in caring for our health. As patients, we entrust clinicians with the power to make import decisions, based on available information about our previous and current health status. We also trust Health System Managers, Policy Makers, Researchers and Educators to use reliable and appropriate information to make our collective healthcare system work well. Achieving this level of
effectiveness requires the availability of health information and the sharing of this information across care settings and disciplines, and across jurisdictional boundaries. The collection, management and transmission of electronic patient data has been available for some time, albeit in a restricted state. The next logical step is to break free from the “islands of information” model to ensure the disparate systems are interoperable, working together to support health and healthcare initiatives in Canada. Canada Health Infoway has been mandated to develop an information and interoperability framework or architecture that will support the development of solutions for sharing critical health and healthcare information across the country, so that the appropriate health information is available for patient care no matter where providers or patients are.\textsuperscript{13}

4.3 EHRS Blueprint Background

In November 2004, the Romanow Commission released its final report entitled “Building on Values: The Future of Healthcare in Canada”.\textsuperscript{14} The report included a myriad of recommendations designed to strengthen and modernize healthcare in Canada. Recommendations number eight and nine stated respectively:

\begin{quote}
A personal electronic health record for each Canadian that builds upon the work currently underway in provinces and territories.
\end{quote}

\begin{quote}
Canada Health Infoway should continue to take the lead on this initiative and be responsible for developing a pan-Canadian
\end{quote}

\textsuperscript{13} (Canada Health Infoway, 2006b)
\textsuperscript{14} (Romanow, 2002)
electronic health record framework built upon provincial systems, including ensuring the interoperability of current electronic health information systems and addressing issues such as security standards and harmonizing privacy policies.

In response to the recommendations, Canada Health Infoway created a framework to ease the development of the Canadian Electronic Health Record Solution (EHRS). This enterprise system architecture will guide the overall development of both the whole and the individual parts. The EHRS Blueprint provides a comprehensive description of the components necessary for the interoperable EHR. It also explains how the pieces are designed to work together.

4.4 EHRS Blueprint Value

As a conceptual architecture document, the EHRS Blueprint gives solution providers a way to get the right information about health and healthcare, to the right people at the right time in the right format. Canada Health Infoway’s Blueprint prescribes creating a robust and extensible framework and standard for sharing health information to achieve these goals.

Recognizing that there currently exists a large collection of deployed healthcare solutions, the EHRS Blueprint is designed to support them, as well as being flexible enough to incorporate new developments in Information Technology or healthcare best practices.

Finally, the EHRS Blueprint is designed to be technology-neutral. That is, no particular vendor’s technology, product or services are mandated. An EHRS
compliant solution will provide access to patient information in both their home jurisdiction and nationally.

4.4.1 Patient Value

The ultimate goal of both Synapse and any other health information system is improved patient care. The EHRS Blueprint provides the framework that enables the sharing of a patient’s health information, providing a more accurate and complete picture of events that clinicians can rely on to make better decisions on behalf of their patients.

EHRs also provide patient value by increasing the availability of information to remote specialists, reducing the need for patient travel, inconvenience, risk, and the time needed to start treatment. Shared electronic health records stand to make a significant difference in reducing medication errors and adverse events that occur in hospitals. A 1998 study conducted in the United States showed that after implementing a computerized order entry system, medication errors decreased by 55% and there was a 17% reduction in preventable adverse drug events. In a follow up study by the same group, rates of serious medication errors fell by 88%. In Canada we know that at least 7.5% of hospital admissions (185,000 of 2.5 million) were associated with an adverse event, and close to 70,000 were potentially preventable.

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15 (Booz, Allen, & Hamilton, 2005)
16 (Baker, Norton, Flintoft, & Blais, 2004)
4.5 Methods for Sharing EHR Information

When designing the architecture to enable sharing of clinically-relevant healthcare data, the EHRS Blueprint authors considered four possible methods to achieve this goal. These original options are relevant to this analysis because they have wide reaching implications for the future of Synapse and its ability to integrate into a pan-Canadian infostructure.

1. Single database or the “Big Database in the Sky” where data from all point of service applications, such as Synapse, are stored in the same data store and all users pull data from that store.

2. Data broadcast to all, or a logical subset of systems. This would involve replication of data from one system to all other relevant or participating systems, and every point of service would hold the same kind of information in similar formats. Direct connection would occur between each point of service and all other participating systems.

3. A single index/locator service, or the “Big Index in the Sky,” where an EHR Index or locator service holds links to all point of service applications where information resides. Each point of service system interfaces to other systems.

4. Use of a shared reference information source that is populated with clinically relevant data by the various point of service systems such as Synapse. Other point of service systems or viewers reference it, and pull needed data from it. This reference source remains external to the operation of each point of service, and thus does not directly touch the point of service.

The last method of using a shared reference information source was chosen for many of the following reasons:
• It protects both point of service application performance and core data by removing the impact of other systems reaching in to retrieve data (the problem with Method 3).
• It requires the lowest number of direct interfaces, dramatically reducing the overall cost of integration (the problem with Method 2).
• It requires standards to be applied to all data exchanged with the EHRS, improving the consistency and usability of that data.
• It allows for the re-use or leveraging of legacy systems.
• Overall, it is the most cost effective method.

Finally each jurisdiction will have its own EHR solution that is customized to its specific needs. However, each solution will share the overall enterprise architecture prescribed in the EHRS Blueprint. This provides the adaptability required at the jurisdictional level while preserving the health information standards required for a pan-Canadian solution.

4.6 The EHR Solution Concept

Refer to Figure 4-1 while exploring the components of the Electronic Health Record Infostructure (EHRi). The EHRi is composed of:

• Registry Systems to manage and provide the information required to uniquely identify the actors (patients, clinicians, etc.) and resources (providers, locations, terminology, etc.) in the EHR. Registries which hold patient consent information are also part of the EHRi.
• EHRi Domain Repositories that manage and persist subsets of clinical data pertinent to the clinical picture of a patient. For example, a diagnostic imaging Picture Archiving and Communication System (PACS) solution, where digital diagnostic images are held in an information repository.
- The Shared Health Record repository that holds basic information on health encounters and health service events, and the clinical observations associated with those events.
- A set of Longitudinal Record Services to coordinate accesses to patient-centric information and updates to that information across domains and applications. It also manages metadata to help locate data across multiple domains and registries.
- Standardized common services and communication services to sustain the interoperability of the different components within the infostructure. Provide interoperability and a high degree of abstraction between the EHR infostructure and the point of service applications.
- Standardized information, message structures and business transactions to support the exchange of information in and out of the EHRi.
- An EHR viewer as a generic presentation application allowing end users to access, search and view relevant and authorized clinical data about clients. The viewer provides a single seamless view of all available and relevant healthcare information on a patient regardless of its source.

Figure 4-1 EHR Infostructure (EHRi)

Figure created by author; data from EHRS Blueprint Version 2 (http://knowledge.infoway-inforoute.ca/EHRSRA/doc/EHRS-Blueprint-v2-Exec-Overview.pdf)
4.7 EHR as a Network of EHR Infostructures

To leverage the work done in any one jurisdiction, the EHRS Blueprint defines a pan-Canadian architecture that will link jurisdictional EHR Infostructures, in effect creating a network of connected EHR Infostructures. This model provisions sharing of information while at the same time permitting jurisdictional control over rights and responsibilities for healthcare standards. For example, British Columbia will have its own EHRS, or more likely, many regional EHR Solutions working together, that will be managed provincially. Yet for pan-Canadian issues such as Public Health Surveillance, the jurisdictional EHR databases can be federated to support decision-making.

Figure 4-2 shows a graphical representation of multiple EHR Infostructures linked via the Health Information Layer (HIAL) to create a nationwide network. For end users, the result is perceived as a single source of all relevant clinical information operating seamlessly and invisibly across all components - a black box with a set of transactions. From the perspective of the end user at a PoS, the EHR Infostructure is seen as a gateway which it can use to contribute or access data for a given patient.
4.8 Key Elements of the EHRS Blueprint

4.8.1 The Point of Service (PoS) Applications

Within the context of an EHRi, Synapse would be considered a Point of Service (PoS) application. From a clinician’s point of view, the required information is readily available, yet in fact that information may come from many different systems. This is much like the situation that exists today within Synapse. Provincial databases are accessed to seamlessly retrieve patient information for the clinician.
Point of Service applications, such as Synapse, are responsible for most, if not all, of the collection of clinical data that will eventually form the patient’s EHR. PoS’s are not information islands, instead they are collection and sharing points for the majority of clinical data. The role of the PoS is paramount in an EHRi and represents the primary point of value, the place where all data is gathered and managed within the EHRS. Finally, the PoS can be thought of as the confluence of the patient, the healthcare provider, and the EHRS.

Many of the guiding design principles of the EHRS Blueprint are apparent here, they include:

- Clinicians will continue to manage and contribute to the development of the highly specialized functional applications they use on a daily basis. The needs of clinicians will continue to drive the design of subsequent versions. It is not the intent of the Blueprint architects to impose rigid guidelines that end up serving as technical impediments to improved patient care. The design objective is to build solutions to capture clinical data from one PoS application for use within all other PoS’s that share the EHR.
- The architecture leverages prior investment such as technology, capital, and most importantly, clinical knowledge captured in existing applications. Effective applications such as Synapse will be adapted for continued and expanded use within the architecture. The vast amount of wisdom captured and embedded in these systems should not be lost.

There are a few subtleties to notice with respect to the PoS within the EHRS, they are described here and shown graphically in Figure 4-3. First, each
PoS is assumed to have its data stored locally, which is shown graphically as the data cylinder inside each PoS. Second, each PoS does not communicate directly with each other. Instead, they rely on the services provided by the Health Information Access Layer (HIAL). This allows the HIAL to verify the correct patient identity and if appropriate, anonymize the data, validate the identity of the requester and ensure authorized use.

Figure 4-3 Point of Service (PoS) Within the EHRS

There are many types of PoS applications that will exist in a functioning EHRS. To help illustrate the point Figure 4-4 shows a collection of common Point of Service applications. The list is not intended to be representative of any one jurisdiction nor exhaustive, it simply illustrates the variety of applications that may participate in an EHRS.
In summary, each PoS site is considered a stand-alone instance of a clinical application, so that it can maintain information relevant to the practice setting, without that information being part of the shared EHR that is accessible to others through the infostructure. This implies a series of business decisions that must be made by PoS management in conjunction with other stakeholders: namely, which pieces of data to continue to keep local, and which pieces to share with other users of the EHR. For example, a clinician may want to keep notes about locally provided services or questionnaire details used in a patient interview, that are not necessary for the shareable EHR. Finally, it should be noted that information pushed to the EHR for sharing is a copy, not the original.

4.8.2 EHR Repositories: The Shared Data

Effective healthcare is an information intense endeavour, and any one PoS will likely contain only a fraction of the information required to make appropriate clinical decisions. A good portion of the information will reside in
systems external to any given PoS. This information must also be available at the point of care, yet sometimes resides in Public Health services or external diagnostic services. The EHRS Blueprint includes a few domain repositories to ensure the availability of this type of clinical information. Each domain repository is usually associated with a province or jurisdiction, and contains a significant subset of the overall EHR data available for sharing with other domain repositories and jurisdictions.

The Point of Service applications, such as Synapse, are responsible for publishing, into an EHR Data Repository, data that is to shared. Once a PoS system pushes data in this manner, it is known as an “EHR Source System.” The EHR repository will then store this data in it local databases until it is requested by another authorized user.

Figure 4-6 combines the PoS systems from the previous section with this section’s EHR repositories to show a high level view of their interaction.
The double headed arrows in Figure 4-6 show the PoS systems acting as both sources and users of the information stored in the four EHR domain repositories located at the level above. All information exchanges are performed with strict adherence to standards-based interfaces defined in Interoperability Profiles, discussed next.

4.8.3 Interoperability Profiles

Interoperability Profiles specify the interfaces between PoS applications and the EHRi. They are a description of the types of business functions/service requests a Point of Service system requires the EHR Infostructure system to
provide in order to support the EHR clinical activity business (use case) requirements. Interoperability Profiles position which data is to be exchanged by referring to data views of the data model. The messaging system assumes SOAP-based web services calls where XML encoded HL7 V3 message requests and responses are carried between POS applications and the EHRi. Interoperability Profiles are made up messages using standard message definitions, such as DICOM and HL7. Messages are further supported by data standards, including reference terminologies such as SNOMED CT. (See section 6.1.2 for a discussion of SNOMED CT.) These interfaces carry the patient’s data between the EHR infostructure and the Point of Service applications.

4.8.4 Registry Services: Correctly Identifying Patients, Service Providers, and Service Locations

The information a clinician gets from the Interoperable Electronic Health Record must be both reliable and accurate. In addition, the clinician needs to be sure the EHR information relates to the person they are dealing with and not someone else. To address these issues, the Blueprint includes repositories called registries for identifiers of key attributes, such as patients, providers, locations and clinical terminologies. The aim is to ensure that the correct clinician or user, accesses and provides the right information on the right person in relation to the right location. This helps ensure that safe decisions can be made as the end user can be assured they have valid, reliable and understandable information. Figure 4-7 below illustrates the different registries defined in the EHRS Blueprint.
4.8.5 Longitudinal Record Services: The Whole View

In the ideal case, when a healthcare provider makes a clinical decision, she has all the available data in one place for the given patient. However, the actual sources of the patient data will undoubtedly reside in many locations. When combined, the data effectively creates the perception of a single longitudinal record.

The fact that there are multiple repositories each holding some portion of the EHR data presents a challenge with respect to data retrieval even if the unique patient identifier is known. To aid in such data retrieval the Blueprint defines a set of services, the Longitudinal Record Services (LRS), to perform the functions of collecting and combining data from registries, repositories and other sources. The LRS also normalizes that data for common understanding, records instances of its use, and manages other relevant information on behalf of the PoS System. Quick responses to PoS’s requests are ensured because the LRS has the required knowledge about the EHR data in the EHRS. This type of architecture is prevalent and proven in many other enterprise class systems in
various industries, and is commonly known as a Service Oriented Architecture (SOA). See the Appendix for a SOA Primer.

Figure 4-8 Longitudinal Record Services

In a sense the LRS can be considered the central nervous system or the kernel for the execution of EHR data access transactions. All transactions that access data in the clients’ health records are processed by the LRS. The LRS is the only component of an EHR Infostructure that knows the transactions and business logic and data access rules required to compile a true longitudinal and comprehensive view of any data subject being accessed.
4.8.6 Health Information Access Layer (HIAL): The Glue that Binds

Connecting hundreds of Point of Service applications with multiple repositories could present a logistical nightmare. The HIAL’s job is to act as a gateway, or critical sharing point, to make it possible for differing pieces of information to be shared with the complete range of EHRs. The Health Information Access Layer provides a unified standardized way to connect PoS applications and the EHR Infostructure. This connection mechanism is independent of how a particular jurisdiction has partitioned EHR services and domains.

Once again, the design paradigm is similar to that of many other industries, which allows the Blueprint to leverage the technologies that have been previously developed for other industries. However, despite the synergy with other industry solutions, the level of complexity and stringent privacy requirements of healthcare solutions mandate differing sets of terminologies, concepts and information standards, including the use of HL7 v3.

The HIAL is composed of services, service roles, information models, and messaging standards required for the exchange of EHR data and the execution of interoperability profiles between EHR services.
Figure 4-9 The Health Information Access Layer (HIAL)

Figure created by author; data from EHRS Blueprint Version 2 (http://knowledge.infoway-inforoute.ca/EHRSRA/doc/EHRS-Blueprint-v2-Exec-Overview.pdf)
Figure 4-10 Details of HIAL Communication Bus and Common Services

Figure created by author; data from EHRS Blueprint Version 2 (http://knowledge.infoway-inforoute.ca/EHRSRA/doc/EHRS-Blueprint-v2-Exec-Overview.pdf)
4.8.7 EHR Viewer: The Common Window

Up until this point there has been an implicit assumption that all user interaction with the EHRi will be performed through a PoS system, such as Synapse. However, if a user does not have a PoS or if their PoS is not EHR capable, the EHR Viewer can be used. The EHR Viewer is a special kind of PoS application that unlike its peer PoS applications, does not rely on a local data store, and must obtain all of its data from the EHR. This lack of local data storage can be seen graphically in the lower right hand corner of Figure 4-9 where the cylinder representing local data storage is not shown for the EHR Viewer, as it is with other PoS applications.

The EHR Viewer is likely a web based application providing a user friendly environment for authorized health professionals to access a client’s electronic health records. The EHR Viewer is envisioned to evolve over time to provide a richer set of capabilities, the details of which are laid out in detail in the EHRS Blueprint and are thus not covered here. It is important to note that the EHR Viewer interacts with the same standards-based communication mechanisms that other PoS applications would use. Figure 4-11 outlines some of high level interactions between EHRS components and facets of an EHR Viewer application.
4.9 Summary

This chapter provided an introduction to the Canada Health Infoway organization, its mission, and detailed the core sub-systems contained in the EHRS Blueprint. The EHRS Blueprint is the starting point for the infostructure described in Infoway’s vision statement. An infostructure is a shared foundation of components including software, hardware, communication technologies and the associated architectures that allow the desired uninterrupted flow of pertinent information. Through the application of the Blueprint principles and
conceptual frameworks, Infoway strives to establish a shareable EHR for all of Canada.

The vision shaping the Blueprint is broad enough to encompass all jurisdictional requirements, regardless of geography, yet practical enough to recognize and embrace the vast expenditures already committed to existing information technology solutions.

The next chapter applies the theoretical adoption frameworks introduced in Chapter 3: to the EHRS Blueprint document discussed in this chapter, always mindful of the Blueprint’s relevance to Synapse. Chapter 3: attempts to foresee whether or not Infoway’s recommendations will be widely adopted. Further, what are the ramifications to Synapse if it were to adopt the Blueprint recommendations?
5: APPLICATION OF THE FRAMEWORK TO SYNAPSE AND THE EHRS BLUEPRINT

5.1 Diffusion of Innovations (DOI)

According to the Diffusion of Innovations perspective, an innovation’s adoption rate and ease of implementation are primarily determined by its relative advantage, compatibility, complexity, trialability and observability. Yet we must also consider the perspective of the adopter when assigning scale values to each of the aforementioned attributes. For example, are the adopters of the EHRS Blueprint the members of the Synapse development team, the clinicians using the Synapse application, or the patients who ultimately receive the benefit of integrated systems? Ultimately, the answer is “they all are” because before patients receive the benefits, clinicians must embrace the changes, and prior to that, the Synapse management and development teams must become proponents. This analysis will attempt to give a balanced perspective when assigning low, medium, or high scores to the DOI attributes, noting where scores may be contradictory depending upon which perspective is taken.

5.1.1 Relative Advantage

Relative Advantage is a difficult attribute to measure because the EHRS Blueprint is not a specific technology, but a reference architecture describing how to build interoperable systems. The Blueprint does mandate certain
standards for implementation, such as HL7 V3 and SNOMED CT, but does not state exactly how the standards are to be used to create clinical value. This is analogous to stating “We are communicating in English, but you can make up any sentence you want to convey your intent.” However, if a standards-based approach is used as one proxy for quality, following standards creates better software. The adoption of standards in software development has many benefits including a reduced maintenance burden, a higher degree of interoperability and ultimately produces solutions that are much easier to extend in the future as business needs evolve. There are inherent cost trade-offs as the initial adoption of new standards implies additional analysis, comprehension and development time. Yet, once the standards are internalized, subsequent development becomes easier as people are familiar with the protocols. In the short term, there is additional cost associated with adopting the Blueprint, however the short-term investment in such activities as learning and retooling will create leverage and provide long-term benefits that will outweigh the initial costs.

From the point of view of Synapse clinicians and patients, the successful implementation of a truly pan-Canadian Mental Health EHR delivered via Synapse offers a high relative advantage. The expanding universe of clinical data from which practitioners can base their decisions on, provides improved patient care as clinicians would be equipped with all available information.
5.1.2 Compatibility

One of the most elegant features of the EHRS Blueprint design is the provision for a phased rollout. Canada Health Infoway’s architects clearly recognized the vast technological investments made in the current healthcare system and accordingly designed a solution that ensured compatibility with existing systems. Synapse is free to choose an incremental adoption strategy, adding additional integration and interoperability as appropriate.

The Synapse architecture currently mirrors many of the proposals in the EHRS Blueprint. Specifically, it seamlessly integrates data from its local data stores with information obtained from provincial registries to create a unified data set for a clinician’s viewing. This distributed data access model is analogous to the proposal in the EHRS Blueprint. While Synapse would need to redirect its information requests to the newly established infostructure, the data access paradigm is nothing new to Synapse. However, the adoption of the EHRS Blueprint does require specific changes to the data access, display, and possibly security mechanisms currently provided in Synapse.

Clinicians would continue to interact with Synapse in the same manner, regardless of whether the underlying data comes from a remote infostructure or a local data store. All of the low-level data access remains hidden from these users. Clinicians simply see a richer set of information based on the contents of a growing shared electronic health record. However, due to the technical requirements to redirect Synapse to the shared repositories in the
new infrastructure, the score for DOI Compatibility is reduced from a high score to “med-high.”

5.1.3 Complexity

The distinction should be made between Synapse application developers and the users of the Synapse system (the clinicians). From a clinician’s perspective, there is very little additional complexity, if any, caused by adopting the EHRS Blueprint. In fact the system may become simplified as information from different sources is integrated and becomes more accessible. Thus, the complexity value for clinicians is a desirable “low.”

From the perspective of a programmer on the Synapse development team however, the EHRS Blueprint increases complexity. Data access becomes more intricate due to the multiple levels of indirection. What was once a direct lookup in a local data store would become a series of calls via the Health Information Access Layer’s Longitudinal Record Services to locate and retrieve the desired information. Adopting the EHRS Blueprint means Synapse must migrate data it intends to share with other systems, data that was once stored in a local repository, to a shared EHRi Data Repository (see Section 4.8.2 “EHR Repositories: The Shared Data” for a discussion of shared data services). These changes will require Synapse to modify the application’s source code and conduct a barrage of associated testing. Thus, a Synapse software developer will experience medium to high complexity as new application programming interfaces (APIs) are explored and the subtleties of the HIAL are mastered. (See
Section 4.8.6 “Health Information Access Layer (HIAL): The Glue that Binds” for a discussion of the HIAL.

5.1.4 Trialability

One of the hallmarks of a strong design is its ability to extend in ways not necessarily envisioned when originally developed. The EHRS Blueprint positions itself to achieve this goal through a layered design approach, the provision of core services, and the use of interoperable standards. This allows systems developed to the Blueprint specifications to evolve incrementally at a marginal cost while still providing benefit to the users. For example, initially Synapse could elect to adopt only the EHRS Blueprint’s SNOMED CT terminology standards to become familiar with EHRi development paradigms. The ability to experiment on a limited basis without undue effort and expense while still providing a positive benefit leads to a “high” score for the Trialability DOI attribute.

5.1.5 Observability

An valuable property of the EHRS Blueprint is its observability. Upon adoption of the EHRS Blueprint, clinicians and patients clearly would see improvements in the breadth of information Synapse provides. These benefits are easily observed by both expert and first-time Synapse users. High observability helps promote the adoption of Synapse in jurisdictions contemplating its use. Once Synapse is integrated into the EHRi, a simple live demo of the product would be sufficient to convince potential adopters that
Synapse can be the gateway to a wealth of integrated health related information.

5.2 Economics of Technology Standards

Canada Health Infoway’s EHRS Blueprint is subject to increasing returns to adoption. Healthcare systems adopting the model become more valuable to individual adopters to the extent that others adopt. Each new user of a EHRS Blueprint designed system contributes to the core of the entire infostructure, namely the shared electronic health record. For example, contributions from Pharmacy systems help clinicians in a physician’s office because the clinician has immediate access to the patient’s complete drug prescription and fulfilment history. Aggregate information from Diagnostic Imaging and Laboratory systems aid Public Health Providers in making better administrative decisions through the use of actual data as the basis for decision making, also known as evidence based management. The positive network externalities, or so called “network benefits” provide some of the most obvious and profound value to the community.

Widespread adoption ultimately leads to faster maturation as clinicians, and more importantly, system development personnel accumulate experience and become more productive as they develop EHRS Blueprint compliant solutions. The experience gained by early adopters “learning by using” is key to further adoption as it helps increase the depth of the knowledge pool that can be leveraged in subsequent development cycles.
As the EHRS Blueprint compliant ecosystem matures, companies will emerge to capitalize on opportunities to sell components and services that serve the community. A similar situation occurred when Microsoft’s Visual Basic™ programming language grabbed mind share in the early 1990’s. Third-party component developers entered the market place selling commonly used graphical components such as toolbar or print preview controls. The presence of these interrelated off-the-shelf components made the decision to adopt Visual Basic as the preferred programming language much easier. The existence of pre-tested, widely available components eased the task of software development.

Table 3-2 Economic Factors Affecting Technology Adoption described the four factors used as the key determinants of whether a technology will become dominant. The four factors are: prior technology drag, irreversibility of investments, sponsorship, and expectations.

5.2.1 Prior Technology Drag

A design tenet of the EHRS Blueprint was to leverage the existing expenditure in health care systems. However, by definition this creates prior technology drag as thousands of information technology solutions must be altered to participate in the EHRS. As a currently deployed production system, Synapse too faces prior technology drag. However, due to the specialized nature of the software, the installed base is quite small which helps minimize that drag. Contrast this situation with the one facing a company set to release
a competing word processor given the ubiquity of Microsoft Word™. The tens of millions of existing MS-Word™ installations and associated end-user data files create an almost insurmountable challenge to a market newcomer, even if the new technology is superior or less expensive. The entrenched nature of the incumbent technology creates massive technology drag.

5.2.2 Irreversibility of Investments

Canada Health Infoway recognizes the steep costs facing potential EHRS Blueprint adopters and has attempted to offset those costs with over 1.1 billion dollars in development grants. Synapse’s adoption of the EHRS Blueprint architecture will require some irreversible investments in staff training and possibly software. These types of asset investments are highly specialized and lose most or all of their value if the initiative is abandoned at a later date. To some extent, this is a classic “catch-22” situation. Companies are risk averse with respect to investing in technologies that require a critical mass of other adopters to realize the benefit, yet unless many companies adopt, the technology will struggle to achieve critical mass.

5.2.3 Sponsorship

The key to solving the conundrum outlined in section 5.2.2 is found in sponsorship. The technology must be backed by a key industry player. Canada Health Infoway is that key sponsor that can bridge the gap between emerging technology initiatives and sustainable long-term Canadian healthcare solutions. Canada Health Infoway was established to advance the adoption of electronic
health information systems. It establishes and promotes unified standards, subsidizes early adopters and makes credible commitments to the development of standards-based solutions, even if it expects delays in widespread adoption.

Canada Health Infoway’s initiatives reduce Synapse’s risk in adopting a new technology platform as its vehicle to create a comprehensive standards-based EHR for Mental Health & Addictions. Specifically, Synapse’s risk is mitigated through the following:

- Infoway’s provision of funding.
- the incorporation of standards-based solutions such as SNOMED-CT.
- the leveraging of best practices such as Service Oriented Architectures (SOA), adopted from other industries.
- the provision for a phased or incremental adoption strategy to avoid the highly undesirable “bet the farm” approach.
- a robust technology-neutral design which avoids a reliance on any one vendor's technology, product or services.
- support for leveraging existing work to avoid senseless re-coding of deployed information system solutions.

5.2.4 Expectations

While EHR solutions offer the promise of improved healthcare systems through the strategic use of technology, adopters must remain realistic in their expectations. EHRs are not a panacea and their adoption will likely introduce new problems to be solved. In his book Good to Great, Jim Collins observed that technology works as an “accelerator of momentum, not as a creator.”

Synapse’s adoption of the architecture guidelines in the EHRS Blueprint is only

17 (Collins, 2001)
part of the journey towards improved efficiency, data quality, and the foundation for improved clinical care. Ultimately almost all health related information will be available electronically, it is simply a question of timing for those potential adopters who are currently “sitting on the fence.” Given Canada’s nationalized health care structure the expectation of a successfully implemented pan-Canadian solution is high.

Despite the hard work and careful planning that would go into the architecting and implementation of a national health care information solution, there is an inherent risk that the accumulated goodwill could be wiped out by a few high profile fiascos. This is exactly what happened in Australia. The Australian government was publicly berated by its political opponents for wasting hundreds of millions of dollars on failed attempts to introduce a national EHR system.18 As a result of these widely publicized failures, the Australian government scrapped the $1.1 billion project for Medicare Smart Cards.

5.3 Complementary Framework

In summary, the Diffusion of Innovation (DOI) perspective rates the adoption of the EHRS Blueprint guidelines with respect to Synapse as follows:

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18 (Australian Associated Press Pty Limited (AAP), 2006)
The Economics of Technology Standards (EoTS) perspective has the following ratings:

<table>
<thead>
<tr>
<th>Facet</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prior Technology Drag</td>
<td>Low - Med</td>
</tr>
<tr>
<td>Irreversibility of Investments</td>
<td>Low - Med</td>
</tr>
<tr>
<td>Sponsorship</td>
<td>High</td>
</tr>
<tr>
<td>Expectations</td>
<td>High</td>
</tr>
</tbody>
</table>

The combination of the two frameworks can be used to forecast the likelihood of successful adoption of the EHRS Blueprint and its success within Synapse. Figure 5-1 EHRS Blueprint Adoption Grid below provides a unified framework for estimating this possibility. The horizontal axis shows the EoTS perspective of community adoptability. The vertical axis reveals the DOI view of organizational adoptability.
Given the combination of Low-Med and High scores for the EoTS framework, the overall score would be a “medium plus,” that is, a slightly better than medium score. This can be seen visually in Figure 5-1 EHRS Blueprint Adoption Grid by the placement of the red star just to the right of the vertical centre line. The combination of scores from the DOI perspective also provide a slightly better than medium score. The additional complexity and lower compatibility facing Synapse developers reduces the overall organizational adoptability score. This can be seen visually in Figure 5-1 by the vertical placement of the red star slightly higher than the horizontal centre line.
The quadrants of the matrix shown in Figure 5-1 can be interpreted as follows:

<table>
<thead>
<tr>
<th>Quadrant</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Niche</td>
<td>Adoption will start out fast among adopters who are relatively insensitive to standards issues or who have optimistic expectations about future levels of adoption. But adoption will plateau at a position short of dominance because of a failure to achieve critical mass.</td>
</tr>
</tbody>
</table>

Figure created by author; data from Fichman & Kemerer - Adoption of Software Engineering Process Innovations: The Case of Object Orientation.
<table>
<thead>
<tr>
<th>Dominant Technology</th>
<th>The technology will be rapidly adopted as a dominant process technology. It will face relatively low barriers to individual or community adoption.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slow Mover</td>
<td>The technology will diffuse steadily but slowly because of the difficulty of adoption facing individual organizations.</td>
</tr>
<tr>
<td>Experimental</td>
<td>The technology will need to evolve before it is widely adopted by mainstream organizations as a dominant technology.</td>
</tr>
</tbody>
</table>

In summary, the combination of the DOI and EoTS frameworks provides a broader base for analysis than any standalone framework could provide. Given the high Relative Advantage, Trialability, and Observability coupled with the breadth of support for the EHRS Blueprint by Canada Health Infoway and the mandate to integrate electronic healthcare systems for the benefit of all Canadians, this analysis predicts the technologies outlined in the EHRS Blueprint will ultimately become dominant. Adoption of the EHRS Blueprint by Synapse will align it with initiatives to deliver a truly pan-Canadian health care solution.
6: RECOMMENDATIONS

Chapter 2: “Profile of Synapse” describes Synapse’s key components and in general concludes that, aside from a few minor usability issues, Synapse provides great value to clinicians in managing across the continuum of care. Further, it has enjoyed fairly significant regional success in its efforts thus far. However, Synapse needs to keep in mind its stated goal of ultimately improving patient care, raising awareness and heightening the profile of the issues surrounding Mental Health & Addictions Services and EHRs. To achieve this goal, Synapse needs to take the next step by aligning itself with the emergent standards and initiatives outlined in Infoway’s EHRS Blueprint.

The adoption of any developing standard is not without risk. The uncertainty surrounding adoption is exemplified by various attributes such as relative advantage, compatibility, complexity, trialability and observability. For example, a new technology with low relative advantage and compatibility will likely face an early demise. Recall Sony’s Digital Audio Tape (DAT) format that required users to buy new tape players and re-purchase their entire cassette collection to get a marginal increase in sound quality that most couldn’t hear anyway. In addition, other factors such as prior technology drag, irreversibility of investments, sponsorship and expectations can play a significant role in determining whether a new set of innovations is ultimately adopted. A set of new innovations backed by significant sponsorship and
possessing little or no prior technology drag is more likely to be adopted than those without these attributes.

The application of the two complementary theoretical adoption frameworks (DOI and EoTS) to the initiatives proposed by the EHRS Blueprint have led to the hypothesis that the healthcare provider industry will eventually embrace the initiatives. The combination of strong sponsorship, high expectations and observability support the prediction that this will become the dominant technology paradigm.

The adoption of the principles outlined in the EHRS Blueprint will bring many benefits to the Synapse stakeholders. These include:

For Synapse Healthcare Providers

- Improved quality and consistency of care through timely access to comparable data from multiple sources.
- Increased use of structured and measurable information allowing faster and more reliable review of health information and increased user confidence.
- Reduced reliance on verbal and anecdotal exchange of health information.
- More accurate and effective communication among providers.
- Reduced duplication of effort.
- Better ability to consolidate clinical findings.
- Shorter elapsed time between steps in the care process.
- Higher probability of positive patient outcomes.
For Synapse Patients

- Reduced need to repeatedly provide personal and family health history each time they encounter a different health care provider.
- A personal health history that accumulates data with each encounter and that is easily understandable across a range of providers.
- Better coordination of services across providers.
- Reduced duplication of diagnostic procedures.
- Better health outcomes.

For the Governing Synapse Collaborative

- The ability to reuse its EHRS Blueprint compliant solution in other Canadian jurisdictions.
- Improved ability to work effectively in a regionalized or collaborative capacity with other organizations, across different geographies and care settings.
- The ability to interface to the interoperable EHR for access to compatible data from a vast array of sources beyond its boundary.
- Higher confidence in the Synapse software product through improved ability to predict suitability for use, effectiveness and return on investment.

For Educators and Researchers

- Health care data is often used for education and research. Standardized data increases that data’s relevance and usefulness.
- Higher quality, comparable data across a broader range of sources.
- Better ability to measure and assess outcomes and identify health determinants. ¹⁹

¹⁹ (Canada Health Infoway, 2004)
The remainder of this chapter presents detailed arguments for Synapse’s adoption of the EHRS Blueprint.

6.1 Top Ten Reasons Why Synapse Should Adopt the EHRS Blueprint

What follows is a collection of ten reasons to support the recommendation that Synapse adopt Canada Health Infoway’s Electronic Health Record Solution Blueprint.

6.1.1 Adherence to Standards

A key goal of Synapse is to expand its adoption throughout Canada and ultimately produce a pan-Canadian EHR solution for Mental Health & Addictions. The use of standards will ease the effort required for the replication of Synapse throughout the Canadian healthcare landscape.

Interoperability between diverse care settings, information systems, and jurisdictions cannot possibly occur without a clearly defined set of common standards. Standards facilitate information exchange and are the critical foundation for any EHR system. Defining a standard way to perform a task reduces future costs as vendors and systems converge on pan-Canadian and international standards. Canada Health Infoway recognizes that establishing standards is an evolutionary process. Initially, the system will contain imperfections. In some cases standards will not exist or have been ratified, yet developers must proceed anyway. Throughout the process, developers should
leverage existing standards work whenever possible and practical. In cases where standards have yet to be established, the development team should work with standards bodies to expedite processes to test, refine and evaluate emergent standards.

Infoway promotes the adoption of standards for vendors and jurisdictions in two ways. First, the Health Level 7 V3 (HL7 V3) messaging standard is required for all new message development related to EHR in order for Infoway to invest in the project. Infoway’s second method of promoting standards is through suasion in its communications and joint planning sessions. Infoway’s view was that some older standards didn’t meet business requirements on a pan-Canadian basis and did not facilitate jurisdictional interoperability. A number of respondents did question Infoway’s role in the development of standards, suggesting instead it was the domain of the Canadian Standards Association (CSA) or even that Infoway should adopt international standards instead of leading the development of them. In contrast, the vast majority of respondents strongly supported Infoway’s standards development leadership and felt this was an area Infoway has achieved results and added value.

Finally, Infoway will support early adopter investment projects that set the establishment of pan-Canadian standards as a goal.

6.1.2 Identified Gaps are Actively Filled

Infoway conducted extensive research across Canada with focus groups, Health Information Standards Symposia, stakeholder interviews and
international research and literature reviews to identify gaps in standards. The
top priority gap was a lack of standards on common clinical vocabulary
including diagnostic and intervention nomenclature. To address this gap
Infoway adopted SNOMED CT (Systematized Nomenclature of Medicine--Clinical
Terms) and the Clinical Terminology Integration (CTI) pan-Canadian Standards
Group (pCSG) recommended it as the best choice of terminology for 24 priority
clinical information groupings (or sub-domains) of the core interoperable EHR.
Additional studies have also encouraged health care organizations to adopt
SNOMED CT to drive their decision support applications.

In April of 2007, in participation with other charter nations, Canada helped established the International Health Terminology Standards
Development Organization (IHTSDO) to acquire SNOMED CT from the College of American Pathologists. SNOMED CT will be available through the Infoway
Standards Collaborative which will be setting up a National Product Centre to provide a central point for managing, distributing, supporting and monitoring the use of this standard and related assets.

Through its use of common terms for clinical messaging, SNOMED CT can offer significant benefits including improvements to patient data accuracy and diagnosis and treatment accuracy.

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20 (Canada Health Infoway, 2004)
21 (Elkin et al., 2006)
22 (Canada Health Infoway, April 26, 2007)
The efforts to actively identify and fill the gaps in its proposed solution helps establish Infoway’s credibility and ultimately achieve its goal to have providers build interoperable standards-based solutions.

6.1.3 Lays the Groundwork for pan-Canadian Expansion

EHRi’s are replicated throughout Canada. Getting it right in BC can be the springboard for a national rollout.

6.1.4 Investment Funding Contingent on Compliance

Canada Health Infoway’s role is to set standards and requirements for robust, interoperable products and outcomes. Given the magnitude of the undertaking and the importance of “getting it right,” Infoway will only invest in projects that exhibit compliance to the infostructure standards outlined in the EHRS Blueprint. All funded initiatives must comply with existing guidelines or standards adopted by Infoway. Where standards or guidelines do not exist, projects must support longer-term interoperability and congruence of solutions. From a purely financial perspective, Synapse must adopt the architectural standards prescribed in the EHRS Blueprint guidelines if it has any penchant of additional funding from Infoway.
6.1.5 The Timing is Right For Synapse to Move

Infoway has well over one billion dollars to invest in Canadian healthcare initiatives. Currently, only a small portion is spoken for. This presents a viable opportunity for Synapse to pursue additional funding. Table 6-1 outlines Infoway’s investment portfolio as of November 30th, 2005 and budget information as of December 31, 2005.

<table>
<thead>
<tr>
<th>Investment Program</th>
<th>Funding Approved by Strategy ('000$)</th>
<th>Total Approved Project Budget ('000$)</th>
<th>Total Number of Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Registries</td>
<td>134,400</td>
<td>87,089</td>
<td>27</td>
</tr>
<tr>
<td>Diagnostic Imaging Systems</td>
<td>280,000</td>
<td>236,377</td>
<td>26</td>
</tr>
<tr>
<td>Drug Information Systems</td>
<td>185,000</td>
<td>58,448</td>
<td>15</td>
</tr>
<tr>
<td>Laboratory Information Systems</td>
<td>150,000</td>
<td>64,639</td>
<td>13</td>
</tr>
<tr>
<td>Interoperable EHR</td>
<td>175,000</td>
<td>19,382</td>
<td>18</td>
</tr>
<tr>
<td>Telehealth</td>
<td>120,000</td>
<td>9,809</td>
<td>30</td>
</tr>
<tr>
<td>Innovation and Adoption</td>
<td>60,000</td>
<td>25,479</td>
<td>10</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>25,000</td>
<td>15,970</td>
<td>12</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,129,400</strong></td>
<td><strong>517,193</strong></td>
<td><strong>151</strong></td>
</tr>
<tr>
<td>Cross-Program Projects</td>
<td></td>
<td></td>
<td>(10)</td>
</tr>
<tr>
<td>Total Project Count</td>
<td></td>
<td></td>
<td>141</td>
</tr>
</tbody>
</table>


Despite having a sizable portion of the budget unallocated, Figure 6-1 shows that Infoway is currently near its peak project approval levels. The expectation is that approvals will begin to fall and the expenditures to the approved projects will rise, implying the Governing Synapse Collaborative should move fast and apply for funding.
For 2006-2007 Infoway has an investment target range of $285-$385 million in project approvals. On a cumulative basis this will result in approvals of over $1.0 billion, which represents approximately 85% of the $1.2 billion that Infoway has committed to its nine investment programs. This investment target will result in major increases in project approvals to the Drug Information systems, Laboratory Information systems and Interoperable EHR (iEHR) investment programs during 2006-07.\(^\text{23}\) Synapse belongs to the Interoperable EHR category (Implement solutions that allow clinicians to view and update an integrated patient-centric health record anywhere at anytime.)

\(^{23}\) (Canada Health Infoway, 2006a)
As Figure 6-2 illustrates, Infoway still has a significant amount of investment room remaining.

Figure 6-2 Forecast Investment Approvals by Program (as of March 31, 2006)

![Figure 6-2 Forecast Investment Approvals by Program](http://www.infoway-inforoute.ca/Admin/Upload/Dev/Document/Business%20Plan%202006-07%20EN.pdf)

6.1.6 Independent Evaluation Confirms Results

Given the amount of effort, capital, and time required to build an Infoway compliant EHR Solution, it is understandable for potential adopters to be leery. Widely publicized and financially costly EHR failures in other countries such as the previously mentioned Australia, or Britain may cause apprehension about Infoway’s governance of its allocated funding.²⁴,²⁵ To allay the fears of potential adopters and provide transparency on how the funding is allocated, Infoway commissioned BMB Consulting Services Inc. to perform an analysis of Canada Health Infoway’s performance. The analysis included

²⁴ (Larry Medina, 2006)
²⁵ (Keith Hall, 2006)
document review, interviews and case studies. Interviewees included Health Ministers on the Infoway Board of Directors, jurisdictional Chief Information Officers (CIO), project executives and managers, and industry associations and companies among others. The objective of the performance evaluation was:

...to conduct a mid-term (formative) evaluation in accordance with a Board-approved framework and timeline as specified in the Funding Agreement. The report will be submitted to the Members no later than March 2006 and made available to the public.  

BMB Consulting Services Inc. reached the following conclusions based on its findings:

- Infoway has achieved results (e.g., Pan-Canadian vision, multi-jurisdictional approaches, specific projects implemented, replication and reuse, and increased capacity in jurisdictions) that would not have been achieved without Infoway.
- Infoway has had positive impacts on iEHR in Canada and there is support for it to complete its work.
- Infoway has the strategies and organization in place to complete its work.
- With the exception of Telehealth, Infoway has made a reasonable amount of progress on each of the outcomes defined in Funding Agreement outcomes 4.2.1.1 to 4.2.1.9 related to EHR.
- Infoway is managing compliance with privacy, confidentiality and security requirements and with privacy principles (Funding Agreement outcome 4.2.2) within the scope of its mandate.
- Infoway can demonstrate that, by March 31, 2006, it will have absorbed “a material part of the fixed development costs of the EHR Health Infostructure.” (Funding Agreement outcome 4.2.3)

26 (BMB Consulting Services, 2006)
BMB went on to recommend that Infoway should “stay the course” in:

- building upon the gains it has made to date, especially since mid-2004
- leveraging its pan-Canadian positioning
- continuing to improve its relationships with jurisdictions and other stakeholders
- executing on its seven corporate strategies.

BMB Consulting’s independent analysis concluded Infoway is on the right track and is providing leadership, meeting most of its stated goals, and offering transparency in its operations while collaborating with its various stakeholders.

6.1.7 The First Step Immediately Provides Value

By virtue of participating in the implementation of Infoway’s EHRS, Synapse will immediately add value to the business of health services delivery and the quality of care for all involved. Sharing the data collected via a Synapse Point of Service application adds to the universe of clinical information available to caregivers across the continuum of care, promoting better decision making. By connecting existing Point of Service applications that manipulate and present clinical data to an EHR Infostructure, the value of the PoS itself is increased. While Synapse’s contribution of data to the virtual EHR helps other clinicians participating in the continuum of care, Synapse itself will also benefit. That is, a symbiotic relationship is created among previously unconnected systems, creating greater value than existed when the PoS applications were in standalone mode. Synapse will be able to retrieve and view data previously collected in other PoS applications, benefiting Synapse
clinicians. As an example, consider a patient presenting at a hospital’s emergency department. Without the contribution that Synapse could bring, ER doctors would not be able to see critical information about the patient’s current clinical disorders.

The health care ecosystem will only thrive and flourish if existing operational systems, such as Synapse, load and feed its data into the EHR Infostructure. This implies existing systems will have to be modified to support EHRi interaction, so caregivers can view information from other Points of Service. Figure 6-3 below shows a connected health care ecosystem with multiple existing applications contributing and sharing information.

Figure 6-3 EHRS Data - Value Enabler for Existing Applications

Figure created by author; data from Canada Health Infoway - EHRS Blueprint: An interoperable EHR framework (http://knowledge.infoway-inforoute.ca/EHRSRA/doc/EHRS-Blueprint.pdf)
6.1.8 Standing on the Shoulders of Giants

Once Synapse is augmented to work as a EHRi connected PoS, an even higher level of value can be achieved by creating new classes of applications. The core of these new applications would be based on the aggregate and summarized data that an operational system like Synapse could provide. These new systems are made possible by the existence of working interoperable EHR Infostructures, in fact they are a prerequisite to the next generation of healthcare applications. Although there is no limit to the types of new intelligent applications that could be developed, a short list of some of the more obvious examples will help illuminate the idea.

- Workflow driven applications to help automate and manage the flow of information between different caregivers involved in a patient’s circle of care. An application of this nature could generate alerts when a request becomes due. Addressing case management on a much broader basis becomes possible when systems are integrated.
- Studies done in the United States have shown that patients are more likely to provide more personal information when responding to a computer based questionnaire than when being interviewed by a caregiver. Intelligent interviewing software could be developed to aid in identification and automated routing of patients to the appropriate care provider.
- When existing data is used as the basis for decision making, managerial tasks are simplified. Advance reporting applications could be created to help answer questions such as, “What percent of our patients presenting with disorder X, respond to treatment Y and suffer little or no
Questions of this nature are likely difficult (and costly) to answer. The allocation and direction of a scarce resource (capital, equipment, facilities, clinicians, etc.) would be better handled if its assignment was based on actual data rather than educated hunches. Evidence based management presents a huge opportunity to maximize the utility of the healthcare organization and its patients, especially in times of budgetary constraint.

The next generation of healthcare applications, made possible through interconnected and interoperable solutions, present exciting opportunities. The transition to care prevention and pro-active care delivery (in contrast to the “fix your problem” approach available today) will propel the Canadian healthcare system into the future.

6.1.9 Synapse Can Take an Evolutionary Path To Compliance

The Blueprint design allows for a gradual move to the prescribed infrastructure, leveraging work done thus far (and not discarding it), and allowing the move to be on Synapse’s timetable. The Service Oriented Architecture (SOA) approach used by the EHRS Blueprint permits the incremental addition of new or improved services without impacting previous implementations. This allows Synapse to migrate to EHRS Blueprint compliance at a pace that management can rationalize, gradually increasing the number of sources and consumption of shared EHR data.

Many of the concepts prescribed in the EHRS Blueprint are already implemented in Synapse. For example, remote retrieval of client data is not a new concept in Synapse. The required change in Synapse would be to switch to
use the new EHRI Client Registries to retrieve client data and additionally start using the Provider, Location, and Terminology Registries. (See section 4.8.4 Registry Services: Correctly Identifying Patients, Service Providers, and Service Locations for a description of Registry Services.)

Once Synapse shares previous event histories and clinical information with the infostructure, this architecture presents the opportunity to restructure and even retire antiquated components while incorporating new and better systems to meet the changing needs.

Given an EHRS Blueprint compliant solution’s reliance on Client and Provider registries to associate health information with the subjects and sources of services across different care settings in a jurisdiction, these services must evolve early. In April of 2007, the Province of British Columbia in conjunction with Sun Microsystems (B.C.) announced a contract to advance patient care by building the infrastructure needed for electronic health records and improving access to laboratory test results. This agreement will produce:

• An infrastructure to enable access to a secure interoperable Electronic Health Record (iEHR) for physicians and other caregivers anywhere in B.C., while protecting patient privacy;
• The program’s first major clinical component, the Provincial Laboratory Information Solution (PLIS), which will consolidate lab test results in one repository; and
• Operations and support services for iEHR/PLIS for 10 years.

27 (Canada Health Infoway, 2007b)
6.1.10 The Business As Usual Will Cause Synapse to “Rot on the Vine”

The future is about connectedness, information sharing, and collaboration. We see it in almost all other industries and all around us within healthcare. A model of limited interoperability is myopic and reduces Synapse’s chance to be accepted as a pan-Canadian solution. Without penetration into new markets (other health authorities) with an interconnected long-term solution, Synapse risks losing the opportunity to realize its vision of creating a comprehensive, standards-based EHR for mental health.
7: SUMMARY

Synapse is an implementation of the electronic health record for Mental Health & Addictions services. It has been specifically designed to support the full continuum of mental health care across institutional, community, and residential domains. Synapse is the collaborative effort of health authorities, federal and provincial governments, research and data institutes, and countless individuals and organizations. Finally, Synapse is owned and operated by the Health Authority partners that use it.

This analysis presented an overview of Synapse in its current form, noting a few minor shortcomings and highlighting an area to pursue as a strategic initiative. The recommendations were for Synapse to adopt Health Canada Infoway’s EHRS Blueprint going forward. The EHRS Blueprint is the starting point for the development of a nation-wide infostructure. An infostructure is shared foundation of hardware, software and communication technologies that enable an uninterrupted flow of information. The EHRS Blueprint provides the conceptual framework and working principles for development of shareable electronic health records across Canada.

The conclusion that Synapse should adopt the EHRS Blueprint came after the application of two complementary adoption frameworks to the principles outlined in the EHRS Blueprint. The two frameworks, Diffusion of Innovation (DOI) and the Economics of Technology Standards (EoTS), help analyse and
predict the eventual adoption of the technology or innovation in question. Through careful analysis of such facets as the compatibility, complexity, and observability of an innovation, we can gain additional insight into whether or not the technology eventually will be accepted into the mainstream. This analysis uncovered a low to medium level of prior technology drag, irreversible investments offset by extensive development grants, and strong sponsorship from Canada Health Infoway. The application of the two theoretical adoption frameworks to the EHRS Blueprint suggests that it will eventually become the dominant technology. This is the basis for the recommendations that Synapse adopt the new initiatives.

Synapse already coexists with many other components of the electronic health record maintained in the local Health Authorities. The adoption of the Blueprint would simply shift the target of the interchange from its current location to the emerging EHR Infostructure Data Repositories. Given this existing structure, Synapse is well positioned to transition to the new solution and become a contributor and a consumer of information contained in a truly interoperable national EHR.
APPENDIX

Service Oriented Architecture (SOA) Primer

In computing, the term Service-Oriented Architecture (SOA [pronounced “es-o-a”]) expresses a perspective of software architecture that defines the use of services to support the requirements of software users. In an SOA environment, resources on a network are made available as independent services that can be accessed without knowledge of their underlying platform implementation. Service Oriented Architecture is a style of multitier computing that helps organizations share logic and data among multiple applications and usage modes, it is not a product.

SOA is usually based on Web services standards (e.g., SOAP) that have gained broad industry acceptance. These standards (also referred to as Web service specifications) also provide greater interoperability and some protection from lock-in to proprietary vendor software. However, one can implement SOA using any service-based technology.

The following guiding principles define the ground rules for development, maintenance, and usage of the SOA:

- Reuse, granularity, modularity, composability, componentization, and interoperability.

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28 (SOA Software, 2007)
29 (Various, 2007)
• Compliance to standards (both common and industry-specific).
• Services identification and categorization, provisioning and delivery, and monitoring and tracking.

The following specific architectural principles for design and service definition focus on specific themes that influence the intrinsic behaviour of a system and the style of its design:

• Service encapsulation
• Service loose coupling - Services maintain a relationship that minimizes dependencies and only requires that they maintain an awareness of each other
• Service contract - Services adhere to a communications agreement, as defined collectively by one or more service description documents
• Service abstraction - Beyond what is described in the service contract, services hide logic from the outside world
• Service reusability - Logic is divided into services with the intention of promoting reuse.
• Service composability - Collections of services can be coordinated and assembled to form composite services.
• Service autonomy - Services have control over the logic they encapsulate
• Service optimization - All else equal, high-quality services are generally considered preferable to low-quality ones.
• Service discoverability - Services are designed to be outwardly descriptive so that they can be found and assessed via available discovery mechanisms
REFERENCE LIST


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