KNOWLEDGE MANAGEMENT USING SpiCE

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by
Timothy Joseph Maciag
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Timothy Joseph Maciag, candidate for the degree of Doctor of Philosophy in Computer Science, has presented a thesis titled, *Knowledge Management Using SpiCE*, in an oral examination held on April 14, 2016. The following committee members have found the thesis acceptable in form and content, and that the candidate demonstrated satisfactory knowledge of the subject material.

External Examiner: **Dr. Marjorie Delbaere, University of Saskatchewan**

Supervisor: Dr. Daryl Hepting, Department of Computer Science

Committee Member: Dr. Lisa Watson, Faculty of Business Administration

Committee Member: Dr. Howard Hamilton, Department of Computer Science

Committee Member: Dr. Robert Hilderman, Department of Computer Science

Committee Member: Dr. JoAnn Jaffee, Department of Sociology and Social Studies

Committee Member: Dr. Katherine Arubthnott, Department of Psychology

Committee Member: *Dr. Dominik Slezak, Computer Science Adjunct*

Chair of Defense: Dr. Paul Laforge, Faculty of Engineering & Applied Science

*Not present at defense

** Via Skype
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Abstract

The idea of Knowledge Management (KM) is continually evolving. A traditional and popular idea of KM is one that emphasizes the activity of transforming data to information, and information to knowledge. Another popular idea of KM emphasizes the building of capabilities through learning; how KM can help people learn individually and collaboratively toward an individual or shared outcome. This dissertation presents an integrative framework for KM that builds on these ideas. The framework that is introduced is called SpiCE, an acronym for spime wrangling, culture of participation, and ethical decision making. SpiCE uses the idea of spime wrangling to describe a type of interaction for data and information exploration. The idea of a culture of participation is used within SpiCE to describe an interactive space where individual and social learning and knowledge creation occurs through data and information explorations. To help guide development of sustainable outcomes, SpiCE integrates theories and ideas from the field of ethical decision making. As will be illustrated, the benefit of SpiCE over existing models and frameworks in KM is in its precise description of how to balance the interactions between people, process, and technology toward the goal of aiding development of decision making outcomes that are sustainable. This dissertation will describe SpiCE in detail and illustrate an example of its use. Future work is also discussed.
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Contents

Abstract iii

Acknowledgements iv

Post Defense Acknowledgments v

Contents vi

List of Tables x

List of Figures xii

1 Introduction 1

1.1 About Knowledge Management . . . . . . . . . . . . . . . . . . . . . 2
1.2 Problem Statement . . . . . . . . . . . . . . . . . . . . . . . . . . . . 5
1.3 A Brief Introduction to SpiCE . . . . . . . . . . . . . . . . . . . . . . 7
1.4 Evaluation . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 8
1.5 Scope, Limitations, and Discussion . . . . . . . . . . . . . . . . . . . 9
1.6 Author’s Note . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . 9
1.7 Dissertation Outline . . . . . . . . . . . . . . . . . . . . . . . . . . . 9

2 Fundamentals of Knowledge Management 10
2.1 About Knowledge Creation ........................................ 12
   2.1.1 Beginning with Data ........................................ 12
   2.1.2 From Data to Information .................................. 13
   2.1.3 From Information to Knowledge ............................. 14
2.2 Ideas and Frameworks in Knowledge Management ............. 15
   2.2.1 The Cynefin Framework ...................................... 16
   2.2.2 Knowledge Centered Support ................................. 17
   2.2.3 SECI ......................................................... 19
2.3 Learning and Knowledge Creation ............................... 21
   2.3.1 Experience, Continuity, and Interaction ................... 21
   2.3.2 Reflection, Critical Consciousness, and Praxis .......... 23
2.4 People, Process, and Technology ............................... 24
   2.4.1 Beginning with Rational Choice ............................. 26
   2.4.2 From Rational Choice to Bounded Rationality ............ 27
   2.4.3 Human Computer Interaction ................................. 29
   2.4.4 Open Knowledge Cultures ................................... 31
   2.4.5 MOOC: An Example and Inspiration ....................... 34
   2.4.6 Knowledge Crowds and Communities ....................... 40
   2.4.7 Communities of Practice .................................. 45
2.5 Sustainable Knowledge Cultures ............................... 47
2.6 Chapter Review .................................................. 49

3 SpiCE and its Foundations ........................................ 50
   3.1 People Interacting Within a System Using SpiCE ............ 52
      3.1.1 Prosumerism Within a Culture of Participation .......... 52
      3.1.2 Prosumerism in the Bazaar ............................... 55
<table>
<thead>
<tr>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1.3 Guiding Principles of SpiCE</td>
</tr>
<tr>
<td>3.2 Technology Design Within a System Using SpiCE</td>
</tr>
<tr>
<td>3.2.1 Communities of Practice and Decision Support</td>
</tr>
<tr>
<td>3.2.2 Data Management with Spimes</td>
</tr>
<tr>
<td>3.2.3 Sustainable Human Computer Interaction</td>
</tr>
<tr>
<td>3.2.4 Using Roset for Focused Spime Interaction</td>
</tr>
<tr>
<td>3.2.5 Initializing a Digital Habitat using Createx</td>
</tr>
<tr>
<td>3.3 Process Within a System Using SpiCE</td>
</tr>
<tr>
<td>3.3.1 Cyean Wrangling</td>
</tr>
<tr>
<td>3.3.2 Ethical Decision Support Using TriM Evaluation</td>
</tr>
<tr>
<td>3.3.3 Sustainable Happiness and Trust Metrics</td>
</tr>
<tr>
<td>3.4 Summary</td>
</tr>
<tr>
<td>4 Food Knowledge and SpiCE</td>
</tr>
<tr>
<td>4.1 Food, Sustainability, and Knowledge Management</td>
</tr>
<tr>
<td>4.2 Configuring SpiCE for Food Knowledge Management</td>
</tr>
<tr>
<td>4.2.1 Configuring TriM Evaluation for Food</td>
</tr>
<tr>
<td>4.2.2 Research Study: A Focus on Eggs</td>
</tr>
<tr>
<td>4.2.3 From Narratives to Guided Reflection About Eggs</td>
</tr>
<tr>
<td>4.2.4 Configuring TriM Evaluation for Egg Representation</td>
</tr>
<tr>
<td>4.2.5 Configuring Roset for Personalized Egg Evaluations</td>
</tr>
<tr>
<td>4.3 Egg SpiCE, an Illustrative Example</td>
</tr>
<tr>
<td>4.3.1 Designing Egg SpiCE Using Drupal</td>
</tr>
<tr>
<td>4.3.2 Defining an Egg Spime</td>
</tr>
<tr>
<td>4.3.3 Cyean Wrangling Egg Spimes Using Createx</td>
</tr>
<tr>
<td>4.3.4 Enabling Personalized Egg Evaluation using Roset</td>
</tr>
</tbody>
</table>
List of Tables

1.1 Current ideas and frameworks for KM and their stated strengths (+) and gaps (−). OT is Open Thinking. ........................................... 6
2.1 Dixon’s three eras of KM. .................................................. 11
3.1 Approximation system (decision system) with contrived cleaning products. Higher EPA ratings denote environmentally preferred products. 81
3.2 General illustration of Mepham’s ethical matrix. ....................... 96
3.3 TriM filtering matrix. .......................................................... 99
3.4 Socrates’s triple filter test. Adapted from Baron [8]. .................. 101
4.1 A Mepham ethical matrix for food evaluation as developed by the author.107
4.2 Possible SOLE-food attributes as categorized under well-being in Mepham’s ethical matrix. ........................................... 111
4.3 Possible SOLE-food attributes as categorized under autonomy in Mepham’s ethical matrix. ........................................... 112
4.4 Possible SOLE-food attributes as categorized under fairness in Mepham’s ethical matrix. ........................................... 113
4.5 Egg-based TriM evaluation matrix, agents and attributes. .......... 123
4.6 Egg SpiCE top ten reduct results (from the train and test procedure).

The “best” reduct used for further analysis was reduct 7, producer ethics and organic food. 126

4.7 Generated decision rules from the reduct comprising \{producer ethics, organic\}. 127

4.8 Egg SpiCE results from the eclat component of roset. 128

4.9 Egg SpiCE versus Egg SECI, Egg Cynefin, and Egg KCS and their stated strengths (+) and gaps (−). 150

4.10 Egg SpiCE versus Egg SER, Egg CoP, and Egg OT and their stated strengths (+) and gaps (−). OT stands for open thinking. 151
List of Figures

1.1 Dixon’s three eras of KM. The three eras emphasize the evolution of KM from largely an individual practice to one that is social and collaborative. .......................................................... 3

2.1 Snowden’s Cynefin Framework. Learning and knowledge creation occurs as people participate in KM through a technique called sense-making by sharing narratives, transforming data to information, and information to knowledge by applying principles of ordered and unordered activities ranging in complexity. For instance, a step by step baking recipe is an example of the learning done in the simple domain. A baking recipe that departs from its original recipe is an example of learning done in the complicated and complex domains. .......... 16

2.2 The Consortium for Service Innovation’s Knowledge Centered Support (KCS). Learning and knowledge creation is emphasized by documentation, its use, reuse, and quality. .......................................................... 18

2.3 Adapted version of Nonaka and Takeuchi’s SECI model. Learning and knowledge is creation is illustrated as an individual and social activity where documentation of knowledge is a critical activity. .......... 20
2.4 Norman’s Gulfs of Interaction, comprised of the Gulf of Execution (intention, action, execution) and the Gulf of Evaluation (perception, interpretation, evaluation). .......................... 30
2.5 The #ETMOOC blog homepage (accessed February 2013). .......... 36
2.6 #ETMOOC’s blog hub (accessed August 2013). ........................... 37
2.7 Screen capture of the Twitter feed for the #ETMOOC hashtag (ac- cessed February 8, 2013 at 10:00am CST). ............................... 38
2.8 Screen capture of the Google+ community feed for the #ETMOOC hashtag (accessed February 8, 2013 at 10:15am CST). ................. 39
2.9 Screen capture of one of #ETMOOC’s BlackBoard Collaborate sessions. 41
2.10 Knowledge crowds versus knowledge communities (adapted from Ward [148]). 43
2.11 Illustration of a rhizome plant (used from the “Gypsy Scholar, The Rhizome of Life”). A Rhizome can be used as a metaphor for growing a digital habitat for KM, where knowledge creation spans boundaries and can grow organically as people interact. .......................... 46
2.12 Adapted version of Fischer’s *Seeding, Evolutionary growth, and Reseeding* (SER) model [49]. The model illustrates the evolutionary capacity of learning and knowledge as people interact over time. ............... 48
3.1 A high-level schematic view of the SpiCE framework. ................. 51
3.2 Illustration of how SpiCE guides people for learning and knowledge creation. ................................................................. 53
3.3 Change.org’s “Keep Google Reader Running Petition” (accessed Oc- tober 2013). ................................................................. 54
3.5 Illustration of how SpiCE guides development of technology for learning and knowledge creation. ............................... 60
3.6 GasBuddy homepage (accessed November 2012). ......................... 61
3.7 GasBuddy interface for contributing gas prices (accessed November 2012). ................................................................. 62
3.8 GasBuddy interface for Regina, Saskatchewan Canada. Image captured November 26, 2012 at 1:10pm. .......................... 62
3.9 Illustration of the possible spime of an acoustic guitar. ...................... 64
3.10 Mapping of the materials used in the construction of the six string nation guitar. Online: http://www.sixstringnation.com/, Menu —
Navigate the guitar — Guitar Explorer (accessed April 2013). ........... 64
3.11 Illustration of the possible spime of an apple. ............................... 65
3.12 Illustration of the triple top line model (adapted from [138]). ............. 68
3.13 Sourcemap of EarthBound Farms, spring mix salad (accessed November 2012). ................................................................. 69
3.14 Screen capture of the search mechanism for the cogitoEPP tool. Users had the ability to filter their search based on selected values. ....... 73
3.15 Screen capture of the search results for the cogitoEPP tool. Users had the ability to compare eight cleaning products at a given time based on eight environment-based attributes ...................................... 73
3.16 REAP project: landing page. Users had the ability to select an area of interest to explore. Three Canadian provinces, British Columbia, Saskatchewan, and Ontario, were selected for the prototype exploration. 76
3.17 REAP project, provincial view (Saskatchewan). ............................. 77
3.18 REAP project, regional view of typical crops of the specified region (Swift Current, Saskatchewan). ................................. 77
3.19 BILUMI homepage (accessed March 2012). ............................... 78
3.20 BILUMI product browse page. People had access to product name, number of reviews, and overall community rankings (accessed March 2012).

3.21 BILUMI quick rate product page. People could scroll over the stars and click indicated their rating of the product on a scale of one to nine (accessed March 2012).

3.22 Classic illustration of Eclat [21, 88]. The empty root is omitted from the illustration. The depth-first traversal begins at the left-most item, $a$, and traverses the tree structure (backtracking when necessary) until all items are analyzed.

3.23 Illustration of the processes SpiCE introduces for learning and knowledge creation.

3.24 Cyean wrangling, the integration of Lean 5S (sort, set in order, shine, standardize, and sustain) with Snowden’s Cynefin Framework.


3.27 Illustration of the triple top line model (adapted from McDonough [93]). Optimal sustainability is reached when the data and information comprising the three environmental attributes are visually placed in the centre of the triple top line model.

4.1 Hubert’s $\Gamma$ statistic graph representation of participant egg attribute preferences.

4.2 Hierarchical clustering result of participant egg attribute preferences (three clusters, maximum distances).

4.3 Screen capture of the Egg SpiCE homepage (accessed May 2013).
4.4 Screen capture of the Egg SpiCE community question page where community members can ask a question about eggs (accessed February 2013). 132

4.5 Screen capture of the Egg SpiCE question page where community members can see if a similar question has already been asked by another community member (accessed February 2013). 133

4.6 Screen capture of the Egg SpiCE question answer page (accessed March 2013). 134

4.7 Screen capture illustrating the add new egg spime feature in Egg SpiCE (accessed March 2013). 135

4.8 Screen capture illustrating how to extend or alter an egg spime in Egg SpiCE (accessed March 2013). 136

4.9 Screen capture of the roset configuration page in Egg SpiCE (accessed March 2013). 137

4.10 Screen capture of the roset configuration for network #1 (of 3) in Egg SpiCE. As illustrated, egg price and taste are highlighted as per the preferences of network #1 (accessed March 2013). 138

4.11 A partial view screen capture of the Egg SpiCE full search page (accessed February 2013). 139

4.12 Screen capture of the TriM evaluation matrix for Pusch Brothers eggs (accessed March 2013). 141

4.13 Screen capture of the contrived Pusch Brothers Farm Egg Spime with TriM ranking (accessed March 2013). 142

4.14 Screen capture of the Search Results for “certified organic, free range eggs at Costco.” within Egg SpiCE (accessed March 2013). 143

4.15 Screen capture of the egg request form, used if egg data and information is either not represented in the database or no available for purchase (accessed March 2013). 144
4.16 Screen capture of the egg discovery and demand display (accessed March 2013). 145
4.17 Screen capture of the egg discovery and demand display for an individual community member (accessed March 2013). 145
4.18 Screen capture of an egg spime’s trust metrics (accessed February 2013). 147
4.19 Screen capture of the trust metric for the Pusch Brothers Farm contrived egg spime (accessed February 2013). 148
Chapter 1

Introduction

This dissertation presents a new framework for Knowledge Management (KM) called SpiCE. Knowledge Management can be described as the “systematic process[es, practices, and tools] for creating, acquiring, disseminating, leveraging, and using knowledge” [99]. KM supports education by facilitating interaction that helps to impart, or externalize, knowledge; learning by facilitating interaction that helps to take-in, or internalize, knowledge; and decision-making by facilitating interaction that helps people to externalize and internalize knowledge for action [126].

A fundamental goal of KM is to aid the development of a knowledge culture that balances the fundamental components of people, process, and technology [7]. These components are supported by augmented human-computer interactions and defined processes. Many good ideas and frameworks for KM exist, some of which are used and expanded upon within SpiCE. However, most provide only a partial balance of these components. The benefit of SpiCE over existing alternatives for KM is in its clear prescription to balance people, process, and technology. SpiCE builds on many current approaches to KM, acknowledging their benefits by integrating them in its design, allowing them to evolve to provide a detailed and more balanced approach to KM.
1.1 About Knowledge Management

Knowledge, as defined by Davenport and Prusak, is “a fluid mix of framed experiences, values, contextual information, and expert insight that provides [a way] for evaluating and incorporating new experiences and information” [36]. KM provides the foundation for knowledge creation.

The field of KM began approximately forty years ago [150]. KM first gained popularity in business organizations as they sought more sustainable ways to manage organizational knowledge in order to be more effective and efficient [80, 121]. Drucker’s notion of knowledge work and the knowledge worker took root and helped provide a basic understanding of KM and its possible value [42]. Knowledge workers, for Drucker, must continually question, have a willingness for life-long learning, strive to innovate, have a willingness to teach, and be focused on quality. These characteristics of knowledge workers also relate to KM and all forms of knowledge creation.

The evolution of KM can be described by Dixon’s three eras of KM, illustrated in Figure 1.1 [41]. According to Dixon, KM began with a focus on individual knowledge, represented as the era of information management. Knowledge activities within this era focused largely on an individual’s ability and capacity to create knowledge through the collection and storage of repeatable information processes. These activities enabled an individual to evolve their own education, learning, knowledge, and decision-making capacity. As KM evolved beyond individual knowledge, KM shifted toward a focus on individual and group knowledge, represented as the era of experience management. Dixon describes this era as learning and knowledge that is created and shared by individuals within specialized groups or teams. Knowledge activities within this era expanded upon the simple collection and storage of information, emphasizing...
expert-based sharing, education, learning, and collaboration between connected individuals, such as a team or a special interest group. As KM evolved beyond individual and connected group knowledge, it shifted toward a focus on collective knowledge, represented as the era of idea management. Dixon describes this era as learning and knowledge that is created and shared by a global citizenry. Knowledge activities in the KM era of idea management emphasize a union between connected people and groups comprised of experts and non-experts, sharing, educating, learning, creating knowledge, and collaborating together.
Within the current era of idea management, the concept of culture is important. Leider and his colleagues [82] define culture as “the predominating attitudes and behaviour that characterize the functioning of a group or organization.” An open learning culture, or open thinking as described by Couros, can be used to understand a mode of interaction that can be used to promote KM activity [33]. The idea of an open learning culture is inspired by Raymond’s bazaar approach to software development, where software is developed by a global citizenry rather than a selected few [119]. A bazaar approach to an open learning knowledge culture can symbolize the era of idea management, emphasizing the ideas of social inclusion, freedom, and decision making and action that may be characterized as being more sustainable because it is managed by a global citizenry [119, 106]. Thus, encouraging a multitude of learning and knowledge creating opportunities which can better enable praxis, which Freire describes as the social transformation of the world through action and reflection [54].

Bhatt, Okunoyo, and Dalkir each discuss a knowledge culture as one that can provide an equal representation of people, process, and technology [15, 110, 34]. The people component of KM describes the collective, all those who gather to manage their knowledge. The process component describes the precise activities and practices that support KM that define the knowledge culture and that enable sharing, education, learning, and knowledge creation. Finally, the technology component describes the interactive space that facilitates the management of acquired knowledge and performance of associated KM activities, such as collaboration and decision making. Okunoye specifically describes a sustainable knowledge culture as one that requires a specific framework to enable this equal representation.

Many ideas and frameworks for KM exist, from diverse areas that include education, decision making, cognitive science, computer science, social science, and KM research. In general, they provide a broad understanding of what is required to be successful in developing a knowledge culture. The specific ideas and frameworks that
inspired the development of SpiCE include:

- Nonaka and Takeuchi’s SECI framework, which describes a process for explicit and tacit knowledge interaction
- Snowden’s Cynefin (pronounced *kun-ov-in*) framework, which describes five states of KM and the broad processes for interaction between states
- The Consortium for Service Innovation’s Knowledge Centered Support (KCS) framework, which describes a broad process-based methodology for KM
- Fischer’s Seeding, Evolutionary Growth, Re-Seeding (SER) model, which illustrates the design of the process-based interaction for a culture for knowledge creation
- Wenger’s idea of a Community of Practice (CoP), which describes an approach to developing augmented-technological interactions for a knowledge culture
- Couros’s idea of open thinking, which provides a thematic foundation for development of interactive processes for learning and knowledge creation

### 1.2 Problem Statement

Even as there are many ideas and frameworks for KM that provide broad understanding of what is required to be successful in developing a culture for learning and knowledge creation, they do not provide a clear framework to balance people, process, and technology. Table 1.1 describes the strengths and weaknesses of each of the inspirational ideas and frameworks, in terms of the three fundamental KM components. Each entry in Table 1.1 has some weakness in terms of providing a detailed
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<td>People</td>
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<td></td>
<td>Process</td>
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Table 1.1: Current ideas and frameworks for KM and their stated strengths (+) and gaps (−). OT is Open Thinking.
CHAPTER 1. INTRODUCTION

understanding of achieving balance between the people, process, and technology components.

SpiCE, as presented in this dissertation, provides a detailed schematic that addresses the weaknesses of existing ideas and frameworks for KM, providing a more complete balance between people, process, and technology.

1.3 A Brief Introduction to SpiCE

This dissertation presents an integrative framework for KM that builds on these ideas. The framework that is introduced is called SpiCE, an acronym for spime wrangling, culture of participation, and ethical decision making. Sterling [141] describes spime wrangling as a type of interaction for data and information exploration. It is based on the idea of a spime, a type of data representation that enables historical tracking of an object in space and time. A culture of participation, as defined by Fischer, describes an interactive space where individual and social learning and creation of knowledge can result through spime wrangling explorations [47]. People who interact within a culture of participation both consume and contribute to the collective’s learning and knowledge creating capacity. To help guide development of sustainable outcomes of spime wrangling explorations within a culture of participation, SpiCE integrates theory and ideas from the field of ethical decision making [52, 62]. Expanding on these three fundamental components, SpiCE introduces six innovations:

1. Four guiding principles for KM interaction to help govern learning and knowledge creation

2. TriM evaluation. A decision-making framework for enabling sustainable reflective decision making

3. The roset model for personalization to help connect participants with similar
learning interests, as well as to enable more efficient habitual and experiential decision-making

4. Trust metrics to help participants understand the truthfulness, usefulness, and/or ethicalness of created knowledge. Here, the ethicalness of knowledge relates to the action as a result of learning and knowledge creating activity

5. Cyean wrangling to help enable and guide learning and knowledge explorations

6. Createx to describe the interaction to build and evolve learning and created knowledge

As it is hypothesized in this dissertation, these six innovations provide a precise framing for the interactive KM activities that enable an equal representation of people, technology, and process, which in turn can better enable a knowledge culture to evolve through sustainable learning, knowledge creation, and decision making activities.

1.4 Evaluation

To permit evaluation, a configuration of SpiCE called Egg SpiCE was developed at the University of Regina to illustrate how SpiCE could be used to create a knowledge culture for chicken eggs. To help configure the initial knowledge culture for Egg SpiCE, the technique of narrative inquiry was used to solicit information from citizens in Regina, Saskatchewan regarding their experiences purchasing eggs in local grocery stores. Based on the data collected, Egg SpiCE was designed and developed in accordance to the SpiCE framework. A random sampling of the initial group was asked to return and evaluate the Egg SpiCE tool, its technology design, and the processes driving its interaction.
1.5 Scope, Limitations, and Discussion

The scope of the experiment, development, and evaluation of SpiCE was limited to the Egg SpiCE system. However, the SpiCE framework is under active development, currently being successfully used by the author in his workplace.

1.6 Author’s Note

In addition to the typical culture of academia, where closed and proprietary contributions are considered valid sources of data and information, another culture has taken root in the age of the Internet. This is exemplified by open and community-managed repositories such as Wikipedia and the Free Dictionary Project. Each has its own advantages and disadvantages. References to works from both of these learning cultures are included in this dissertation in order to further the development of learning cultures that provide a balance of the two and that are diverse, open, and accessible.

1.7 Dissertation Outline

The outline of this dissertation is as follows. Chapter 2 will provide an overview of the state of the art of KM. Chapter 3 will provide a detailed description of SpiCE and its six innovations. Chapter 4 will provide details of the evaluation of the implementation, configuration and use of Egg SpiCE. Finally, Chapter 5 will provide concluding remarks and an overview of future work.
Chapter 2

Fundamentals of Knowledge Management

A traditional and popular idea of Knowledge Management (KM) is one that emphasizes the activity of transforming data to information, and information to knowledge [36]. Another popular idea of KM emphasizes the building of capabilities through learning; how KM can help people learn individually and collaboratively toward an individual or shared outcome [58]. This Chapter provides a background on the theory and practice of KM. To begin the discussion, consider the following narrative:

A friend kindly let me borrow his car. Just before I was about to leave, I found a note waiting for me: “I should have mentioned that to get the key out of the ignition the car needs to be in reverse.” The car needs to be in reverse! If I hadn’t seen the note, I never could have figured that out. [...] If the driver lacks that knowledge, the key stays in the ignition forever. – Don Norman, 1988 [103]

Norman focuses his narrative on the note, which contained crucial situational data, the note and letters written upon it by its writer, and information, his personal
rendering or understanding of the data. The note can signify the social interaction between its writer and its reader. The content of the note provides an experiential context regarding the unique circumstance of that future state when he must put the car into reverse in order to remove the key from the ignition at his destination. As Norman consumes the data provided by the note and renders it into information, he is able to reflect upon its relevance, learn, and create a plan for how best to advance toward a future state in which he has successfully removed the key from the ignition after arriving at his destination.

Norman’s narrative can provide insight into the transformative and migratory characteristics of each of the three KM eras, described by Dixon as information management, experience management, and idea management (see Table 2.1). Consider that the note left by Norman’s friend represents the characteristics of the information management era, because it captures individual knowledge; Norman’s reading of the note represents a social interaction that takes place between Norman and his friend, which is characteristic of activities in the experience management era; and the reproduction of the note in this dissertation represents the formation of collective knowledge, which is characteristic of the current KM era of idea management.

A fundamental goal of the idea management era is to develop knowledge cultures that support individual and social transformation of data to information, and information to knowledge by balancing people, process, and technology. Referring back to Norman’s narrative, as the characteristics of his situation are unveiled, individual and social knowledge creation is a central emphasis. Social knowledge is created through

<table>
<thead>
<tr>
<th>Era</th>
<th>Focus</th>
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<tr>
<td>Information Management</td>
<td>Individual KM</td>
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<tr>
<td>Experience Management</td>
<td>Group/Social KM</td>
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<tr>
<td>Idea Management</td>
<td>Individual + Group/Social KM (Collective KM)</td>
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Table 2.1: Dixon’s three eras of KM.
the experiential nature of the written note, in its reading by Norman and by you, the reader. The information the note provides is transformed into knowledge as a reader reflects, learns, and devises a plan of action. Thus, as the letters and words of the note form information, reflection and learning occurs that enables satisfying decision and action [36].

2.1 About Knowledge Creation

This section focuses on the idea of KM, where emphasis is on the activity of transforming data to information, and information and learning to knowledge.

2.1.1 Beginning with Data

Davenport and Prusak define data as a subjective grouping of distinct and objective facts [36]. Data can be raw, otherwise known as unstructured or semi-structured [81]. Data can also be cooked, otherwise known as structured [81]. Raw data\(^1\) is data that is not defined by an existing model or structure [24, 117]. An example of raw data can include a patient admitting station in a busy hospital, where patient names, their birth dates, addresses, residences, family physician names, pre-existing conditions, immunization history, illnesses, among other data is collected. The quality and utility of raw data is one of varying degree because there may be difficulty in managing the amount of raw data that is available [19].

Cooked data, or structured data helps to increase its quality and utility. An example of cooking data includes metadata [13].\(^2\) Metadata provides unique identifiers to data. For example, publishers might use author stamps on files to link an author’s


name to a composition or time stamps on files to help control versioning. Furthermore, as in the previous example of hospital patient admitting, medical providers may help realize potential illness trends or outbreaks by recording the type of illness on patient admitting records or using time stamps on patient admitting forms. These identifiers can enable deeper understanding of the raw data because the data is transformed into information.

Berners-Lee describes linked data as a model to help deal with the quality, utility, and general complexity of cooking raw data [13, 16]. Linked data enables a standard way to explore, reuse, and modify data. One of the main benefits of linked data includes its ability to replicate modifications of data from a single source to all sources that are accessing the data. For example, if three databases are accessing the same data, if the data is altered in any one of the three databases, the changes are replicated to the other two. The structure of linked data is characterized by Uniform Resource Identifiers (URIs), unique identifiers that build on the data. Linked data uses open semantic web standards such as the Resource Description Framework (RDF), which uses the form “rdf:some-thing”, to develop associations within data. In the previous example of a patient admitting station in a busy hospital, a linked data model could include entries related to geographic region, stated illness, or reason for hospital visit, such as rdf:city, rdf:province, rdf:hospital, rdf:illness. The open nature of linked data and its standardization helps to increase the availability, portability, usability, and accessibility of data because everyone is working from the same data pool [37].

2.1.2 From Data to Information

Data provides the basis for information. Drucker describes information as “data endowed with relevance and purpose” [43]. Davenport and Prusak describe information as a message, complete with a sender and a receiver [36]. Information can shape the behaviour and judgment of its recipient. It is the recipient’s job to perceive the
quality of the information and assess its merit. Information, more so than data, tends to be organized to fit some specific purpose. Davenport and Prusak [36] state that data is transformed into information by one or more of these actions:

- Contextualizing data to understand its purpose
- Categorizing data to distinguish its key features
- Calculating data to derive its deeper meaning
- Correcting data to exclude errors and possible biases
- Condensing data to summarize and to add conciseness and focus.

For example, when a person is shopping in a grocery store for food, they might categorize food items by type and cost. As well, a person might condense available choice based on the food’s best before date, calculating which food alternative can provide them a greater chance of use before expiry. As stated above, information helps shape the behaviour and judgment of a receiver. These activities can help a person derive insight for decision activities, such as evaluation and praxis, which will be discussed later in this Chapter [36, 35].

2.1.3 From Information to Knowledge

As people transform data into information, past learned experiences and interactions are essential. Davenport and Prusak describe knowledge as a “fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information” that is “broader, deeper, and richer than data and information” [36]. Knowledge is messy. It evolves based on a receiver’s experiences, interactions, and the impact of experienced
decision-based outcomes [134]. Knowledge appears when people perform one or more of these actions [36]:

- Compare information from past and current experiences
- Observe and analyze consequences of experienced actions and decisions
- Make connections between informational sources
- Participate in conversations with people to discuss shared learned experiences

These activities are representative of the current KM era of idea management and they underscore the importance of individual and social experiences and interactions in KM. Continuing with the grocery shopping example, a person may compare previously purchased food items to form a decision on which tastes better. She may also converse with people who previously purchased the food items that she is evaluating. She may initiate connections with like-minded individuals on which food items are preferable. As a person evaluates and acts, she gains experiences that can be incorporated into her current and future knowledge-enabled judgments, decisions, and actions.

2.2 Ideas and Frameworks in Knowledge Management

Many ideas and frameworks for KM exist. Three of these are examined below to illustrate the purpose and goals of KM: Snowden’s cynefin framework; The Consortium for Service Innovation’s Knowledge Centered Support methodology; and Nonaka and Takeuchi’s SECI framework.
Figure 2.1: Snowden’s Cynefin Framework. Learning and knowledge creation occurs as people participate in KM through a technique called sense-making by sharing narratives, transforming data to information, and information to knowledge by applying principles of ordered and unordered activities ranging in complexity. For instance, a step by step baking recipe is an example of the learning done in the simple domain. A baking recipe that departs from its original recipe is an example of learning done in the complicated and complex domains.

2.2.1 The Cynefin Framework

Snowden’s cynefin framework (pronounced kun-ov-in) is illustrated in Figure 2.1 [136]. Snowden describes cynefin to be that which can provide a familiar habitat, an interactive space where people learn and grow knowledge. Cynefin initiates KM through narratives that can “link a community into its shared history, or histories” in a way that empowers the community to focus “while enabling an instinctive and intuitive ability to adapt to conditions of profound uncertainty” [133].

The centre of cynefin (see Figure 2.1) is a place of disorder surrounded by simple,
complicated, complex, and chaotic sub-habitats. Through the sharing of narratives and a technique referred to as sense-making, as a knowledge culture interacts, discovers, and creates, the personal and shared experiences and ideas of that knowledge culture travel between the various sub-habitats. When residing in the simple habitat, people are able to sense situational characteristics, transform available data to information to knowledge through categorization, and respond through appropriate decision and action. Snowden uses the metaphor of cooking to illustrate the knowledge interactions that occur within the five domains of cynefin. In the simple habitat, people read recipes. Knowledge is captured and represented as a series of repeatable steps with the goal of achieving a same result. In the complicated habitat, people adapt recipes to personal tastes and the available ingredients. They sense situational characteristics, transform data to information to knowledge through analysis and reflection, and respond through appropriate decision and action. In the complex habitat, people are master chefs. They are able to probe using experiential activities, past and present habitual knowledge, reflect through critical consciousness, and explore uncertain futures, sense situational characteristics, and respond through appropriate decision and action through praxis. People may read knowledge recipes, and as situational characteristics interfere, people can adapt using experience, as well as adapt through in-depth research, analysis, and critical reflection. In the chaotic habitat, people skip recipes and order take-out. They are, at best, able to react using experiential activities and past habitual experiential knowledge, sense situational characteristics, and respond through some ad hoc decision and action.

2.2.2 Knowledge Centered Support

The Consortium for Service Innovation’s Knowledge Centered Support (KCS) methodology for KM\(^3\) loosely describes a set of knowledge interactions and criteria for KM.

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Figure 2.2: The Consortium for Service Innovation’s Knowledge Centered Support (KCS). Learning and knowledge creation is emphasized by documentation, its use, reuse, and quality.

KCS is best characterized by its defined *Double Loop, Solve/Evolve Process*, illustrated in Figure 2.2. In the solve loop, knowledge is continually captured, structured, reused, and improved. In the evolve loop, knowledge is managed and evolved by reviewing content health, such as quality and usability, developing process integration, developing performance assessment(s), and through leadership and communication.

KM within the KCS framework is guided by the idea of *UFFA*: _use_ captured knowledge (recipes), _flag_ knowledge for improvement, _fix_ knowledge to adhere to content standardization, and _add_ knowledge to a knowledge base.

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The author is currently using SpiCE in conjunction with a modified approach to KCS in his work at eHealth Saskatchewan, which uses an evolved version of SpiCE utilizing aspects of KCS. The author has expanded the UFFA mantra to incorporate an additional “F” for the framing of knowledge content. The author uses the metaphor of writing on a bar napkin, with the rationale that not everyone has time to contribute knowledge in the standard way but generally have time to quickly create ad hoc notes. Framing provides the capability of quickly submitting proposed knowledge content to be incorporated into a knowledge base. In addition, the author has incorporated an additional “A” (making the mantra UFFFAA) for the activity of assuring the quality of contributed content. The author argues that quality assurance of contributed knowledge is something that requires special focus if a KM effort is to be sustainable. SpiCE promotes this by balancing a community and crowdsourcing approach to KM, as will be discussed in Chapter 3.

2.2.3 SECI

Nonaka and Takeuchi developed the SECI framework, and acronym for socialization, externalization, combination, and internalization [102]. An adapted version of the model is illustrated in Figure 2.3. The four pieces of the SECI framework focus on the high-level processes and interactions that can take place within a knowledge culture. Influenced by Polanyi, Nonaka and Takeuchi emphasize explicit and tacit knowledge [116]. Explicit knowledge is simple or repeatable, it can be easily captured, expressed, and transmitted. For example, the knowledge required for using an Automated Banking Machine (ABM) can be easily captured, expressed, and transmitted (in step form). Conversely, tacit knowledge is more complicated, more

5The illustration of SECI in this dissertation is altered slightly, emphasizing the social characteristics of open thinking by visualizing the components of SECI as more loosely separated through the emphasis on the dotted lines. This idea will be described in more detail when discussing rhizomatic learning later in this chapter.
complex. Tacit knowledge is social but can be highly individual, meaning it is often based on a person’s own technical skills and abilities in connection with their previous experiences, beliefs, ideals, values, and emotions, individual or shared. Because of these factors, tacit knowledge can be hard to capture, express, and transmit.

Within the SECI model is the idea of *Ba*, a “shared space for emerging relationships” [101]. *Ba* in Japanese means “place”. *Ba* can be physical, such as a classroom, virtual, such as a website, or mental, such as in the sharing of experiences or ideas,
CHAPTER 2. **FUNDAMENTALS OF KM**

Socialization describes the sharing of tacit knowledge between individuals in Ba. Although Nonaka and Takeuchi place emphasis on closeness or proximity of interactions, highlighting the importance of in-person interactions, with recent technological innovations, other modes of interaction can also prove useful, such as Skype [120]. Externalization describes the knowledge interaction in Ba that enables the transformation of tacit knowledge into explicit knowledge, making it consumable and accessible to others for experiential and reflective activity. Combination describes the knowledge interactions in Ba that enable diversity of knowledge and its dissemination across the boundaries that define a knowledge culture. This will be described later in this dissertation when we discuss the development of networks, clusters, and the seeking and inclusion of xenophile-type personalities. Finally, internalization describes the knowledge interactions in Ba that define the ongoing practices and actions of acquired knowledge, its impact, and its ongoing evolution.

### 2.3 Learning and Knowledge Creation

A fundamental goal for the creation of knowledge is to aid a person, or people, in developing actionable and satisfying decision-based outcomes. Learning and knowledge creation can include both *experiential* and *reflective* decision activities. Experiential decision-making is reactive or immediate [104]. Conversely, reflective decision-making requires analysis, time, and deeper thought [104, 54].

#### 2.3.1 Experience, Continuity, and Interaction

For successful experiential decision activities, a person may require an extensive internal knowledge base to draw upon. This knowledge base accumulates throughout
a person’s lifetime, through her formal and informal educational and learning experiences. This idea is highly rooted in Dewey’s principles of continuity and interaction \[39\].

In the principle of continuity, Dewey hypothesizes that experience, and thus, decision action, is founded on the notion of habit. He states, “the basic characteristic of habit is that every experience enacted and undergone modifies the one who acts and undergoes, while this modification affects, whether we wish it or not, the quality of subsequent experiences” \[39\]. In other words, with each experience a person has, similarly for with each habit a person performs, that person incorporates some qualities of past learning and knowledge-creating experiences, which in turn affect future experiences. It is, as Dewey states, through the principle of continuity that people are able to grow both intellectually and morally as their habits form and evolve. Experiential activity is connected to habit as it is the experiential that allows people to react, or “encounter a situation [and quickly] make an appropriate response” \[104\].

McGonical emphasizes the importance of experiential, habit-forming decision processes in her description of an extreme video gamer \[96, 95\]. An extreme video gamer is someone who is experienced and advanced at playing computer-based video games. McGonical describes how extreme video gamers are, over time, able to conduct successful and satisfying experiential decision-making actions through their in-game experiences. McGonical’s research has shown that some extreme gamers are able to solve complex problems more quickly and easily because of their capacity to use the experiential knowledge that they have created.

Extreme video gamers are able to accomplish this while maintaining focus on in-game goals and seamlessly interacting with hardware devices to achieve desired results. McGonical’s hypothesis is that multi-tasked experiential in-game decision activities allow people to enhance their capacity for satisfying knowledge-creating experiences in the real world. This idea is further extended with Dewey’s principle
of interaction, in which he states that habits are also connected to a person’s interactions with their unique environment. In other words, habits are formed not only individually by experiences, but also socially because habits are impacted by social factors that influence the type of knowledge that is created.

2.3.2 Reflection, Critical Consciousness, and Praxis

Dewey’s principles of continuity and interaction provide an understanding of how knowledge can be created through habit-formed experiential decision processes. Given the goal of evolving habit, reflection can also be thought of as an essential part of learning and knowledge creation. Hoyrup [66] describes reflection\(^6\) as a process pertaining to “careful or long consideration or thought.” Bain elaborates on this idea by providing a model of reflection that includes [6],

- Reporting, describing the key elements of an experience
- Responding, using/discussing the key elements of an experience
- Relation, identifying and connecting personal meaning
- Reasoning, analyzing, questioning, and rationalizing an experience
- Reconstruction, generalizing and applying behaviour to new situational experiences

Bain’s model of reflection helps frame reflective activity. It emphasizes how an individual can conduct deeper thought, helping her to form an enlightened understanding of the relationship between decision and consequence as it relates to her unique individual and social environment. Furthermore, reflection, over time, can

also be a catalyst for enabling experiential activity as good habits form. Too much reflection may result in nothing being accomplished whereas not enough reflection may lead to poor outcomes [104]: a balance between experience and reflection is required to making quality decision-based choices and actions.

The transformation of information into knowledge aligns with Bain’s five elements of reflection described previously. Both Norman and Freire discuss reflection as being an essential process in learning and knowledge creation [104, 44]. Freire, in particular, argues that reflection can help form a deeper understanding of a person’s situational experiences, better equipping a person to break societal, political, economic, and cultural norms by empowering the departure from oppressive situational characteristics [54]. The importance of Freire’s understanding of reflection is in his idea of praxis and the idea that education and learning is a process enabled by reflection, social dialogue, and action benefiting the individual as well as the connected community [53]. Freire describes the practice of critical consciousness as the ability to empower praxis. Critical consciousness encompasses the idea that people need to critically question, think, and act beyond continuity, experiential habit and reflective, status-quo interaction.

2.4 People, Process, and Technology

Knowledge can be created through learning, experiences, reflection, and praxis. Augmented Human Computer Interaction can have a significant impact on the quality of a knowledge-creating experience. This section presents additional ideas and frameworks that can contribute to developing process-driven technology for people.

Kelly describes the technium as the space that defines the entirety of the technology that supports people and process [76]. Within the technium, technology-based artifacts are described as being essential to societal evolution, this in partnership
with the people using technology and the process that guide their interaction. Hence, the idea of augmented Human Computer Interaction as will be discussed later. For example, consider a pencil. A pencil is a technological artefact that resides in the technium. A pencil and paper can aid a person in writing, or the capturing of data. In using paper and pencil to capture narratives with exact precision, information can be passed through generations. People who follow throughout time can read and reflect on the captured narratives, enabling learning and the creation of knowledge. This knowledge can help form habits as well as enable praxis. Similarly, a tablet computer, such as a Samsung Galaxy Tab or an Apple iPad, can aid a person in storing and analyzing data. A software application such as a spreadsheet that is installed on the tablet can provide the means for organizing data and developing information. The result of analyzing the information displayed by the tablet can enable knowledge which can enable praxis.

Norman has stated that “the power of the unaided mind is highly overrated” [104]: technologies residing within the technium can provide facilitators for decision making and action. Specifically, computer technology can aid in the transformation of data to information, and information to knowledge; support experiential and reflective decision making processes that can enable, or empower, praxis and enable people to more effectively contextualize, categorize, calculate, correct, and condense data. Through software technologies, people can also be better enabled to compare, observe, and analyze consequences; make connections; and engage in global conversations. In the early KM era of information management, technology helped realize the possibilities of information and knowledge capture [41]. The same can also be said for the modern eras of experience and idea management. In the field of Computer Science, decision-centric technological solutions have actively been explored and developed as KM solutions. The technologies being developed for KM are largely founded upon,
and influenced by decision theory and human computer interaction [3, 103]. Examples can include the many expert systems and decision support systems (DSS) that have been developed to help align people with process-driven technologies for KM by providing access to expert-made data and information and DSS interfaces that support rational comparison for decision making [60]. For example, Henrion and his colleagues [60] describe experts systems and DSSs that assist medical doctors diagnose and treat patients, assist airplane engineers troubleshoot and diagnose issues with jet engines, and assist electrical professionals troubleshoot and diagnose events in hydro-electrical power generators.

2.4.1 Beginning with Rational Choice

From a historical perspective, rational choice can provide an understanding of the designs for early expert systems and DSSs [69]. Davis defines the idea rational choice as “a person’s behaviour [...] such that under the proper interpretation it can be said to satisfy the requirements of the system. [If satisfaction is attained], [their] behaviour is what is called rational” [142]. Rational choice is a normative decision theory, a hybrid of classical economic theory and psychological and sociological theory. In the classical economic theory, rational choice is founded on mathematical and statistical decision theory. In psychological and sociological theory, rational choice is founded on the theory of cognition. Simon introduces the common constraints and processes of rational choice, namely “the set of alternatives open to choice, the relationships that determine the payoffs [such as the satisfactions, goal attainments or limitations of a rational organism], and the preference orderings among the payoffs” [130]. In rational choice, choosing something to satisfy a constraint is dependent on the criteria that the “rational organism” has control over. Thus, people utilize, as static criteria, or optimize, as an operation of their rational adaptation [130]. It is interesting to note that there have been some criticisms of rational choice theory. Bourdieu, for
example, considered the idea of a rational being as flawed, favoring his theory of “practical sense”, meaning that people generally are not rational but they can have a socially constituted “sense of the game” [23]. An in-depth analysis of rational choice, its benefit and criticism, is beyond the scope of this dissertation.

2.4.2 From Rational Choice to Bounded Rationality

Simon introduced the concept of bounded rationality, evolving the idea of rational choice, stating that people generally have difficulty in completing rational choice based activities, to mirror critics like Bourdieu [131]. As Simon describes, an issue with rational choice is that most of the knowledge-aided judgments, decisions, and actions that a person makes are,

- Specific in scope
- Arguably independent and of equal importance to other decisions, choices, and actions
- Generally, perceived or otherwise, not significantly impacting the total being of that person’s existence.

For example, when a person is at a grocery store buying items to prepare for the current day’s dinner they are not usually also concurrently deciding upon what clothes to wear the next day or where to go during their next vacation. With respect to their main task of purchasing food, they may not even be considering all criteria involved, focusing, for example, only on what they currently are craving for dinner. Simon states that people generally have a great deal of difficulty in fully detailing situational scenarios of all possible future events. Snowden agrees, as he argues that the idea of rational thought is one of the more prevalent issues in modern KM [135]. As Snowden describes, the idea that people can attain an ideal future state through
fully rationalized prediction of best practice in the present using captured knowledge is fundamentally flawed as no one person can predict a future outcome. Snowden proposes that activity in KM should rather focus on the present and evolve naturally toward a sustainable state. Continuing the example of purchasing food, when buying a particular food item, people generally have a defined scope. This scope might include certain lifestyle choices, whether the food needs to be organic or local or just taste good. It might also include possibilities based on income and the amount of money they set aside to purchase food, and the limitations, or possibilities, of buying a particular food item based on the grocery store they are currently shopping at. It is unlikely that a person will analyze much more.

Rational choice and bounded rationality emphasize the concepts of compensatory and non-compensatory decision activities, as defined by Mintz and his colleagues [98]. KM technologies can draw on these ideas to provide a basis for incorporating associated processes and integrating them with technological solutions. Rational choice can describe a compensatory knowledge strategy, used when a person applies a strict, fully rationalized thought process based on predefined preferences, ratings, or rankings to formulate a final decision [86]. A person will systematically weigh all possible alternatives available to them in the present to begin forming an ideal (hopeful) future state or best practice. Compensatory decision strategies have the potential to be quite complex in that a person may not always be an expert in the domain of evaluation. As well, they may also have differing values and preferences. However, given the benefit of technological interaction in support of rational choice, it can represent an important component of design. This can be a benefit when designing interaction to empower praxis, as people can be enabled to review all aspects of their decision making and supported action.

Bounded rationality may provide a more realistic process [90]. Bounded rationality can describe non-compensatory strategies, which are used when a person narrows
the scope of knowledge-aided decisions based on values and preference as described by Wright [152]. Non-compensatory analyses highlight the limitations of a person’s capacity for reaching fully rationalized outcomes [14, 67]. Technological solutions can aid people in these activities, aiding in the rational work that a person may have difficulty in completing, freeing people from the cognitive strain of rational choice and empowering them through technology-supported and guided decision activities. This can be a benefit when designing interaction in support of habit formed decision making, as people can better focus on the aspects of their decision making and supported actions that they deeply care about, or that are deeply ingrained, such as only buying organic food regardless of all other food characteristics.

2.4.3 Human Computer Interaction

Jacob and his colleagues describe expert systems and DSSs as potential technological solutions to mimic the process of rational choice and bounded rationality [69]. Early technological systems sought to provide automatic support tools of the kind [132]. With this, Kochhar and his colleagues [79] describe the varying levels of computer-aided design (CAD) and what can be thought to build on the idea of human-computer interaction (HCI), namely, manual, augmented, and automatic interaction. Although focused on CAD for graphical modelling, the work of the authors can still apply to designing expert systems and DSSs with an emphasis on HCI. With manual forms of HCI, people are required to do all of the work. Conversely, with automatic forms of HCI, people are fully guided by the technology. Kochhar and his colleagues argue for a balanced approach, an augmented form of HCI. The emphasis of augmented HCI is that the technology controls what people would typically have difficulty dealing with, such as rationalized decision activity, and the people would control what the technology would typically have difficulty dealing with, such as bounded rational, unpredictable behaviour.
Figure 2.4: Norman’s Gulfs of Interaction, comprised of the Gulf of Execution (intention, action, execution) and the Gulf of Evaluation (perception, interpretation, evaluation).
In his keynote at the State of the Net in 2012, Snowden stated, “used properly, technology can augment human memory and experience. Used improperly, it can destroy human capability.”  

Snowden’s quote provides insight into the importance of system design in facilitating augmented HCI for KM, or any other activity/practice. Norman provides a model for HCI that can guide design of technological tools, for KM and otherwise [103]. This author also postulates that these can be used for any decision making activity. Norman defines these as the *seven stages of action*, illustrated in Figure 2.4, being forming a goal, forming an intention, specifying an action, executing the action, perceiving the state of the world, interpreting the state of the world, and evaluating the outcome [103]. In understanding the criteria that makes up the seven stages of interaction, a technological design can be developed that enables a person to focus and have an increased level of satisfaction in their interaction and experience. *Emotional design*, as described by Norman as a way that utility and usability can also be influenced by a person’s emotions towards some thing, can also play a critical role [105]. SpiCE utilizes these ideas in the technological component of design for enabling process-driven decision-centric interactions.

### 2.4.4 Open Knowledge Cultures

Culture can have a significant role in KM [82]. Leidner defines culture as “the predominating attitudes and behaviour that characterize the functioning of a group or organization” [82]. As KM has evolved from information management to experience and idea management, an open learning culture has become an essential reality [1, 82, 41]. In this dissertation, the definition of a learning culture is used interchangeably with

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that of a knowledge culture as the author characterizes learning as leading to knowledge, and knowledge enabling learning. The author states that both are essential characteristics of the other.

Couros defines open thinking as that which emphasizes free use, re-use, editing, and sharing of creative cultural artifacts (including knowledge) [32]. In the world of Computer Science, open thinking has its roots in the idea of open source software. As introduced by Perens, the definition of open source software is guided by these characteristics [113] 9:

- The free redistribution of software (for royalty or fee), as Stallman states “free as in freedom, not as in price” meaning people are able to distribute their software as they see fit, without having to worry about political or cultural deterrents 10

- Accessibility and availability of a software’s source code. The programming code is provided so that people can use and adapt it to their own needs

- The option to allow the creation of derived works

- Allow for the integrity of the author’s source code to remain intact if derived works are created, regardless of alterations. The original programming code is to remain available in its original form in some fashion (in some cases, altered code is required to use an alternative name)

- The elimination of discrimination against persons or groups. The software is to remain freely accessible to all (no exceptions)

- The elimination of discrimination against fields of endeavour. To not restrict anyone from developing software for any use

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9Open Source Initiative, the Open Source Definition: http://opensource.org/docs/osd (Accessed October 2012)

• The distribution of a license ensuring rights of redistribution and use of developed software

• The development of a license that is not specific to a product. The right to extract software code and adapt it to a new innovation

• The development of a license that does not restrict other software. It must not restrict the use of proprietary (paid/closed) software alongside open source

• The development of a technology-neutral license. The software can be used on any interface or tool that is applicable

The idea of open source is expanded by Raymond in his book *The Cathedral and the Bazaar* [119]. Raymond describes the advantages and disadvantages between a cathedral approach to software development versus that of a bazaar approach. In a cathedral approach, software development is considered closed or private or proprietary, which is typically developed and supported by a few individuals. In the bazaar approach, software development is considered more open, that which is typically developed and supported by a global citizenry. Raymond emphasizes the added advantages of the bazaar approach, to which this author agrees, although there are pros and cons to each. For example, although open source software is often provided free of charge, there could be monetary costs associated with it, such as maintenance and other types of support and development costs [147, 125]. However, as von Hippel discusses, the pros of a bazaar-style, “free revealing” approach to design and innovation can provide added benefits, such as greater use of the design or innovation, higher chance of adoption, study and evolution of the design and innovation, and increased awareness and reputation of the original inventor, all of which may outweigh the monetary costs that can be associated with such an approach [147].

An idea that can help describe the link between a bazaar-style design with that of learning and knowledge creation can include the idea of connectivism. Connectivism
is an educational and learning philosophy developed by Siemens, and is guided by the following principles [129]:

- Learning rests in the diversity of opinions and is enhanced as people interact from different areas (of knowledge or skill)
- Learning is a process of connecting specialized nodes or information sources, bringing together a wide range of information repositories to expand knowledge
- Learning may reside in non-human appliances, such as a database or a place-based community gathering
- Capacity to know more is more critical than what is currently known
- Nurturing and maintaining connections is needed to facilitate continual learning
- Decision-making is itself a learning process

These ideas are extended and supported by Fischer’s innovative multi-dimensional aspects of learning which emphasize the importance of interdisciplinary knowledge experience, interaction, and creation, that is globally accessible and life-long [48, 49].

2.4.5 MOOC: An Example and Inspiration

A Massive Open Online Course, or MOOC (pronounced MOO-K) is used to help illustrate the ideas previously described [31]. The idea of a MOOC provided a significant inspiration for the development of SpiCE as a MOOC emphasizes a base model for openness and interactive learning/knowledge creation. A MOOC can be described as an online educational, learning, and knowledge creation model for an interactive space, or Ba [91]. As with traditional models of education and learning, a MOOC has facilitators as well as a start and end date. However, unlike traditional
models of education, a MOOC is open, where access and participation is not limited; distributed, not facilitated in one single location; and has the potential to enable life-long individual and social learning and knowledge creation. Cormier discusses the interaction and experiences that a MOOC can provide [30]. To illustrate these, #ETMOOC, a MOOC that was offered by the University of Regina which focused on learning and knowledge creation for Educational Technology, is used to provide a detailed description of a possible MOOC design. \(^1\)

Firstly, MOOCs provide a person with the capacity to orient themselves within Ba. They enable a person to find the common places and common times where they and other participants will base their knowledge creating interactions. The #ETMOOC facilitators provided a blog page, illustrated in Figure 2.5, to help people orient themselves within the community. The blog page acted as a hub, helping people register for the MOOC, find links to other online community locations, such as Google+ and Twitter, find information regarding the time and place, virtual or physical locations of educational and learning events, and find captured and archived educational and learning events.

Secondly, MOOCs provide a person with the capacity to declare their interests and initiate socialization by enabling participation through blogs and discussions. The #ETMOOC provided a blog hub, illustrated in Figure 2.6, where participants could submit their personal blogs. Member blogs were, and still are, made visible so that learning can extend beyond the span of the course. Use of technology-based community tools such as Google+, illustrated in Figure 2.8, \(^12\) and Twitter \(^13\), with the Twitter #etmooc hashtag, as illustrated in Figure 2.7, also helped enable people in interactive and declarative activities.

\(^{11}\) #ETMOOC online: http://etmooc.org/ (accessed February 2013)
\(^{12}\) Google+ #ETMOOC community. Online: https://plus.google.com/u/0/communities/116116451882856472187 (Accessed February 2013)
\(^{13}\) Twitter, online: https://twitter.com/ (Accessed February 2013)
Figure 2.5: The #ETMOOC blog homepage (accessed February 2013).
Figure 2.6: #ETMOOC’s blog hub (accessed August 2013).
Figure 2.7: Screen capture of the Twitter feed for the #ETMOOC hashtag (accessed February 8, 2013 at 10:00am CST).
CHAPTER 2. FUNDAMENTALS OF KM

Figure 2.8: Screen capture of the Google+ community feed for the #ETMOOC hashtag (accessed February 8, 2013 at 10:15am CST).
Thirdly, MOOCs provide people with the capacity to develop networks. A network can consist of a group of people who participate in social discussion on topics of interest. As a network interacts, social bonds can form, providing a basis for lifelong learning. A network can represent weak ties [56, 57]. A weak tie can serve as a base for any interaction. It represents a bringing together of people of diverse knowledge, backgrounds, skills, and abilities. A weak tie emphasizes the connections that people experience as they gather, discuss, share, and innovate in a social manner [57, 139, 129]. Like the #ETMOOC’s Twitter and Google+ pages previously mentioned, Blackboard Collaborate was used to provide a basis for the development of weak and strong ties. Weekly and bi-weekly sessions were scheduled, providing a way for community members to meet, initiate discussion, and begin to form bonds. Figure 2.9 illustrates a screen capture of an #ETMOOC Blackboard Collaborate session.

2.4.6 Knowledge Crowds and Communities

In KM, a network can be represented as a knowledge crowd [59]. Within a knowledge culture, a knowledge crowd can refer to the group of people who participate at a lower level of involvement. A knowledge crowd can provide the initial grouping in which weak ties can develop. Characteristics of a knowledge crowd can include casual engagement in developing knowledge content, casual participation in social discussion, a wide diversity of ideas, beliefs, and opinions, and a high rate of observation and consumption of knowledge with a low rate of contribution. Overall, a network and knowledge crowd can describe the weak ties that can initiate interactions and experiences in a knowledge culture.

As people increase their levels of participation in a knowledge crowd, a knowledge

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CHAPTER 2. FUNDAMENTALS OF KM

Figure 2.9: Screen capture of one of #ETMOOC's BlackBoard Collaborate sessions.
community can result. Within a knowledge culture, a knowledge community can refer to the group of people who participate at a higher level of involvement. Figure 2.10 is an illustration of the differences between a knowledge crowd and a knowledge community (adapted from [148]). Characteristics of a knowledge community can include high engagement in developing knowledge content and high participation in social discussion. Although there can be a wide diversity of ideas, beliefs, and opinions in a knowledge community as in a knowledge crowd, there is a tendency for these to be more narrowed and focused in scope. There is also a high rate of observation and consumption of knowledge, as well as a high rate of contribution.

As an example, within a MOOC, a knowledge community can resemble a MOOC cluster. A cluster consists of a gathering of people who branch from a MOOC network. As people interact in a MOOC network, they can form initial weak ties based on shared ideas, beliefs, and opinions. As interaction intensifies and the ties strengthen, a cluster can form that can enable narrowed and focused interaction, collaboration, and combination, emphasized in the SECI model previously described. The #ETMOOC facilitated the development of networks and their transitioning to clusters in several ways. Discussions during Blackboard Collaborate sessions allowed people to see the interest and opinions of others, which opened opportunities for connection. Similar opportunities were developed through Twitter and Google+ interactions and blog participation.

Although cluster formations can strengthen a knowledge culture, they can also be to its detriment as they can result in the formation of filter bubbles [111]. Pariser describes a filter bubble as a type of narrowed and focused stream of knowledge that can be the result of specialized and personalized interactions. For example, Google search provides people with a personalized search service using fifty-seven characteristic and behavioural qualities, including a person’s location, past search
Figure 2.10: Knowledge crowds versus knowledge communities (adapted from Ward [148]).
history, browser, computer brand, and language. Google claims this service helps a person narrow and focus on what matters most to them. As well, Facebook and Twitter provide similar services through personalized feeds which aim to emphasize what people, groups, and things a person may care deeply about. Filter bubbles may initially help a knowledge culture form and initially grow. However, for a knowledge culture to be sustainable, a diversity of learning and knowledge is a crucial factor [3]. Stephenson states [139],

> Experience has long been considered the best teacher of knowledge. Since we cannot experience everything, other people’s experiences, and hence other people, become the surrogate for knowledge. I store my knowledge in my friends is an axiom for collecting knowledge through collecting people.

Thus, people who actively seek a diversity of knowledge by seeking connection with a diversity of people are more enabled to develop a culture that can sustain and endure. With this idea, Zuckerman describes a xenophile as a person who actively seeks connection with other people, those with both similar and divergent ideas, beliefs, and opinions to engage in knowledge creating experiences that aim to build upon their own experience and knowledge [157, 158]. The recruitment of xenophiles in a knowledge culture may limit the emergence of filter bubbles. In a MOOC, facilitators can provide access to xenophiles through structured online facilitated discussions. As previously mentioned, #ETMOOC provided structured and focused Blackboard Collaborate sessions conducted by a variety of people, on a variety of topics. Thus, the facilitators provided access to xenophile-type interactions and experiences because participants could engage in discussions and other interactions that enabled

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the expansion of their knowledge.

One fundamental weakness of MOOCs as a knowledge creation technique is that they have an end date. Once a MOOC runs its duration, the participants are no longer aided in maintaining their or in nurturing any network and cluster that has formed from the knowledge creating interactions. Using the benefits of a MOOC, an alternative approach could be to develop a community of practice, free from start and end dates, which may help to sustain a knowledge culture.

2.4.7 Communities of Practice

Wenger defines a community of practice (CoP) as an online social environment that provides people with a technology-facilitated place to create knowledge through discussion, sharing, and collaboration, similar to the idea of Ba [149]. CoPs are comprised of:

- A *domain* that binds the common identity of those who participate
- A *practice* that defines the activities that people engage in within the domain
- A technology *community* that facilitates interaction and experience.

A CoP enables creation of a *digital habitat*, and interactive space where a knowledge culture can grow [149]. A digital habitat encompasses [149]:

- Tools that support the activities (of KM)
- Platforms which package the tools for use by people within a community (single tool and multiple tool platforms can exist)
- Features that give tools and platforms utility and usability
- A configuration that sustains and evolves, or grows the habitat
Figure 2.11: Illustration of a rhizome plant (used from the “Gypsy Scholar, The Rhizome of Life”). A Rhizome can be used as a metaphor for growing a digital habitat for KM, where knowledge creation spans boundaries and can grow organically as people interact.
Interaction and experience within a digital habitat can be visualized using the metaphor of a rhizome root, as in *rhizomatic learning* [29]. Cormier describes rhizomatic learning as that which has “no centre, and no defined boundary” [29]. The concept is based on the unique characteristics of a rhizome plant, which grows horizontally and vertically, spawning new plants in a highly networked and connected way (Figure 2.11 [17]) [70]. As networks and clusters form in a knowledge culture, MOOC or otherwise, the connections between them can resemble the “roots” of knowledge. As networks and clusters evolve, knowledge crowds and communities “bloom.” The idea of rhizomatic learning can be considered to expand upon the SECI model (recall Figure 2.3). SECI has a defined structure of experience and interaction for explicit and tacit knowledge creation. In the adapted illustration of SECI, the dotted lines of each knowledge creating activity can illustrate the interconnectedness and openness needed in KM. Knowledge can be represented as rhizome roots, which can grow organically beyond any boundary. Such growth is a fundamental goal of knowledge creation in the modern era of KM development, and it is a prerequisite of knowledge cultures that are sustainable [41].

### 2.5 Sustainable Knowledge Cultures

A primary goal in the current KM era of idea management is to develop knowledge cultures that engage in open thinking where knowledge flows openly to all people, everywhere, regardless of boundaries, and thus, are sustainable because they can evolve by incorporating diversity of learning. Such flow can resemble the growing patterns of a rhizome plant. For a knowledge culture to be sustainable, it requires a state of continuous growth, a willingness to be open and instigate experimentation and change [118]. Through growth, as with a rhizome plant, a knowledge culture can

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continually evolve, refine, and (re)develop.

In support of this idea, Fischer describes the Seeding, Evolutionary growth, and Re-seeding (SER) model for life-long learning, which can be adapted to the development of rhizomatic-inspired sustainable knowledge cultures [50, 49]. SER, illustrated in Figure 2.12, helps describe a high-level process for sustainable KM. SER, in combination with the ideas of open thinking, emphasizes the idea that a knowledge culture can be sustainable by being one that is founded on openness, integrating the idea of a bazaar approach to learning and knowledge creation that enables all people who are part of a knowledge culture for developers and users, or knowledge producers and consumers to participate in the defining and redefining of its evolution.
2.6 Chapter Review

The ideas described in this Chapter all provided inspiration, or were directly used in the design of SpiCE. This Chapter reviewed what constitutes knowledge, its transformation from data and information. It briefly described popular frameworks in KM, including Snowden’s cynefin framework, the Consortium for Service Innovation’s KCS, and Nonaka’s and Takeuchi’s SECI framework. It provided reference to the importance of education and learning in KM, from Dewey’s principles of continuity and interaction, to Freire’s idea of praxis and critical consciousness. This importance was linked to decision making theory, from rational choice to bounded rationality and the importance of the two in designing technology in support of habit formed decision making and action and praxis.

People, process, and technology is a fundamental focus of KM. Specifically, how ideas and techniques in augmented human-computer interaction can help to design technologies in support of process-driven tools for KM. A MOOC, specifically the #ETMOOC, was used to illustrate ideas. As well, the idea of MOOCs in relation to Wenger’s CoPs and how they can be integrated to support design of open thinking tools for KM was discussed. Finally, Fischer’s SER model was described with the purpose of providing a high level model for describing how to sustain a knowledge culture. As will be discussed in the proceeding chapter, combining components and expanding upon them to provide an illumination of how to possibly balance people, process, and technology is the benefit of SpiCE.
Chapter 3

SpiCE and its Foundations

This dissertation presents an integrative framework for KM called SpiCE, an acronym for spime wrangling, culture of participation, and ethical decision making. As will be expanded upon throughout this Chapter, SpiCE uses,

- Spime wrangling to describe a type of interaction for data and information exploration
- A culture of participation to describe an interactive space where individual and social learning and knowledge creation results through spime wrangled explorations
- Ethical decision making to guide development of sustainable outcomes of spime wrangled explorations within a culture of participation.

A high-level schematic of SpiCE is illustrated in Figure 3.1. SpiCE provides an essential balance of people, technology, and process for KM by describing an interactive space for sustainable learning and knowledge creation. To achieve this, SpiCE introduces six innovations,

1. Four guiding principles for KM interaction
2. TriM evaluation for enabling sustainable reflective decision making

3. The roset model for personalization to enable habitual experiential decision making, as well as to aid in building a knowledge culture

4. Trust metrics to vet and evaluate contributed knowledge content

5. Cyean wrangling to guide learning and knowledge explorations

6. Createx to guide learning and knowledge creations and evolution

SpiCE is inspired by and builds upon ideas from traditional and modern research, theory, and practice in KM and decision theory. The processes and technologies that...
SpiCE proposes are also influenced, and built upon ideas within the fields of education and learning, data science, interaction design, and ethics. This Chapter will describe SpiCE and elaborate on how SpiCE provides a more well-defined balance between people, process, and technology in support of developing sustainable learning and knowledge cultures.

3.1 People Interacting Within a System Using SpiCE

SpiCE proposes an interactive space around the idea of Fischer’s culture of participation. Fischer defines a culture of participation as that which enables people to actively participate in “personally meaningful activities” [51]. SpiCE describes a framework for learning and knowledge creation through three components, illustrated in Figure 3.2. First, SpiCE promotes the creation of prosumer cultures. Secondly, SpiCE enables prosumer cultures by integrating bazaar-style learning and knowledge interactions. Thirdly, learning and knowledge interactions are guided by SpiCE’s four guiding principles of KM as adapted from those developed by Stallman for the GNU project.

3.1.1 Prosumerism Within a Culture of Participation

Fischer describes the idea of a culture of participation as one that enables an interactive space where a consumer culture can evolve to a prosumer culture [47]. A consumer culture can be described as a learning and knowledge creating environment where a majority of people engage in read-only activities, where people primarily consume what a minority produces. In KM, a knowledge crowd can resemble a consumer culture, consisting of people with a low level of participatory involvement. Associating
Raymond’s metaphor of the cathedral and the bazaar, a consumer culture resembles a cathedral-style environment. The proprietary software industry can provide an example of a cathedral-style consumer culture because a few corporate giants, such as Microsoft, Apple, and Google, rule the technological landscape. People who interact in a consumer culture often do so at the whim of the people and corporations that develop (produce). This can have real impacts on the utility of a design, where design changes can often occur with little user input, such as when Facebook makes changes.
As well, consumer cultures can have real impacts on the satisfaction of users, such as Google discontinuing its Reader product, leaving several thousands of users on their own to find an alternative. With Google Reader, for example, some users (the author included) had invested years of use in the tool. The public outcry of Google Reader users was captured in a Change.org petition which received over one hundred and fifty thousand signatures (screen capture illustrated in Figure 3.3).\(^1\) Conversely, a consumer culture, and thus, a cathedral-style environment, can also include perceived and real advantages. These advantages can include a higher degree of trustworthiness, quality, and, arguably, product support \([119, 22, 46]\).


Conversely, a prosumer culture can be described as that where people have a capacity to engage in read-write activities. Read-write activities are those where people act as both consumer (user) and producer (creator) [46]. In KM, a knowledge community can resemble a prosumer culture. Associating Raymond’s metaphor of the cathedral and the bazaar, a prosumer culture resembles a bazaar-style environment. Open source software can provide an example of a bazaar-style prosumer culture. As previously described, with open source software, people of varying expertise and skill develop software products. The results of development are provided to all people, with open access to the software code, for education, manipulation, or customization. In opening access to software code, people are provided with the capacity to adapt the software to their unique needs and requirements either by developing, porting, or by reaching out to the community for help or guidance. This is a fundamental difference between proprietary software and open source software. This can have real impacts on the utility and satisfaction of a software design as by the philosophy of open source, a software product is always in a state of evolutionary growth. A prosumer culture can include perceived and real advantages. These advantages can include a sense of greater inclusion, participation, and, relating back to KM, a vastness of information and knowledge creating possibility.

3.1.2 Prosumerism in the Bazaar

SpiCE encourages formation of prosumer cultures by facilitating interaction between knowledge crowds and communities using technology that integrates highly detailed bazaar-style interactions. Although the work in this dissertation argues in favour of bazaar-style interactions for knowledge creation, it also argues for a more balanced approach, one that incorporates both bazaar and cathedral style interactions, as will be described. The idea of crowdsourcing is used to help illustrate this balanced approach.
Howe defines crowdsourcing as an activity where people work together to create content, solve problems, and collaborate [65]. Wikipedia, the highly popular open and free web-based encyclopedia, can provide an example of crowdsourcing. In its design and use, the Wikipedia Foundation has developed a digital habitat where people can engage in prosumer activities, providing a platform for collaborative learning and knowledge creation. Although everyone can contribute content to Wikipedia, content is routinely vetted by Wikipedia administrators to ensure accuracy and quality of contributed knowledge. The result of prosumer collaboration is the Wikipedia website itself, where all open and crowd created knowledge is made publicly available for free. The philosophy of crowdsourcing, its connection to the fundamental idea that collaboration helps enable sustainable knowledge creation and innovation, is of key importance.  

3.1.3 Guiding Principles of SpiCE

SpiCE builds on the ideas described in the previous section by defining a set of guiding principles for crowdsourced knowledge creation. To help define the four guiding principles of SpiCE, the basic rights as defined by Stallman for his GNU project are used. The GNU Project being an example of an early crowdsourcing effort. To provide some context, the GNU Project was started by Richard Stallman 30 years ago (see Figure 3.4). Stallman began the GNU project to provide people with an alternative to proprietary software, providing people the ability to utilize free software-based

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4Wikipedia administrators are a group of 1,345 individuals (and counting) who have elevated privileges to ensure accuracy and quality of contributed knowledge in Wikipedia. Online: https://en.wikipedia.org/wiki/Wikipedia_administrators (accessed September 2015).
5Jimmy Wales, founder of Wikipedia, dislikes the word “crowdsourcing” as it is being similar to the term “outsourcing” which often can refer to contracting work from an external source at the expense of internal source. See “The Next Web Interviews Wikipedia Founder Jimmy Wales.” Online (Approx. time: 16:48): http://youtu.be/ik7jYj5dEg (accessed October 2013).
technology solutions to run their computing systems. Stallman defines “free” as “a matter of liberty, not price […] you should think of free as in free speech, not as in free beer.”  

The GNU project is founded on four basic freedoms (principles): 

1. The freedom to run a program for any purpose

2. The freedom to study how a program works and adapt it to specific needs

3. The freedom to redistribute copies of the original software code and working program(s)

4. The freedom to (re)distribute copies of modified (adapted) versions of the software code and working program(s)

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8Stallman states the four basic freedoms starting at zero (0) to three (3). This is a play on computer programming. To aid the non-technical reader of this dissertation, the author notes these freedoms starting at one (1) and ending at four (4)
An example software project that was a result of the GNU project is the GNU/Linux operating system. There are a myriad of GNU/Linux variations today, two of which include gNewSense\textsuperscript{9}, a strict GNU/Linux operating system that strongly adheres to the four basic rights of the GNU Project in its design as it only uses only GNU-certified softwares, and Ubuntu\textsuperscript{10} (used by the author), which partly adheres to the four basic rights of the GNU Project as it also utilizes in its design some proprietary (\textit{non-free}) softwares, such as audio/video codecs (MP3) and wifi drivers.

SpiCE adapts the four basic rights of the GNU Project to define four guiding principles that help to frame interaction within a knowledge culture. These are:

1. The freedom to openly cross-culturally learn and create knowledge without boundary

2. The freedom to openly learn and reflect upon created knowledge for decision-making

3. The freedom to collect, capture, and share unfiltered and unbiased structured data for knowledge creation

4. The freedom to interact with others to share and evolve knowledge and experiences to form habits that are sustaining, or that can enable praxis

The four guiding principles of SpiCE are used to guide development of technologies and processes for learning and knowledge creation.

\textsuperscript{9}gNewSense GNU Linux. Online: \url{http://www.gnewsense.org/} (accessed October 2013).

\textsuperscript{10}Ubuntu GNU/Linux. Online: \url{http://www.ubuntu.com/} (accessed October 2013).
CHAPTER 3. SPICE & ITS FOUNDATIONS

3.2 Technology Design Within a System Using SpiCE

As described in the preceding section, the people component of SpiCE revolves around the four guiding principles of SpiCE, where a culture of participation is developed through the interactions of knowledge crowds and knowledge communities. The four guiding principles of SpiCE help define the type of technology needed that will facilitate learning and knowledge-creating activities, and the processes that will enable them.

SpiCE describes a framework for technology through a platform for interaction comprised of technological tools, models, and specific design fundamentals, as illustrated in Figure 3.5. SpiCE promotes the creation of a community of practice as a technology-based platform to facilitate KM. SpiCE promotes learning and knowledge creation, firstly, by describing a program for KM using spimes. Secondly, SpiCE promotes the activities of KM be guided by technological design and development using ideas within the research area of sustainable Human Computer Interaction (sustainable HCI). Thirdly, SpiCE describes two technology solutions for system design, one called roset which can initialize network and cluster formation as well as provide personalized displays, and the other called createx (pronounced, cree-eh-tex), which describes the technology-facilitated practices that can help create, evolve, and sustain a knowledge culture.

3.2.1 Communities of Practice and Decision Support

As Fischer describes, there exist a multitude of technologies that can facilitate a culture of participation [46]. SpiCE proposes a community of practice (CoP) to facilitate its culture of participation. CoPs have [149],

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Figure 3.5: Illustration of how SpiCE guides development of technology for learning and knowledge creation.

- A domain that binds the common identity of those who participate
- A practice that defines the activities that people engage in within the domain
- A technology community, an interactive space that facilitates interaction and experience

The collaborative nature of CoPs support crowdsourcing approaches to KM, highlighting the activities common within the KM era of idea management. Thus, they support people in developing individual and social knowledge creation for decision
making activities. For example, GasBuddy is a CoP that allows people to share prices of gasoline in local regions.\footnote{GasBuddy’s website: \url{http://gasbuddy.com/} (accessed November 2012).} Screen captures of GasBuddy are illustrated in Figures 3.6, 3.7, and 3.8. The domain of GasBuddy centres around offering decision support regarding the price of gasoline. The practice of GasBuddy is defined as the crowdsourcing of local gasoline prices. The technology community of GasBuddy is comprised of a website and mobile application that facilitates the practice of the domain.

### 3.2.2 Data Management with Spimes

Recall one of the guiding principles of SpiCE is the freedom to collect, capture, and share unfiltered and unbiased structured data. SpiCE adheres to this guideline by structuring data as spimes. Sterling introduced the concept of a spime to describe a
Figure 3.7: GasBuddy interface for contributing gas prices (accessed November 2012).

Figure 3.8: GasBuddy interface for Regina, Saskatchewan Canada. Image captured November 26, 2012 at 1:10pm.
representation of data that can be associated with a given object [141]. The essential quality of a spime is that through an object’s data representation, people are able to derive information about an object’s history. Sterling provides the example of “old wine in new bottles”, providing a contrived narrative describing a person’s possible interaction with a wine bottle [141]. In his narrative, Sterling describes that through the process of reflection, while reading the name on the wine bottle, the ingredients, the age, and the origin, a person can become more knowledgeable about the wine. A person may learn what foods the wine pairs well with, the type of grapes used, the origin of the glass bottle itself. The spime of a bottle of wine can provide a wealth of data, information, and knowledge, more than that provided by its label. Its complete history can be represented.

Figure 3.9 illustrates the possible spime of an acoustic guitar, which could include its brand, type of wood(s) used in its construction, origin of wood(s), origin of manufacture (city, province, nation), date of manufacture, number of strings (four, six, eight, twelve), and electronic materials used. The spime of an acoustic guitar could also include knowledge on how to play it and how to recycle its wood(s) and electronics if needed. An example of where the spime of an acoustic guitar would be useful could be the guitar named Six String Nation.12 Six String Nation is a guitar created by Jowi Taylor, an award-winning Canadian writer and broadcaster. It is constructed of sixty-four pieces of material, such as bone, metal, wood, stone and fabric, from various regions in Canada. Figure 3.10 illustrates the locations of the materials used in the guitar’s construction. The data, information, and knowledge of the materials may help emphasize Canadian identity.

Figure 3.11 illustrates the possible spime of an apple, which could include health-related qualities in comparison with other apples, fruit, or products, type (gala, spartan, etc.), seasonality, where it was produced and processed (locally or otherwise),

12Six String Nation online: http://www.sixstringnation.com/ (Accessed April 2013)
Figure 3.9: Illustration of the possible spime of an acoustic guitar.

- Body wood type
- Neck wood type
- Origin of wood
- Origin of manufacture
- Date of manufacture
- Number of strings
- Electronics/pickup
- Cost
...etc...

Figure 3.10: Mapping of the materials used in the construction of the six string nation guitar. Online: http://www.sixstringnation.com/, Menu — Navigate the guitar — Guitar Explorer (accessed April 2013).
price (and location of the market with the most effective price), among others. The spime of an apple could include knowledge on how to eat the apple and how to prepare it in recipes.

Sterling associates the idea of a spime with an object’s data and information characteristics. An object is represented in “space”, through geographically locative techniques and applications, and “time” as it relates to an object’s past, present, and envisioned future state. Spimes support life-cycle analysis as all of the object’s historical data and information is linked. Spimes specifically support cradle-to-cradle methods, an understanding of how a thing is used and what can be used in its recapturing, recycling, and re-manufacturing [92, 93]. According to Sterling a spime is comprised of seven qualities [141],

1. Spimes are designed within a network

2. Spimes have a unique digital identity that is distinct from any other object in the world

3. Spimes are physically fabricated from their virtual plans

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4. Spimes can be tracked in real-time

5. Spimes can be searched

6. Spimes are designed for disassembly

7. Spimes leave a historical trace

The first quality of a spime is that a spime is designed within a network. This quality relates to the storage of the data and informational characteristics of an object. In KM, think of the first era of information management. Sterling argues that technology provides the most adequate facilitator. For instance, technology enables the storage of data and information about objects in cloud-based databases, providing high availability and accessibility through networks and associated connectivity tools. Within the Technium, augmented computer technology networks can be of specific benefit as they can enable linked data explorations for efficient and effective learning and knowledge creation.

The second quality of a spime is its uniqueness of identity. This quality corresponds to the idea that every object can be represented as a unique element. For example, consider a shoe. It may be that this shoe shares similarities with all shoes, or a subset of shoes, and those may or may not be representative of that particular brand and style. Although this is the case, each unique shoe, even if the same brand and type as other shoes, may have unique qualities of its own, such as its unique fit (small, wide, comfort). This information may help when deciding which shoe to purchase, among other benefits. Another example could include food. A particular food item may have a uniqueness of its own that lends itself to be distinct, such as type, quality, consistency, day of purchase, and taste as described previously.

The third quality of a spime is its fabrication from virtual plans. This quality corresponds to the idea that a spime only comes into physical reality when its data
or information is accessed from a database. This means that a spime cannot be held as, for example, a pair of shoes, guitar, or an apple. A spime is simply the data and information of an object. The use in having access to this data and information is that it can enable learning and knowledge creation about the object or the world with which it relates.

The fourth quality of a spime is its traceability. This quality deals with the tracking of an objects life-cycle [94]. Life-cycle assessment (also referred to as life-cycle analysis) is a research discipline that strives to understand the environmental impacts associated with an object. This knowledge is often obtained via life-cycle practitioners who develop life-cycle inventories. Life-cycle inventories are detailed analyses that describe the materials used, energy consumed, and the emissions that are produced during an objects life. These whole-life cost assessments highlight an object’s environmental impact from its inception, to its initial creation, to its eventual destruction or demise. This is typically referred to as cradle-to-grave cost assessment [92]. These assessments help people, and companies, deal with the objects that they create and interact with through the object’s entire life-cycle.

In enabling learning and knowledge creation for environmental sustainability, the idea of the triple bottom line is often emphasized [93]. The triple bottom line is illustrated in Figure 3.12. The goal of the triple bottom line is to operationalize knowledge for sustainable growth of business operations. Each element comprising the triple bottom line is distinct, meaning that the attributes profit, people, and planet are maximized in separate. This maximization can describe how eco-efficient an object is [92]. For an object to be eco-efficient, the three attributes of the triple bottom line are maximized to their upper capacity at the time of object’s conception, production, or manufacturing.

Sterling states, “without sustainability, information is top-heavy, energy-hungry,
and heading for a crash; while sustainability is impractical without precise, comprehensive information” [141]. The traceability of a spime may help make data and information more precise and comprehensive. For example, consider Sourcemap [20]. Sourcemap enables people to visually explore the material composition and transportation qualities of consumable objects. Figure 3.13 is an illustration that depicts the ingredients and manufacturing components of EarthBound Farm’s organic spring mix salad product. As realized in the product’s Sourcemap visual display, all three components of the salad’s composition originate from California, United States of America. With the provided visual and associated data and information about these elements people are enable to learn and evolve their knowledge for comparison and selection. Data and information is precise, comprehensive, making it less top-heavy and more manageable.

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Figure 3.13: Sourcemap of EarthBound Farms, spring mix salad (accessed November 2012).
The fifth quality of a spime is its searchability. This quality correlates back to the first quality of a spime, their network design. Having vast qualities of data and information accessible in online networks, the World Wide Web is increasingly transforming into an Internet of Things (IoT) [4, 137]. In an IoT, all known things in the world are stored as data and information in the World Wide Web. A spime is a potential modelling for this data and information. Through an IoT, people are enabled to explore the composition of an object of interest. They are empowered to learn and create knowledge about the object. For example, a person could find all there is to know about the type of beer that they enjoy drinking, its ingredients, location of production, where the company is located, how many employees the company has, among other things.

With this type of intense interaction, people need to be considerate of cognitive loading and associated opportunity costs [141]. Here, cognitive loading refers to the amount of energy and time needed to become knowledgeable on a given thing. Opportunity costs refer to the lost amount of time and energy needed to do such for something else. For instance, in learning all there is to know about a specific object, a person’s time and effort is constrained when learning about others.

The sixth quality of a spime is that a spime is designed for disassembly. This quality corresponds to an object’s ability to be recaptured, recycled, or re-manufactured. For example, if a person decides that an item they have has reached the end of its utility, rather than discarding the item, an opportunity may be presented toward its continued use. For example, a person may realize the item could be recaptured and used for something different, such as an old shoe being used as a planting pot. As well, a person may see value in recycling the item, using it for spare parts. Furthermore, a person may see value in re-manufacturing an item for the creation of a new item, such as old seat belts being used to manufacture purses. The process of recapturing, recycling, or re-manufacturing would inherently alter an object’s spime, maintaining
the historical trace and adding new data and information accordingly.

The seventh quality of a spime is that a spime leaves a historical trace. Building from the sixth quality of a spime, if an object is re-manufactured, its spime is altered but the history of what the object once was is maintained. By providing a historical view of an item’s life-cycle people are more equipped to learn about an object and its possible (re)use. This helps educate people on intended and possible uses and helps enable collaboration and innovation as people realize an object’s potential as a whole, or in-part.

A spime relies on an extensive object-based meta-history. The meta-history of an object encapsulates its past, present, and envisioned future state. An object’s meta-history may comprise the data and information about the object, how an object is used, its composition, its utility, and possible innovations from its disassembly. An object’s spime attempts to capture this meta-history. Manufacturers and product innovators can provide an object’s meta-history. However, relying only on object manufacturers and product innovators may not be the best option as the meta-history provided may not be clear, completely truthful, or transparent. Alternatively, in relying on manufacturers, product innovators, knowledge crowds, and knowledge communities, this shortcoming may be addressed. As hypothesized here, a CoP may provide an effective coordination of these groups, enabling the development of an IoT.

3.2.3 Sustainable Human Computer Interaction

As mentioned in the preceding section, the domain of sustainability is a key theme of SpiCE. The idea of sustainability is used, in part, to define an idea for how to create a knowledge culture that is adaptable and that can evolve. SpiCE also emphasizes the idea of sustainability as a domain of KM itself. With this, the area of sustainable interaction design, also known as sustainable human-computer interaction (sustainable HCI) is used to further illustrate SpiCE’s purpose and goals.
Blevis defines sustainable HCI “as a starting point for a perspective of sustainability” [17, 18, 40]. In hardware and software design this can be defined as *sustainability in design* and *sustainability through design* [89]. The concept of sustainability in design can be used to emphasize the sustainable nature regarding the physical qualities of a technological artefact residing in the technium, such as the energy consumption and associated carbon footprints, device reuse, and reduction of waste of a technological artefact. For example, consider Western Digital’s Green standard hard drives which provide reduced power in their operation and usage and are environmentally-friendly by design. Another example could include an Operating System’s suspend mode, which partially shut downs a computer, putting it to sleep and requiring it to use less power while remaining partially running for quick and easy access to any opened documents and applications. These functionalities are integrated within their physical design of the specified technologies.

The concept of sustainability through design can be used to describe design of technological augmented digital habitats for sustainability. Digital habitats can focus on KM for sustainability at an individual, group, and societal level. At the individual level, systems supporting sustainability through design focus on activities relevant to the information management era of KM. Data and information is collected and stored to enhance individual learning and knowledge creation.

The cogitoEPP tool, developed by the author, is an example of a digital habit supporting individual learning and knowledge creation for sustainability. The cogitoEPP tool was modelled after a system called cogito, a tool designed by Hepting to better enable the exploration of objects and information spaces [61]. The author expanded upon the core functionalities of Hepting’s cogito, developing an augmented

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18 EPP stands for “environmentally preferable purchasing.”
CHAPTER 3. SPICE & ITS FOUNDATIONS

Figure 3.14: Screen capture of the search mechanism for the cogitoEPP tool. Users had the ability to filter their search based on selected values.

Figure 3.15: Screen capture of the search results for the cogitoEPP tool. Users had the ability to compare eight cleaning products at a given time based on eight environment-based attributes.
decision making support tool for enabling comparison of environmentally preferable cleaning products [83, 84]. The cogitoEPP tool is illustrated in Figures 3.14 and 3.15. The idea of the tool was to better aid people in the effective and satisfying comparison of industrial cleaning products using eight environmental attributes:

- Skin irritation
- Food chain exposure
- Air pollution potential
- Contains a fragrance
- Contains dye
- Uses recyclable packaging
- Product is packaged as a concentrate
- Product reduces exposure to concentrate

At the group level, systems supporting sustainability through design focus on activities relevant to the experience management era of KM, describing group knowledge. Data and information is collected, stored, and shared to enhance group learning and knowledge. The Resilience Enhancement of Agro-Ecological Production Zones (REAP) tool, developed by the author, is an example of a digital habit supporting group learning and knowledge creation for sustainability. The REAP tool is illustrated in Figure 3.16. \(^{19}\) REAP is a decision support tool that helps to enable crop producers to explore and evaluate crops, their growing ability in specified regions, and how variations due to climate change might impact their ability to grow. Exploration and evaluation was conducted using six common crop characteristics [63]:

\(^{19}\)The REAP prototype is accessible online at: http://reap.cs.uregina.ca/ (accessed July, 2012).
• Growing degree days
• Corn heat units
• Frost free days
• Required moisture (annual/regional)
• Drainage
• Fertility

Figures 3.16, 3.17, and 3.18 illustrate the REAP support tool and a possible exploration for the Swift Current, Saskatchewan region.

At the societal level, systems supporting sustainability through design focus on activities relevant to the idea management era of KM. Data and information is collected, stored, and shared to enhance collective or societal learning and knowledge creation. The now defunct website “Buy It Like You Mean It” (BILUMI) is example of a digital habitat for sustainability at a societal level. BILUMI was developed by researchers at the Massachusetts Institute of Technology (MIT) Center for Civic Media. BILUMI provided a digital habitat which enabled people to share data and information about a wide range of items as they related to qualities of social responsibility. These included,

• Transparency
• Ecological sustainability
• Company ethos
• Animal treatment

\(^{20}\)BILUMI, online: http://bilumi.org/Main (last accessed March 2011), it is currently offline as of November 2012).
Figure 3.16: REAP project: landing page. Users had the ability to select an area of interest to explore. Three Canadian provinces, British Columbia, Saskatchewan, and Ontario, were selected for the prototype exploration.
CHAPTER 3. SPICE & ITS FOUNDATIONS

Figure 3.17: REAP project, provincial view (Saskatchewan).

Figure 3.18: REAP project, regional view of typical crops of the specified region (Swift Current, Saskatchewan).
BILUMI’s homepage is illustrated in Figure 3.19. Through collaborative interaction, people had the option to contribute data and information, browse available products (Figure 3.20), and rank products accordingly (Figure 3.21).

SpiCE helps to develop sustainability through design at the societal level. In the design of technological solutions for KM to aid sustainability through design, SpiCE integrates a technological solution for network and cluster formation and personalized decision support called roset. As well, SpiCE integrates technology-facilitated practices that enable knowledge creation and evolution called createx (pronounced, cree-eh-tex). The roset model for personalization aims to help develop initial focus points for knowledge creation using spimes. Createx helps initialize an instance of a digital habitat that is based on the development, refinement, and evaluation of knowledge as spimes. Through these knowledge interactions, createx also helps enable the realization of opportunities for innovation within the domain of sustainability through critical reflection and specification.
CHAPTER 3. SPICE & ITS FOUNDATIONS

Figure 3.20: BILUMI product browse page. People had access to product name, number of reviews, and overall community rankings (accessed March 2012).

Figure 3.21: BILUMI quick rate product page. People could scroll over the stars and click indicated their rating of the product on a scale of one to nine (accessed March 2012).
3.2.4 Using Roset for Focused Spime Interaction

The roset model for personalization is a hybrid algorithm for personalization that integrates aspects of the classical rough sets approach and the eclat association mining algorithm [83, 87]. In KM, roset can aid in developing technological solutions that better enable learning and knowledge creation. Recall from the previous section, Sterling defines cognitive loading and opportunity costs. Cognitive loading is the amount of energy and time needed to become knowledgeable on a given thing, whereas opportunity costs are the lost amount of time and energy needed to do the same for something else [141]. Personalization can help in the initial reduction of cognitive loading and opportunity costs in KM as it can aid in the focus of task. The fundamental purpose of the roset model for personalization is to provide a useful algorithmic approach to personalization.

The first component of the roset model for personalization is the integration of techniques from the Classical Rough Sets Approach (CRSA). CRSA was developed by Pawlak in the early 1980’s [112]. Techniques from the CRSA can be used to generate a conceptualization of approximations, decision rules (if-then-else) based on feature classes, some decision factor or outcome. Pawlak [112] defines the fundamental concepts of CRSA as follows: suppose an approximation set (decision system), \( A = (U, R) \). In the approximation set there is \( X \subseteq U \), the lower approximation set (LOW), resembling the positive region (POS), encapsulates the objects that are without doubt a member of \( X \), as defined by Equation 3.1.

\[
LOW_R(X) = \{ x \in U : [x]_R \subseteq X \} = POS_R(X) \tag{3.1}
\]

The upper approximation set (UPP) encapsulates objects represented in the approximation class (decision class), that are possibly a member of \( X \), defined by the
Table 3.1: Approximation system (decision system) with contrived cleaning products. Higher EPA ratings denote environmentally preferred products.

Equation 3.2.

\[ UPP_R(X) = \{ x \in U : [x]_R \cap X \neq \emptyset \} \] (3.2)

The negative region (NEG) encapsulates the objects that are without doubt, not a member of \( X \), as defined by Equation 3.3.

\[ NEG_R(X) = U - UPP_R(X) \] (3.3)

The boundary approximation set/region (BND) encapsulates the objects that cannot be classified with absolute certainty as being a member of \( X \), as defined by Equation 3.4.

\[ BND_R(X) = UPP_R(X) - LOW_R(X) \] (3.4)

SpiCE incorporates the techniques of CRSA, in part, to provide a model for personalizing a display for KM. The idea is to generate a minimal set of distinguishing characteristics, represented in SpiCE as spimes, that can enable designers to develop a display providing an initial focus for KM based on decision habits and preferences. To illustrate this idea, consider the decision system in Table 3.1. The decision system is comprised of five contrived environmentally friendly cleaning products. Illustrated are
five contrived cleaning products, each with values for three environmental characteristics, skin irritation (skin), air pollution percentage (air), and recyclable packaging (rec), and the one decision characteristic, an Environmental Protection Agency rating (EPA rating). For the purposes of this example, preferred products are considered to be those that have lower skin irritation, lower air pollution percentage, use recyclable packaging, and have a higher EPA rating. In using the techniques of CRSA, positive regions (POS) based on each of specific EPA ratings are: \( \text{POS}(4) = \{a, e\} \), \( \text{POS}(3) = \{b\} \), \( \text{POS}(2) = \{c\} \), \( \text{POS}(1) = \{d\} \). One of the benefits of CRSA is in its reduction techniques [10]. In exploring Table 3.1, an attempt can be made to try and remove distinguishing characteristics step by step while keeping the positive regions unchanged.

First, consider the removal of the attribute “skin” from the Table. In removing the attribute “skin”, it is still possible to discern products with different EPA ratings based on their values for attributes “air” and “rec”. Thus, it can be safe to remove “skin” from the decision system. Second, given “skin” is already removed from the Table, consider removing “air.” However, with only the attribute “rec” remaining, it is no longer possible to discern products with different “EPA ratings” since products a, b, and e have the same value for “rec”, yet have conflicting “EPA ratings.” Given no ability to remove “air” from the Table, backtracking, the removal of the attribute “rec” is attempted. Upon removing the attribute “rec” (and with the attribute skin still removed), having only the attribute “air” remaining, it is still be possible to discern products with conflicting “EPA ratings.” Thus the attribute “air” comprises what is called a reduct, an attribute that is absolutely required to discern other objects in a decision system. Decision rules can be generated as follows:

- If \( \text{air} = 1\% \) then \( \text{EPA rating} = 4 \)
- If \( \text{air} = 3\% \) then \( \text{EPA rating} = 3 \)
• If $air = 5\%$ then $EPA\ rating = 2$

• If $air = 10\%$ then $EPA\ rating = 1$

In using the generated decision rules, a personalized display for KM can be developed asking the user’s opinion of the attribute “air”, categorizing and displaying cleaning products based on a user’s preferences for products that have a specified “EPA rating.” SpiCE integrates this aspect of the roset model for personalization to provide a personalized search for individual, group, and societal learning knowledge creation. As well, SpiCE uses it as an initial base for knowledge crowds and communities to discover and develop into networks and clusters, connecting with people through weak and strong preference matches.

The Eclat Algorithm

The second component of the roset model for personalization is the integration of the Eclat algorithm. The Eclat algorithm was developed by Zaki, Parthasarathy, Ogihara, and Li in the late 1990’s [155]. Figure 3.22 provides a classic illustration of the Eclat algorithm [21, 88, 25]. The eclat algorithm works alongside CRSA to enable a deeper understanding of the associations between the people interacting within a community of practice and the things that make up its domain of interest (the spimes) [154, 88, 25]. Although CRSA does provide some insight into these associations through generated decision rules, CRSA may miss certain interesting characteristics that eclat discovers. These discoveries can aid in the the development, and evolution, of a digital habitat. Eclat is a data mining algorithm that is used for mining what are called frequent item sets, listings of associated values meeting a minimum support and confidence threshold. These thresholds are described in
Equations 3.5 and 3.6.

\[
\text{Support}(X \rightarrow Y) = P(X \cup Y)
\]  

(3.5)

\[
\text{Confidence}(X \rightarrow Y) = \frac{P(X \cup Y)}{P(X)}
\]  

(3.6)
The Eclat algorithm can be used to determine qualities of interestingness, meaning how is thing $X$ associated with thing $Y$ and to what degree (support and confidence) [21, 88]. An example of its use could include calculating the percentage that a decision criteria is used together with another, or when and item $X$ and $Y$ are purchased together. The Eclat algorithm is a depth-first tree algorithm that develops association rules, the set(s) of rules that could be used to describe relationships among data. To use the same data illustrated in Table 3.1, if there is a support threshold of 75%, meaning at least 75% of associations must be supported, it can be said that those products that have an EPA rating of 3 or greater also have mild or less skin irritation, an air pollution percentage of 3% or less, and use recyclable packaging with 100% confidence.

**Cautionary Note on Filter Bubbles**

Filter bubbles can be defined “as type of narrowed and focused stream of knowledge that can be the result of specialized and personalized interactions.” The roset model for personalization, and other personalization models, can help people focus, form networks, and build clusters. However, there is need to build mechanisms to avoid filter bubbling which is why SpiCE only supports personalization as an initial guide for interaction with spimes. With a personalized display, by design, roset also encourages accessibility to unfiltered data, information, and knowledge creating capability. This idea is reinforced in the guiding principles of SpiCE, the freedom to collect, capture, and share unfiltered and unbiased structured data.

### 3.2.5 Initializing a Digital Habitat using Createx

SpiCE introduces createx to describe the creation and extension of knowledge within a digital habitat. In designing a digital habitat using createx, the digital habitat’s
tools and platforms are built as, or adapted from existing, Free Libre Open Source Softwares (FLOSS). By its nature, anyone can contribute to FLOSS, or evolve it for their or their community’s need. Specifically, SpiCE promotes the use of the Drupal 21 content management system (CMS).

Drupal is a variant of FLOSS. Key benefits of Drupal (version 7) are its extendability and its compliance of open semantic web standards. Supporting a crowdsourced approach to its design, developers and users from all around the globe contribute to its base functionality as well as contribute extensions to its core functionality, called modules. By design, Drupal supports raw/linked data through its integration with the resource description framework (RDF) [28] 22 23 Various modules can help support integration of the technological solutions that SpiCE proposes as well as help enable unique process that guide the editing, refinement, and extension to community contributed spimes.

Createx also describes the features and practices for learning and knowledge creation within a digital habitat. Createx facilitates evaluation of spime-based content by enabling people to evaluate life-cycle assessments to obtain a deeper understanding of the things they are exploring. Createx also enables people to specify their needs and desires if, through exploration, gaps in available data, information, or products are realized. A useful outcome of this is the identification of needs and desires that are currently unavailable, gaps which can lead to new opportunities and innovation. For example, if a certain item, such as locally produced beer or free range hogs, are desired but not currently available in the current marketplace.

21Drupal CMS, online: http://drupal.org/ (accessed March 2013)
3.3 Process Within a System Using SpiCE

SpiCE introduces three fundamental processes for learning and knowledge creation, as illustrated in Figure 3.23. Briefly, SpiCE introduces the process of *cyean wrangling* (pronounced, *kee-ean wrangling*), *TriM evaluation*, and *trust metrics*.
3.3.1 Cyean Wrangling

Cyean wrangling is a hybrid approach to spime wrangling that integrates Snowden’s cynefin framework with an existing improvement methodology called lean manufacturing. Cyean wrangling helps guide learning and knowledge creation by guiding exploration of data and information, and structuring the knowledge and the documentation that is created as a result of the exploration and learning activity.

The idea of spime wrangling is used to help guide exploration data and information. Spime wrangling directly correlates to activities in KM, being in the exploration of data and information, and information to knowledge. Sterling states,

A true spime creates spime wranglers. Wranglers are the class of people willing to hassle with spimes. And it is a hassle. An enormous hassle. But its a fruitful hassle. It is the work of progress. Handled correctly, it can undo the harm of the past and enhance what is to come [140]

For example, a spime wrangler exploring the data and information of a cellular phone, might find out about the date of its manufacture, the material(s) used in construction of its display, and the quantity of megapixel provided by its embedded camera, how to turn the device on, how to make a phone call, etc. This data and information can form knowledge about how to use the phone, what materials were used in its construction, and whether materials used in its construction can be recycled or used for future re-manufacture.

To help structure spime wrangling activities, cyean wrangling integrates Snowden’s cynefin framework [136] with ideas from lean manufacturing [109]. Lean manufacturing, or simply “lean”, is a methodology based on the Toyota Production System developed by Ohno [109]. Lean focuses on the idea of waste elimination, providing a set of practices for demand-centric environments that produce “just-in-time” products while generating zero waste in terms of time, effort, and product [153]. One of
the foundations of lean is the idea of *kaizen*, loosely translated from Japanese to English as “change for the better” [73]. Of the practices lean and kaizen provide, SpiCE integrates the *5S system* with cynefin to aid people in the spime wrangling process. The 5S System (or simply “5s”) is a set of practices that can provide a foundation for experiential and reflective evaluation, namely [26],

1. Sort, to broadly categorize
2. Set in order, to formally categorize based on utility or importance
3. Shine, to emphasize usability
4. Standardize, to ensure consistency
5. Sustain, to provide quality assurance

The result is illustrated in Figure 3.24. As cyean wrangling occurs, the spime of an object can reside in any domain and also be moved into any other while 5S is conducted. A spime may be already known to a community, meaning the knowledge may already exist in one of the four domains. For example, knowledge documentation for how to turn a cellular phone may exist in the simple domain. A spime may also be completely unknown, and may begin in the chaotic domain. Cyean wrangling is initialized by moving a spime into the domain of disorder, using 5S to enable learning and knowledge creation as the spime of an object travels throughout the various domains and learning and documentation occur.

### 3.3.2 Ethical Decision Support Using TriM Evaluation

TriM evaluation is a hybrid ethical decision support measure that integrates McDonough and Braungart’s Triple Top Line model for sustainable development [92]
Figure 3.24: Cyean wrangling, the integration of Lean 5S (sort, set in order, shine, standardize, and sustain) with Snowden’s Cynefin Framework.

and Mepham’s ethical matrix [97]. SpiCE’s fundamental process that binds KM activity and promotes sustainability is ethical decision making and evaluation. The theory of ethics can help to describe the degree of moral action and associated consequences for a particular decision activity [68]. For example, a popular theory of ethics is the Hunt-Vitell model which characterizes ethical decision making as having: [68]

- A cultural environment, as based on a culture’s religious, legal, and political systems
- A professional, industrial, and organizational environment, as based on norms
and codes of conduct, values and rules of moral behaviour

- A personal environment, as based on an individual's personal religious beliefs, values, general beliefs, morality, and sensitivity

One of the guidelines from which a person may manage ethical decision activities could include the ethical and moral codes that they self impose when conducting decision activities. In this self imposing interaction, a moral spectrum or loose boundaries based on norms and codes as in the Hunt-Vitell model, may be constructed to help a person realize and weigh alternatives. In constructing a moral spectrum, the difficulty for any one person includes the differentiation between environments. Questions that an individual may ask might include:

- How does this situational feature impact my moral code?
- Does this course of action fall within my moral boundary?
- What are the consequences for this action?
- What are the alternatives?

Answers to these questions may be complex. As a knowledge culture debates and discusses these characteristics, internally and externally, an ethical foundation can help the culture form a better understanding of what truly can be defined as sustainable [11].

An example of a digital habitat that supports ethical decision-making is Knowmore.org. Knowmore.org’s homepage is illustrated in Figure 3.25. 24 Founded by Bernard Dolan (B. Dolan) and Sage Francis in the mid-2000’s, Knowmore.org’s motto is “question your goods, vote with your wallet.” The primary goal of Knowmore.org

Figure 3.25: Knowmore.org homepage (accessed January 2013).
is to empower ethical consumerism, raising consumer awareness of abuses done by corporations as evaluated using five attributes [78],

1. Worker’s rights abuses, which can help to raise awareness of employee rights, such as inhumane working conditions, inexpensive labour practices, long working hours, sweatshop conditions, lack of labour laws, children labourers (under the age of 14), employee equal rights and compensation, access to health care, union development (if workers’ desire), and job safety

2. Human rights abuses, which can help to raise awareness of the impact company practices have on society, such as Monsanto’s alleged controlling via terminator seeds and potential monopoly of the modern agricultural landscape

3. Environmental concerns, which can help to raise awareness of the impacts corporations have on the environment, such as air and water pollution

4. Political influence, which can help to raise awareness of corporations (and politicians) that coerce the political system by, for example, devising contribution schemes to influence election outcome

5. Business ethics, which can help to raise awareness of corrupt business practices, such as corporations that price-fix, conduct insider trading, bribery, or advertise falsely

Knowmore aids people by empowering them to investigate corporate ethical practices. Utilizing a crowdsourcing approach to KM, registered members of the Knowmore.org community are also empowered to contribute their knowledge. Corporations receive ethical scores, represented as text and corresponding coloured icons that

Figure 3.26: A&P’s (The Great Atlantic & Pacific Tea Company, Inc.) Knowmore.org page (accessed January 2013).
include praise (green), neutral/lack of information (yellow), and criticism (red). Illustrated in Figure 3.26 is the Knowmore.org page for the American supermarket A&P (The Great Atlantic & Pacific Tea Company, Inc.). Although the general metrics are clearly stated, the rationale for ethical criticism, neutral, or praise, that a company receives is not clear. For example, it is unclear what truly distinguishes a neutral rating over a praise rating. SpiCE’s TriM evaluation uses Mepham’s ethical matrix to guide ethical judgments. Mepham’s ethical matrix encompasses both consequentialist and deontological ethical philosophies as derived from normative ethics and has three essential criteria, namely [97, 143, 72, 64],

- An agent who represents the person involved in a decision opportunity
- An action that represents the actual course of action taken by the person
- A consequence, or consequences that represent the degree of morality on a person’s moral spectrum as a result of undergoing a given act

Both consequentialism and dentology provide a general framework for ethical behaviour [143]. Consequentialism deals specifically with deriving an acceptable, or right choice from an agent-neutral good [115]. In other words, if an act is perceived as morally good by most people, it is to say that this action is high on a moral spectrum. In consequentialism, it is the result, hence, the consequence of the act that is evaluated on the moral spectrum. In deontological ethics, it is the act itself that is first evaluated, before consequences.

Mepham’s ethical matrix is comprised of three attributes that guide ethical evaluation. These are [97]:

- Well-being, which represents the consequences that maximize respect for an agent
CHAPTE 3. SPICE & ITS FOUNDATIONS

<table>
<thead>
<tr>
<th>Respect for</th>
<th>Well-Being</th>
<th>Autonomy</th>
<th>Fairness</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Agent #1</strong></td>
<td>How to maximally (ethically) increase the well-being for this agent</td>
<td>How to maximally (ethically) increase the autonomy (self-governance) for this agent</td>
<td>How are well-being and autonomy maximally (ethically) increased for this agent</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
<tr>
<td><strong>Agent #n</strong></td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

Table 3.2: General illustration of Mepham’s ethical matrix.

- Autonomy, which represents the actions that maximize well-being or consequences of fairness

- Fairness, which represents the actions that maximize autonomy

The fundamental idea of Mepham’s ethical matrix is that each attribute is evaluated using a designed scoring system. Agents, or stakeholders are identified. Based on each agent’s characteristics, ideas are generated that align with each of Mepham’s ethically-based attributes. Ratings are devised that provide a detailed indication of how well described activities, actions, or consequences align with high moral respect or standards. This is visualized in a matrix, as illustrated in Table 3.2.

SpiCE’s TriM evaluation also integrates McDonough and Braungart’s Triple Top Line model for sustainable development. The triple top line for sustainable development builds on the idea of the triple bottom line for sustainable development as discussed previously [92, 94]. Rather than maximizing the environmental attributes of profit, people, and planet in isolation, the triple top line maximizes these attributes in union. Meaning that optimal sustainability is reached when the data and information comprising the three environmental attributes are visually placed in the centre of the triple top line model, illustrated in Figure 3.27.
Figure 3.27: Illustration of the triple top line model (adapted from McDonough [93]). Optimal sustainability is reached when the data and information comprising the three environmental attributes are visually placed in the centre of the triple top line model.
SpiCE uses TriM evaluation to integrate an evaluative model for ethics and sustainability. The result is the *TriM evaluation matrix*, illustrated in Table 3.3. The TriM evaluation matrix helps to rationalize ethical choice using the three characteristics of a Mepham ethical matrix in union with triple top line ideals. It is argued that in utilizing TriM evaluation, a knowledge culture can be provided with a higher quality, trust, and transparency of spimes which can result in higher quality, trust, and transparency for KM. A culture is able to address sustainability by making deeper connections between decision action(s) and consequence(s). For example, if a producer receives a living wage, how does this relate to social, economic, environmental implications?

The indented use of a TriM evaluation matrix is to collect all data and information that encompass social, environmental, and economic associations and derive their ethicalness. Some overlap may exist. An survey-type evaluative process could be completed, assigning a value to each evaluated item according to its placement on a moral spectrum. The average summation of these values may then form a general scoring. The goal is to provide a knowledge culture with a quick, accessible way to evaluate decisions, where they are succeeding, and where they can improve.

### 3.3.3 Sustainable Happiness and Trust Metrics

In using SpiCE and its integrated processes of cyean wrangling and TriM evaluation, learning and knowledge creation are guided by the idea of *sustainable happiness*. O’Brien defines sustainable happiness as “the pursuit of happiness that does not exploit other people, the environment, or future generations [107]. The idea of sustainable happiness was developed to emphasize the positive impacts that certain actions have and how they align with immediate and long-term consequences as they relate in the pursuit of happiness and sustainability. This philosophy is closely tied with the idea of ethical decision making and evaluation. With TriM evaluation, an
<table>
<thead>
<tr>
<th>Respect for</th>
<th>{Well-Being, Autonomy, or Fairness}</th>
<th>Triple top line</th>
<th>Possible evaluative attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agent #1</td>
<td>Maximizing feature for Well-Being, Autonomy, or Fairness</td>
<td>Social</td>
<td>Socially-influenced attribute, such as living wage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Environmental</td>
<td>Environmentally-influenced attribute, such as pesticide free</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Economic</td>
<td>Economically-influenced attribute, such as price</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>Social</td>
<td>...</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Environmental</td>
<td>...</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Economic</td>
<td>...</td>
</tr>
<tr>
<td>Agent #n</td>
<td>...</td>
<td>Social</td>
<td>...</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Environmental</td>
<td>...</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Economic</td>
<td>...</td>
</tr>
</tbody>
</table>

Table 3.3: TriM filtering matrix.
optimal measure or score is one that provides a balance to all characteristics, social, environmental, economic well-being, autonomy, and fairness. These metrics and their evaluative outcomes are central to the idea of sustainable happiness [107].

In the process of cyean wrangling, sustainable happiness helps to frame learning and knowledge creation by emphasizing positive ethical actions and their corresponding consequences. Often sustainability narratives focus on the impacts of negative action and consequence. For instance, the Knowmore website, previously discussed, often emphasized negative knowledge regarding worker’s rights, human rights, environmental, political, and business abuses. Current research by O’Brien [107, 108] and others [146, 128, 5] have noted that the focus on negative, “doom and gloom” knowledge can have a numbing effect which can often have detrimental effects on sustainable development. Numbing can impact the emotional well-being of an individual or culture, and can have a reverse effect on positive change, leading to a lack of caring and inaction [128]. Chesterson states, “It is easy to be heavy, hard to be light” [124]. Thus, in re-focusing decision-making and evaluation toward positivity, an ethical and sustainable action and consequence may arguably be more rewarding in its selection, the idea of being light as more difficult yet more rewarding than being heavy [123].

To aid in positive evaluative measure and knowledge creation, SpiCE introduces a feature called trust metrics, largely influenced by the idea of sustainable happiness, numbing, and Socrates’s triple filter test as illustrated in the narrative in Table 3.4. Through trust metrics, SpiCE can enable people to assess and emphasize positive knowledge contributions within a digital habitat. Trust metrics is comprised of the characteristics that make up Socrates’s triple filter test, modified slightly as truthfulness, usefulness, and ethical goodness. Ethical goodness is emphasized, rather than just “good” since the nature of the term “good” can be ambiguous. For example, something “bad” might be good to know, such as a company that doesn’t pay their employees a standard minimum wage. Knowledge contributions are ranked in
In ancient Greece, the philosopher Socrates, who held knowledge in the highest esteem, was asked by a man he met that day: “Do you know what I just heard about your friend?”

Socrates replied: “Before you tell me, I would like you to pass a test. It is called the Triple Filter Test. I would like you to pass what you are going to tell me through three filters. The first filter is truth. Have you made absolutely certain that what you are about to tell me is true?”

His acquaintance responded with: “No, actually I had just heard about it and...”

Socrates replied: “As you do not really know if it is true or not, let us apply the second filter. Is what you are about to tell me about my friend something good?”

His acquaintance replied with: “No, quite the contrary...”

Socrates replied: “I see. You want to tell me something bad about him, even though you are not certain it is true? You may still pass the test because there is one last filter. Is what you want to tell me about my friend useful?”

His acquaintance responded with: “No, not really”

Socrates replied: “Well, if what you wish to tell me is neither true nor good nor even useful, why then tell it to me at all?”

Table 3.4: Socrates’s triple filter test. Adapted from Baron [8].
a system using SpiCE’s trust metrics through features supporting survey rankings. Thus, participants within a knowledge culture rate contributed knowledge as being,

- Truthful
- Useful
- Truthful and useful
- Not truthful
- Not useful
- Not truthful and not useful

Some combinations are purposefully left out of the trust metrics options to aid in providing clarity for evaluative action. For example, the combination “truthful” and “not useful” is omitted, as is the combination “not truthful” and “useful” as the true value of these combinations may be ambiguous.

3.4 Summary

This Chapter described SpiCE, an integrative framework for KM that can be used to initialize development of a knowledge culture. The theme of sustainability is used to describe both a structure for knowledge culture development, and an end result of the knowledge culture’s practice and purpose. In proposing a structure for knowledge culture development, SpiCE proposes a balanced approach of people, technology, and process. The knowledge created within this balanced approach can be used to create and evolve knowledge about sustainable practice (positive cultural growth).

In relation to people, SpiCE proposes development of a culture of participation. A culture of participation can describe a prosumer (consumer + producer),
crowdsourced approach to learning and knowledge creation as underlined by the four guiding principles of SpiCE. In relation to technology, SpiCE proposes development of Free/Libre Open Source Software communities of practice as a decision support system-based digital habitat composed of spime-based knowledge creation for sustainable change. SpiCE integrates the feature of personalization by introducing roset to provide initial evaluative focus for community building and exploration, as well as the feature createx to guide knowledge culture interaction, exploration, and discovery of new opportunities and innovations. Finally, in relation to process, SpiCE proposes creating, editing, and expanding techniques using ethical knowledge enabling spimes through cyean wrangling, TriM evaluation, and trust metrics. Through these processes, technologies, and people interactions, SpiCE provides a blueprint for a sustainable knowledge culture. In the following Chapter, an illustrative example of a system using SpiCE called Egg SpiCE will be described.
Chapter 4

Food Knowledge and SpiCE

This Chapter describes a specific knowledge culture that is formed using SpiCE that focuses on developing KM for food, specifically chicken eggs. The example knowledge culture that is developed is called Egg SpiCE. Egg SpiCE will illustrate how SpiCE can provide a balance of people, process, and technology for KM regarding the consumption and production of chicken eggs. This Chapter will begin by discussing the idea of food sustainability. As part of this discussion, this Chapter will also include a description of a research study that was conducted using Egg SpiCE. A detailed overview of the Egg SpiCE system is provided, as well as a discussion regarding preliminary user interactions.

4.1 Food, Sustainability, and Knowledge Management

Over the last several years, the idea of sustainable production and consumption of food has had increasing interest [55, 114, 100, 156, 75, 9, 127]. People, as consumers and producers, have a significant role to play. Nocella and Kennedy, for instance,
discuss how knowledge created through legislation can positively aid consumers in making healthier and more sustainable food selections [100]. Uribe et al. emphasize knowledge as enabling more healthy and sustainable eating habits through consumer and producer interaction within Community Supported Agricultural (CSA) practices. Their research illustrates the positive knowledge creating benefits CSA programs can have, including an increased knowledge of sustainable farm practices as well as knowledge of seasonal and sustainable healthy food options [145]. Barreiro-Hurle et al. discuss how food labelling impacts consumer knowledge and choice [9]. Similarly, Goodman et al. discuss food labelling and other knowledge creating trends for consumer food selection [55]. These works are just a sampling of current interest and research. A key thematic area of focus throughout each, however, is the idea of developing a sustainable food-oriented knowledge culture. As in the discussion on sustainable happiness in the preceding Chapter, another theme in these examples is an emphasis on how to positively build and evolve food knowledge for sustainable adaptation and change.

### 4.2 Configuring SpiCE for Food Knowledge Management

Any KM effort that uses SpiCE requires an initial planning and configuration phase to map a knowledge culture’s unique characteristics. In this configuration phase, a TriM evaluation matrix is first developed. The author provided the initial configuration of the TriM evaluation matrix, which was created through the aid of a narrative inquiry analysis as will be discussed later. Narrative inquiry is a form of storytelling for assisting a narrator define who they are and what they are experiencing from their unique perspective [27]. In building a TriM evaluation matrix using SpiCE, the
individual or group leading development can build the initial configuration of the TriM matrix. If possible, those leading development can use narrative inquiry to base this initial configuration. For example, as it relates to food KM, they might pose a question to interested participants regarding “what types of food do they consider to be the healthiest?” Based on resulting discussions, key data and information may result to help guide the initial TriM configuration accordingly.

For the TriM configuration that was developed, it is important to emphasize that the characteristics defined in this example are not meant to be all inclusive. This is to emphasize that, in using SpiCE, any knowledge culture will have this initial configuration phase. As mentioned, the configuration phase will typically be completed by those leading or initializing the knowledge culture, where narrative inquiry is one of many useful techniques that may aid in providing a deeper understanding of a knowledge culture. It is important to note that the composition of a TriM evaluation matrix will evolve with a knowledge culture as the knowledge crowd and community interacts over time.

4.2.1 Configuring TriM Evaluation for Food

The first phase in configuring a TriM evaluation matrix for food is to develop a version of a Mepham’s ethical matrix. As with any Mepham ethical matrix, agents, actions, and consequences are identified as are the initial characteristics that describe their ethicalness, or their degree of respect for the specified agent. For the example described here, five agents and their ethicalness are initially represented:

- Producers
- Consumers
- Animals
Table 4.1: A Mepham ethical matrix for food evaluation as developed by the author.

<table>
<thead>
<tr>
<th>Respect for</th>
<th>Well-Being</th>
<th>Autonomy</th>
<th>Fairness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Producers</td>
<td>Income &amp; working conditions</td>
<td>Freedom of action</td>
<td>Fair trade laws and practice</td>
</tr>
<tr>
<td>Consumers</td>
<td>Food safety &amp; quality</td>
<td>Informed choice</td>
<td>Affordable food</td>
</tr>
<tr>
<td>Animals</td>
<td>Animal welfare</td>
<td>Behavioural freedom</td>
<td>Quality of life</td>
</tr>
<tr>
<td>Plants</td>
<td>Conservation</td>
<td>Maintenance of biodiversity</td>
<td>Seasonality &amp; natural (typical) growing conditions</td>
</tr>
<tr>
<td>Land</td>
<td>Conservation</td>
<td>Maintenance of landscape diversity</td>
<td>Natural landscape maintenance</td>
</tr>
</tbody>
</table>

Table 4.1 illustrates the result of the developed Mepham ethical matrix.

As illustrated in the Mepham ethical matrix for food in Table 4.1, the represented agents may not automatically lend themselves to the adaptation of ethical evaluation. Three of the five agents are non-human. It is argued that in attaching human characteristics to non-human agents that it may increase or enhance the agent’s perceived respect in the evaluative process. This idea was inspired by a project that the author was involved in called sharing productive capital (SPC) [85].

The SPC project was guided by philosophy praxis for sustainability by associating human qualities and rights to manufactured capital, such as a hammer, lawnmower, post hole digger. The SPC project worked with a group of people living in the town of Craik, Saskatchewan, specifically with a group of people associated with the Craik Sustainable Living Project. Craik is a rural prairie community located in the

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1Craik Sustainable Living Project. Online: [http://www.craikecovillage.com/](http://www.craikecovillage.com/) (accessed April...
south-central area of the Canadian province. The project initially set out to design a digital habitat in the form of an online repository to manage the townspeople’s manufactured goods. By attaching human characteristics to manufactured goods they are personified and are provided with similar rights and freedoms to that of people. For example, a snow blower would have a place of residence, a schedule guiding daily activities, and require routine check-ups to ensure quality of health. The snow blower could indicate a willingness to provide services to other people residing in the town through a shared community calendar. The snow blower could also indicate when a health check (maintenance) is needed when “part of its being” needs repair. The goal of the SPC project was to explore how this change in perspective could increase awareness in supporting the community’s efforts in achieving sustainability. It was hypothesized that a community that not only more effectively reduces, reuses, and recycles, but also rethinks and (re)imagines how to best integrate sustainable practices and higher ethical thought and behaviours, that a community is strengthened and more empowered to do good. This project is still in-progress (as of January 2015).

By evaluating the agents representative of food within a Mepham ethical matrix, as was hypothesized in the SPC project, people may be provided with a much richer perspective of sustainable decisions, judgments, and actions. Much of what comprises food information today comes in the form of labeling, certification, policy, or some alternative channel outside the regulatory framework. Trust, in those providing the information, and the governments that monitor them, can play an essential role. For example, trust has arguably declined in government food inspection agencies that once provided assurance to people. People, when left on their own, can rely on themselves to research all available data and information, form judgments, and action. However, the likelihood of becoming overloaded with data and information is high. People can

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also rely on other people directly, such as seeking out the producers of foods they are interested in purchasing. Although this can be rewarding, an increased effort and visibility on both consumers and producers is needed to be truly successful.

The second phase in configuring a TriM evaluation matrix for food using SpiCE is to use the process of syntactic wrangling to explore initial food characteristics as they relate to the Mcdonough and Braungart’s triple top line model. The triple top line model can provide a sound foundation for the categorization of food information. However, complexities can still exist. For example, it may be hard to truly map where a given characteristic fits within the model, e.g. is the cost of food associated with economic or social characteristics? Another difficulty is the transparent understanding as to why a certain mapping is proposed. To help in defining a TriM evaluation matrix for food, the concept of sustainable, organic, local, and ethical (SOLE) food can be used. For example, the ideas of organic food and environmental sustainability can be seen as interconnected, and thus, mapped in union. In evaluating food in terms of SOLE, a knowledge culture for food is more able to:

- Realize local impacts of food selections
- Foster heightened relationships between people and food
- Foster community between people, land, and food
- Reconnect people with local food systems, through these comparative mappings

A question one might consider could be why not simply use SOLE to frame an evaluation? In evaluating food just from the perspective of SOLE food, there may still exist complexities in KM, such as what might be SOLE food for one person or group may not be for another. An example can include when defining what is to be considered local food. Although certain foods may be produced sustainably, organically, and ethically there may exist more SOLE-ful selections depending on
where a person or group is situated. What this indicates is the potential need for varying diets in those different locations. Local can be viewed at different scales under different circumstances as it relates to the triple top line. What is seen as local at any particular moment may depend on geography, history, climate, and so on. Further, the reason people value the notion of local may be different. Some people may see it as inherently more sustainable, while others may act in the spirit of defensive localism, where those who place high value on the idea of protecting their home region is paramount [151]. In using SpiCE for development of a knowledge culture for food, SOLE food characteristics are explored concurrently with triple top line and Mepham matrix characteristics using cyean wrangling. The primary practice of food evaluation begins in the sub-domain of disorder and moves throughout complex, complicated, and simple domains. As sorting, setting in order, and shining of food characteristics takes place using 5S practice and moving within the cynefin habitat space, categorical mappings between SOLE food and triple top line model characteristics can be developed resulting in an instance of a TriM evaluation matrix.

For example, consider, within the scope of the above description, the SOLE food attribute “affordable food” from the perspective of the consumer agent. Through lean 5S, affordable food can be mapped to the economic category as it relates to the price of food. It may also map to the social category as it relates to the availability of quality affordable food. As a cyean wrangler senses, categorizes, analyzes, and responds, this rationalized and transparent mapping is standardized, providing the initial evaluative characteristics comprising a TriM evaluative matrix. An instance of a TriM evaluation matrix for food, as a result of cyean wrangling done by the author, is illustrated in Tables 4.2, 4.3, and 4.4.

As illustrated in the Tables 4.2, 4.3, and 4.4, cyean-wrangled characteristics may span, or cross-cut the other attributes of the model. For instance, the SOLE food characteristic of locality could correspond to the environmental categorization, because
<table>
<thead>
<tr>
<th>Respect for</th>
<th>Well-Being</th>
<th>Triple top line</th>
<th>Possible SOLE-food attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Producers</td>
<td>Income &amp; working conditions</td>
<td>Economy</td>
<td>- Salary</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Farming expenses</td>
</tr>
<tr>
<td>Consumers</td>
<td>Food safety &amp; quality</td>
<td>Social</td>
<td>- Quality nutrition</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Health guides</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Quality indicators</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Emotional factors (brand, appearance)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Product packaging</td>
</tr>
<tr>
<td>Animals</td>
<td>Animal welfare</td>
<td>Environmental</td>
<td>- Free range</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Maximal grazing space</td>
</tr>
<tr>
<td>Plants</td>
<td>Conservation</td>
<td>Environmental</td>
<td>- Adherence to natural (typical) growing conditions</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Organics</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Pesticide free</td>
</tr>
<tr>
<td>Land</td>
<td>Conservation</td>
<td>Environmental</td>
<td>- Adherence to natural (typical) land use</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Pesticide free</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Transportation type</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Food miles</td>
</tr>
</tbody>
</table>

Table 4.2: Possible SOLE-food attributes as categorized under well-being in Mepham’s ethical matrix.
<table>
<thead>
<tr>
<th>Respect for</th>
<th>Autonomy</th>
<th>Triple top line</th>
<th>Possible SOLE-food attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Producers</td>
<td>Freedom of action</td>
<td>Social</td>
<td>- Use of preferred (SOLE-ful) farming practices</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Development of a cooperative regulatory system</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Economic</td>
<td>- Government initiatives &amp; funding</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- External funding opportunities</td>
</tr>
<tr>
<td>Consumers</td>
<td>Informed choice</td>
<td>Social</td>
<td>- Available truthful &amp; useful information</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Economic</td>
<td>- Available truthful &amp; useful information</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Environmental</td>
<td>- Available truthful &amp; useful information</td>
</tr>
<tr>
<td>Animals</td>
<td>Behavioural freedom</td>
<td>Social</td>
<td>- Consideration of typical (natural) feed</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Free range</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Maximal grazing space</td>
</tr>
<tr>
<td>Plants</td>
<td>Maintenance of biodiversity</td>
<td>Environmental</td>
<td>- Consideration of preferred (typical) climate growing conditions</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Pesticide free</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Organics</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Seasonal</td>
</tr>
<tr>
<td>Land</td>
<td>Maintenance of landscape diversity</td>
<td>Environmental</td>
<td>- Consideration of preferred (typical) land use</td>
</tr>
</tbody>
</table>

Table 4.3: Possible SOLE-food attributes as categorized under autonomy in Mepham’s ethical matrix.
Table 4.4: Possible SOLE-food attributes as categorized under fairness in Mepham’s ethical matrix.

<table>
<thead>
<tr>
<th>Respect for</th>
<th>Fairness</th>
<th>Triple top line</th>
<th>Possible SOLE-food attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Producers</td>
<td>Fair trade laws &amp; practice</td>
<td>Social</td>
<td>- Fair laws of farming production</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Incentives for hiring labourers</td>
</tr>
<tr>
<td>Consumers</td>
<td>Affordable food</td>
<td>Economic</td>
<td>- Price</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Consideration of class impacts</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Availability of quality food selections</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Food miles</td>
</tr>
<tr>
<td>Animals</td>
<td>Quality of life</td>
<td>Social</td>
<td>- Consideration of natural animal life span</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Free range</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Maximal grazing space</td>
</tr>
<tr>
<td>Plants</td>
<td>Seasonality &amp; natural (typical) growing conditions</td>
<td>Social</td>
<td>- Consideration of preferred (typical) climate growing conditions</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Organics</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Pesticide free</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Seasonal</td>
</tr>
<tr>
<td>Land</td>
<td>Natural landscape maintenance</td>
<td>Social</td>
<td>- Consideration of preferred (typical) land use</td>
</tr>
</tbody>
</table>
knowledge regarding the distances that food travels from producer or manufacturer to a consumer’s plate can be considered. As well, locality could also correspond to the economic categorization, because certain foods may provide a region with greater economic wealth through imports and exports. Furthermore, locality can also correspond to the social categorization, because job creation may be impacted. TriM evaluation uses the triple top line model as a catalyst for learning and knowledge creation. The goal being to empower people to develop a more well-rounded understanding regarding the relationship between sustainability and food. For all available food attributes, as guided and organized by the three distinguishing characteristics of the triple top line model, people can be provided with a useful mental mapping representative of the degree in which a given food selection is truly sustainable. This organization can help guide decision-making activity, enabling a focus of efforts that can positively lead toward sustainable food selections. This may impact perceived effectiveness, the idea that in being pro-active, praxis can occur and lead to an increased chance of sustainable results [77, 45, 2].

4.2.2 Research Study: A Focus on Eggs

Eggs are used to help illustrate the potential usefulness of SpiCE for development of food KM. The rationale for focusing on eggs specifically was a result of the perceived richness of egg data, information, and knowledge. A person might argue that “an egg is just an egg” and that there are no meaningful distinctions to be made between different egg suppliers. However, in initiating the processes that SpiCE provides, a person can become aware of much more. For example, a person may find out about specific egg producers that practice battery cage egg production. As well, a person may better be equipped to understand the local economic impact of selecting one brand or producer over alternatives. Furthermore, a person may learn how some producers provide more of a living wage to their workers. An egg may no longer be
just an egg.

In support of this research, twenty-one participants from Regina, Saskatchewan were recruited to participate in a qualitative narrative activity as well as a quantitative questionnaire. The majority of the participants were female (90 percent), the majority of which were teachers by profession (33 percent). Participant age varied between twenty-five and greater than sixty-six. The majority of participants had completed post-secondary education (86 percent). The average income of participants ranged from one-thousand dollars per month to greater than four-thousand dollars per month. The number of people in participant households varied from: one (19 percent), two-to-three (67 percent), to greater than four (14 percent). All participants indicated that they were the primary purchaser of food for their households. The degree of which participants indicated they shop for food varied from daily to bi-weekly, majority of which shopped weekly (48 percent). The majority of participants preferred to shop at a medium-to-large supermarket (67 percent), the majority spending between between fifty-one ($51.00) and one-hundred and fifty ($150.00) dollars (67 percent). All participants indicated they visit restaurants at least once per month. Finally, a small majority of participants spent on average zero ($0.00) to fifty ($50.00) dollars per month on entertainment (52 percent), the rest spend greater than fifty ($50.00) per month.

A fundamental goal of the questionnaire was to gather data and information about eggs for the configuration of Egg SpiCE. The technique of narrative inquiry was used to build an understanding of typical egg purchasing behaviors [27]. Snowden states, “...We always know more than we can say, we will always say more than we can write down[...]We live in a narrative flow that defines what we think, who we are.”

assisting a narrator define who they are and what they are experiencing from their unique perspective [27]. Building on the importance of the narrative form, Snowden describes the idea of *messy coherence* to define, in part, the significance of impartial connections which are made visible in the telling of a narrative. The metaphor of a spider’s web after a rain storm can help describe this idea, a web being partially constructed/damaged, however still arguably usable and useful for its (re)framing.

The purpose for selecting and conducting narrative inquiry was to form a high level understanding how people evaluate and purchase eggs. In Snowden’s quote he states that “we always know more than we can say, we will always say more than we can write down.” This statement highlights the importance of narrative to, however partially, frame a situation. Narratives can provide an increased understanding of a specific experience, emphasized from a narrative’s ability to highlight situational interactions, habits, reflections, and practices of critical consciousness. In the study conducted, the narrative discussions between the author and participants provided an increased awareness of the choice-forming experiences and habits when it came to egg purchasing and consuming habits and reflections. To help guide narrative inquiry, the following script was used:

1. What influences you when purchasing food (in general, grocery or restaurant)?

2. Thinking about the last time you purchased eggs, what do you remember or recall that guided (or influenced) your choice?

3. What egg attributes did you consider (price, organic, free range, etc.), and why?

4. What store/market did you purchase the eggs at? - How did (does) this influence your choice?

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5. Did others play a role in the eggs you purchased, i.e. kids, parents, etc. with unique eating requirements?

6. If there is one (or more) thing(s) you would say about the eggs you last purchased, what would it be?

7. Thinking about all of the times you have purchased eggs, what are the things that stick out?

8. If there is one (or more) thing(s) you would say about the eggs you generally purchase, what would it be?

As each participant’s narrative was provided to the author, an intensity of critical consciousness was experienced as participants begin to think back, review, and question their actions. Snowden further states that “the narratives of [a person’s] family inherit from [their] workgroup, from [their] society [...] Stories and metaphors are part of [a person’s] day to day discourse.” ⁵ This statement emphasizes the capability of narratives to bring forth a heightened understanding of pattern-based habits and experiences. Although the script questions provided the foundation for discussion, often participants expanded on them, departing from the general theme and even asking questions of their own. In this interactive activity, both the researcher and the participant became active learners. As participants provided their narratives, they evolved through reflection and emerging patterns. Narratives provided were used to guide design of the initial configuration of Egg SpiCE. The following illustrates examples of a kinds of narratives that resulted.

(Sample participant #1) I am primarily influenced by the type of food and ethical behaviours of the producers. I am vegetarian and when shopping

---

at a grocery store I make sure all my selections are organic. The last time I purchased eggs I was primarily influenced by the fact that they were locally produced eggs, free run. Price and taste does not matter to me. I primarily eat eggs for the protein. I purchased these eggs from Nature’s Best (a local shop in Regina, Saskatchewan). I shop there for most of my food as it is close to my home. I live alone so most of my food purchases are made from my personal preferences. If there is one thing I would like to say about my eggs is the fact that I like the colour of the yolk, bright yellow.

(Sample participant #2) I am primarily influenced by the price. I have a large family so when it comes to eggs, quality and price play into my purchasing decisions. I purchase most of my eggs from Costco. It’s where I do the majority of my grocery shopping. I use eggs in a lot of baking and cooking. If there is one thing I would say about the eggs I buy is that they are all the same, generic. Now saying this, I wonder what that means that they all look the same. Is that a good thing?

(Sample participant #3) I am primarily influenced by the fact that I am vegetarian. I basically only purchase organic foods whenever possible. Price does not matter. Taste does matter. Although I do find that organic food has a better taste than non-organic. I shop all mostly at Extra Foods as it is close to my home. They have a great selection of organic food options. I buy mostly for myself and my boyfriend. The last eggs I bought were really tasty. Nice yellow yolks. I’m not sure the difference of white and brown eggs but I suspect it relates to the fact that they are organic?
4.2.3 From Narratives to Guided Reflection About Eggs

In building on the results from narrative inquiry, participants were also asked to complete an activity of critical reflection. The focus of the activity concerned both food and eggs, highlighting specific purchasing behaviours and practices, qualitative and quantitative. Participant responses provided additional data and information in for the configuration of Egg SpiCE.

Food, Health, Environment, and Ethics

When asking participants where they saw food as being on their list of life priorities, all indicated that the connection was important (76 percent indicated it as very important). When asking people if they viewed their food choices being connected to their quality of health, all responded that the connection between food and health is important (91 percent responded with very important).

When asking people if their food selections were a result of ethical considerations, such as factory farmed animals, a majority of participants responded that the connection is at least moderately important (72 percent, with 48 percent responding with important). The rationale provided by those participants who responded that the connection is moderately important or important included the idea that they felt they were being supportive of local and animal caring producers and manufacturers. The rationale provided by those participants who responded that the connection is not important indicated that they had a lack of available information or an unawareness of the significance of the connection.

As food choice related to environmental considerations, a majority of participants responded that the connection is important (72 percent). Many participants indicated the importance of understanding life-cycles of food production (food miles, packaging, pesticide-free) for both consumers and producers and manufacturers. Of those who
indicated the connection is not important (20 percent), no rationale was provided.

**Egg Data, Information, and Knowledge**

When asked whether there was enough information available about eggs, the majority (62 percent) said there was not and a small minority (15 percent) said they were unsure. Information that participants claimed is missing included ethical issues, visibility of data and information on egg cartons, information about the egg industry, and benefits about the health qualities of certain eggs, such as omega 3, organic, free range eggs, and egg shell colour and shape.

When participants were asked whether they had trust in manufacturer-provided information, roughly 50 percent responded with yes. The other 50 percent consisted of those participants who trusted only some manufacturer-provided information (as required under law, for example). Those who did not trust any manufacturer-provided information claimed that manufacturer-provided information is misleading.

When participants were asked whether they had trust in consumer-provided information, a minority responded yes (38 percent). The majority of participants said they might trust consumer-provided information the contributor identity is also provided so that they could map the contributor values, what sources they used, and understand the contributor’s personal shopping selections and preferences. A minority of participants indicated that they might have difficulty dealing with any biases that might result from consumer-provided information (24 percent).

This data provided the building blocks for the configuration of Egg SpiCE.

**Egg Preferences**

Participants were also asked to rate their preference of a larger sub-set of possible egg attributes. A frequency scale comprised of the values “not important”, “important”, and “critical” was utilized. An analysis of available egg items was conducted at
various egg selling stores in Regina, Saskatchewan. From this analysis a listing of attributes for rating was compiled. Attributes included:

- Price – Retail price point of an egg product
- Packaging – Reduced, recycled, recyclable
- Cost – Including the environmental, economic, and societal, such as food miles
- Taste – Personal, group, such as family
- Nutrition – Calories, added vitamins, amount of lutein, amount of sodium, amount of cholesterol, amount of DHA-Omega 3, low in fat
- Labelling – Canada Heart&Stroke Health Check(TM), ingredient usage, egg grade, eggs selected from young hens, amount of yolks
- Local – Canada, Saskatchewan (provincial), city or town
- Ethics – Behaviour of producers and manufacturers, treatment of hens, chicken feed, season, fair trade
- Organics – Global, national (Canada), local (Saskatchewan)

Participants were also asked to rank their top five attributes from those rated (in order of importance). The responses provided were compared with those given in the narrative analysis and used in the development of Egg SpiCE.

4.2.4 Configuring TriM Evaluation for Egg Representation

The results of analysis, along with the initial creation of the TriM evaluation for food described in the preceding sections, helped to develop an initial TriM evaluation matrix for eggs. A condensed TriM evaluation matrix is illustrated in Table 4.5. Note,
CHAPTER 4. FOOD KNOWLEDGE & SpiCE

the TriM evaluation matrix for eggs is condensed, combining the Mepham ethical matrix characteristics (well-being, autonomy, and fairness) with the characteristics of the triple top line (environmental, social, and economic sustainability), to simplify the illustrative example of Egg SpiCE.

4.2.5 Configuring Roset for Personalized Egg Evaluations

The first phase of roset is to use techniques within the classical rough set approach approach (CRSA). In conducting a pre-processing phase, traditional statistics (k-means) are used to cluster participants based on their stated preferences. As per the procedure, Hubert’s Γ statistic is used to determine the degree of match with respect to the number of appropriate clusters. As illustrated in Figure 4.1, a subjective selection from the author of three clusters was decided. The result of the clustering is illustrated in Figure 4.2.

Continuing with the next step in roset, CRSA techniques were evaluated using the Rough Set Exploration System (RSES) software. Utilizing the genetic algorithm functionality in RSES and a train and test procedure, the top ten reducts were calculated and evaluated. The reducts generated are illustrated in Table 4.6. A total classification accuracy (10-fold validation) of 85 percent, with a total coverage of 100 percent was achieved. The reduct selected for use in the Egg SpiCE configuration was comprised of only two of thirty-three attributes, “producer ethics” and “organic.” As was found, these two attributes were tested to be successful in accurately defining the preferences of 91 percent of participants based on their responses (91 percent accuracy with 100 percent coverage respectively). With the reduct selected, decision rules were generated which provided an indication of the important attribute preferences of people residing within each of the three clusters generated. From this result, a classification scheme for the networking or clustering of people based on attribute preferences was deemed possible.
<table>
<thead>
<tr>
<th>Agent</th>
<th>TriM egg characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Producers</td>
<td>- Provided adequate salary/compensation</td>
</tr>
<tr>
<td></td>
<td>- Management of farm expenses</td>
</tr>
<tr>
<td></td>
<td>- Access to funding</td>
</tr>
<tr>
<td></td>
<td>- Working conditions</td>
</tr>
<tr>
<td></td>
<td>- Follows laws of farm practice</td>
</tr>
<tr>
<td></td>
<td>- Provides hiring incentives</td>
</tr>
<tr>
<td></td>
<td>- SOLE-ful farming practice</td>
</tr>
<tr>
<td>Consumers</td>
<td>- Eggs are provided at a fair price</td>
</tr>
<tr>
<td></td>
<td>- Information about egg price is truthful and useful</td>
</tr>
<tr>
<td></td>
<td>- Accessibility of egg producer</td>
</tr>
<tr>
<td></td>
<td>- Quality of Eggs</td>
</tr>
<tr>
<td></td>
<td>- Availability of eggs</td>
</tr>
<tr>
<td></td>
<td>- Information about egg accessibility and quality is truthful and useful</td>
</tr>
<tr>
<td></td>
<td>- Packaging is reduced/environmentally friendly</td>
</tr>
<tr>
<td></td>
<td>- Information about egg packaging is truthful and useful</td>
</tr>
<tr>
<td>Animals</td>
<td>- Chickens live a natural life</td>
</tr>
<tr>
<td></td>
<td>- Chickens are provided natural feed</td>
</tr>
<tr>
<td></td>
<td>- Chickens are free range</td>
</tr>
<tr>
<td></td>
<td>- Chickens are provided excellent grazing space</td>
</tr>
<tr>
<td>Plants</td>
<td>- Naturally grown feed</td>
</tr>
<tr>
<td></td>
<td>- Organic feed</td>
</tr>
<tr>
<td></td>
<td>- Feed is pesticide free</td>
</tr>
<tr>
<td></td>
<td>- Feed is grown in-season</td>
</tr>
<tr>
<td>Land</td>
<td>- Typical land use</td>
</tr>
<tr>
<td></td>
<td>- Land is pesticide free</td>
</tr>
<tr>
<td></td>
<td>- Transportation and delivery is environmentally friendly</td>
</tr>
<tr>
<td></td>
<td>- Food miles (kilometres)</td>
</tr>
</tbody>
</table>

Table 4.5: Egg-based TriM evaluation matrix, agents and attributes.
Figure 4.1: Hubert’s $\Gamma$ statistic graph representation of participant egg attribute preferences.
Figure 4.2: Hierarchical clustering result of participant egg attribute preferences (three clusters, maximum distances).
Table 4.6: Egg SpiCE top ten reduct results (from the train and test procedure). The “best” reduct used for further analysis was reduct 7, producer ethics and organic food.

The rules generated by the CRSA component are illustrated in Table 4.7. From the generated rules qualities of interestingness are derived (what attributes the people residing in each cluster truly care about). Within the Egg SpiCE tool, the idea is to ask a knowledge culture their preference of values for these two egg attributes, classifying community members accordingly. This also enables people to begin to form networks of people who have similar values to their own. The results also illustrate the composition of preferences of those people within each network.

Continuing with the next step in ros, the eclat component is used to build on the qualities of interestingness provided by the decision rules of the CRSA component. As part of the research study, participants were asked to choose their top five decision criteria when selecting eggs from those characteristics provided (or indicate ones that were missing). From the resulting responses the eclat association mining algorithm was deployed. Table 4.8 provides the result, which noted qualities of interestingness
### Table 4.7: Generated decision rules from the reduct comprising \{producer ethics, organic\}.

<table>
<thead>
<tr>
<th>Generated Rule</th>
<th>Network</th>
</tr>
</thead>
<tbody>
<tr>
<td>Producer ethics = not important, Organic = not</td>
<td>1</td>
</tr>
<tr>
<td>important</td>
<td></td>
</tr>
<tr>
<td>Producer ethics = not important, Organic =</td>
<td>2</td>
</tr>
<tr>
<td>important</td>
<td></td>
</tr>
<tr>
<td>Producer ethics = not important, Organic = critical</td>
<td>3</td>
</tr>
<tr>
<td>Producer ethics = important, Organic = not</td>
<td>1</td>
</tr>
<tr>
<td>important</td>
<td></td>
</tr>
<tr>
<td>Producer ethics = important, Organic = important</td>
<td>3</td>
</tr>
<tr>
<td>Producer ethics = important, Organic = critical</td>
<td>3</td>
</tr>
<tr>
<td>Producer ethics = critical, Organic = not</td>
<td>3</td>
</tr>
<tr>
<td>important</td>
<td></td>
</tr>
<tr>
<td>Producer ethics = critical, Organic = important</td>
<td>2</td>
</tr>
<tr>
<td>Producer ethics = critical, Organic = critical</td>
<td>3</td>
</tr>
</tbody>
</table>

above 80 percent deemed significant while observing all associations above 55 percent.

Recall that the associations discovered in the eclat component in roset provide additional insight into the composition of the people that comprise a network. For example, in evaluating the composition of the third network, the reduct attributes, illustrated in Table 4.7, and the qualities of interestingness generated by eclat, illustrated in Table 4.8, are quite similar in that ethical producers and organic eggs are quite important. Alternatively, in evaluating the composition of the second network, eclat provides a more detailed illustration of the compositional characteristics that resemble the network, also emphasizing a connection with the attributes of price, taste, and local.
Table 4.8: Egg SpiCE results from the eclat component of roset.

4.3 Egg SpiCE, an Illustrative Example

This section describes Egg SpiCE, illustrating the result of a people, process, and technology approach to the development of a knowledge culture around eggs. The focus in this section will be in describing the Egg SpiCE digital habitat, developed by the author at the University of Regina, and how interaction can enable prosumer practices as guided by the four founding principles of SpiCE. The emphasis in the example of Egg SpiCE is in illustrating how people can benefit in using a system framed by SpiCE, how SpiCE can empower a knowledge culture through technology and process to evolve toward sustainability in decision making and action.

4.3.1 Designing Egg SpiCE Using Drupal

Egg SpiCE uses Drupal 7 as the foundation for its digital habitat. The Egg SpiCE homepage is illustrated in Figure 4.3. In support of a knowledge community model an authenticated user login is necessary. This provides the knowledge culture the ability to vet provided knowledge by verifying who is providing and evolving knowledge about eggs. Given the academic nature of this work, access to Egg SpiCE is currently limited to the author. The core functionalities that Drupal provided Egg

---

Table 4.8

<table>
<thead>
<tr>
<th>Network</th>
<th>Associated preferences</th>
<th>Confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Price</td>
<td>86%</td>
</tr>
<tr>
<td></td>
<td>Taste</td>
<td>57%</td>
</tr>
<tr>
<td>2</td>
<td>Organic, Price, Taste, Local (Varying subsets of the above attributes)</td>
<td>67%</td>
</tr>
<tr>
<td></td>
<td>Price, Taste</td>
<td>100%</td>
</tr>
<tr>
<td>3</td>
<td>Ethical producers, Organic</td>
<td>82%</td>
</tr>
<tr>
<td></td>
<td>Organic</td>
<td>100%</td>
</tr>
</tbody>
</table>

CHAPTER 4. FOOD KNOWLEDGE & SpiCE

Figure 4.3: Screen capture of the Egg SpiCE homepage (accessed May 2013).
SpiCE included,

- A database for storage
- The user module to support the creation of a knowledge community
- The RDF module to support linked data
- The field module to support the creation of eggs spimes using createx
- The views module to support the design, capture, and display of knowledge

Egg SpiCE also utilizes the following community contributed modules in its design to enhance the core functionality provided by Drupal,

- The answers module to support trust metrics
- The field track changes modules to support the historical tracking of egg spimes
- The search API module which aided developing the experiential (non-compensatory) and reflective (compensatory) egg search platform
- The simple field UI module to support the evolution of egg spimes using createx

### 4.3.2 Defining an Egg Spime

Egg SpiCE was designed with the following features to represent an egg spime and to support KM activities associated with their exploration:

- A Drupal-based database for the storage of egg spimes.
- Features to create instances of individual egg spimes
- An interface to its digital habitat that provides a graphical user interface (GUI) that has a digital-based visual representation of wrangled egg spimes
• Features and functionality to enable the life-cycle assessment of an egg spime

• A personalized search

• The capability to evolve individual egg spimes.

• The ability to view a historical mapping of the evolution of an egg spime

4.3.3 Cyean Wrangling Egg Spimes Using Createx

Egg SpiCE uses createx to enable the initial wrangling, or creation of egg spimes. Egg SpiCE facilitates discovery by providing a community-driven question and answer platform where the knowledge community are able to complete a 5S activity on the characteristics that make up the composition of the egg spime, such as by brand, store, taste, price. Figures 4.4, 4.5 and 4.6 illustrate this functionality. As people pose questions, answers are provided and rated accordingly for relevance. These ratings help to enable a 5S activity on the community contributions and structure an initial ordered representation of an egg spime. From this sense-making activity, the result or response is the inclusion of a new egg spime into the Egg SpiCE database. Figure 4.7 illustrates the functionality of adding a new egg spime using Egg SpiCE.

Cyean wrangling can also support the extension of the initial representation of an egg spime. If a compositional characteristic produces interest or demand, candidates for additional egg characteristic inclusion are identified, such as egg shell colour, which may not be part of the initial egg spime but could be added after if deemed needed by the knowledge crowd or community. Only a member of the knowledge community would be able to extend an egg spime, meaning only a person who has an authenticated account within the Egg SpiCE tool can evolve egg spimes. This is to aid in the building of trust and transparency of contributed knowledge. Figure 4.8
illustrates this feature and functionality within Egg SpiCE. As illustrated, a knowledge community member can extend an egg spime by clicking on the “Add a new, or revise an existing egg attribute” link under the “Egg administration” header on the left-hand side of the interface as illustrated in Figure 4.7 and by selecting the “Create a new field” link on the resulting page as illustrated in Figure 4.8.

### 4.3.4 Enabling Personalized Egg Evaluation using Roset

Egg SpiCE uses roset to help design an interface for experiential and reflective egg evaluation. As well, roset helps people form networks and clusters based on preference indicators. The configuration defined in the research study helped design a personalized platform for egg evaluation. From the results of the configuration previously described, the members of the Egg SpiCE knowledge community are asked to state their preference regarding producer ethics and organic eggs. From responses gathered, the knowledge community is structured into appropriate knowledge networks.
CHAPTER 4. FOOD KNOWLEDGE & SpiCE

Figure 4.5: Screen capture of the Egg SpiCE question page where community members can see if a similar question has already been asked by another community member (accessed February 2013).

for interaction where people have personalized displays based on egg preferences. Figures 4.9 and 4.10 illustrate the technological representation of roset within Egg SpiCE.

Personalization helps to initiate experiential, habit-formed, non-compensatory egg evaluation because a network is able to focus on the characteristics that are critical to their typical egg interests. For example, if a person only cares to see organic eggs, they only see eggs and egg brands that are organic. To deal with the potential of the formation of a filter bubble, a knowledge network can expand its search criteria to conduct reflective evaluation as well as practice critical consciousness. For example, continuing the previous example, a person would be able to see all eggs and egg brands, regardless if they are organic or not (compensatory analysis). Figure 4.11 illustrates the expanded search functionality that Egg SpiCE provides.
Figure 4.6: Screen capture of the Egg SpiCE question answer page (accessed March 2013).
Figure 4.7: Screen capture illustrating the add new egg spime feature in Egg SpiCE (accessed March 2013).
Figure 4.8: Screen capture illustrating how to extend or alter an egg spime in Egg SpiCE (accessed March 2013).
Figure 4.9: Screen capture of the roset configuration page in Egg SpiCE (accessed March 2013).
Figure 4.10: Screen capture of the roset configuration for network #1 (of 3) in Egg SpiCE. As illustrated, egg price and taste are highlighted as per the preferences of network #1 (accessed March 2013).
4.3.5 Evaluating Egg Spimes Using TriM Evaluation

Egg SpiCE uses TriM evaluation to guide knowledge creation. As discussed in the preceding section, in using Egg SpiCE, knowledge networks are provided with a personalized egg evaluation display to support experiential evaluation and are also provided with full egg evaluation display for reflective and critical analyses. Figure 4.11 illustrates a partial interface of the full egg evaluation display that Egg SpiCE provides. Egg spimes are displayed using a colour-coding to indicate preferred selections.
as dictated by the configured TriM evaluation matrix. The colour green is used to represent preferred selection (a TriM rating of 80 percent or higher). The colour yellow is used to represent a partially preferred selection (a TriM rating between 60 and 79 percent). The colour blue is used to emphasize when an egg spime has been altered, but not verified by the community. In the spirit of the process of sustainable happiness, egg selections that are considered less preferable are still visible, just not emphasized (colourized) in any way.

Figure 4.12 is a partial view of the TriM evaluation matrix platform that Egg SpiCE provides. As illustrated, survey options of “no” (given a value of zero), “needs work/no information” (given a value of one), “acceptable” (given a value of two), and “good/yes” (given a value of three) is used to enable the knowledge community to contribute to the TriM ranking of specific egg spimes. As the knowledge community contributes rankings, results are averaged, developing an up-to-date instance of an egg spime’s TriM rating, a score or percentage out of eighty-one. Egg spimes with higher TriM ratings are those considered as preferred with respect to the TriM evaluation matrix. Contributed ratings are made visible to assure the transparency and quality of community-based rating contributions. This is also done so that the knowledge community can be empowered to support formation of weak-tied networks and strong-tied clusters as well as support the process of sustainable happiness through Trust metrics. Figure 4.13 illustrates a contrived example of the egg spime for Pusch Brother eggs.

4.3.6 Discovery of New Egg Opportunities using Createx

Egg SpiCE supports discovery of new egg production and selling opportunities through createx. As with supporting the creation and extension of egg spimes through cyean wrangling, createx is also represented within Egg SpiCE by its integrated platform for evaluation and specification. As the knowledge culture uses Egg SpiCE to search
Figure 4.12: Screen capture of the TriM evaluation matrix for Pusch Brothers eggs (accessed March 2013).
Figure 4.13: Screen capture of the contrived Pusch Brothers Farm Egg Spime with TriM ranking (accessed March 2013).
and evaluate egg spimes, depending on the experiential and reflective search criteria used, discovery of potential gaps in specified egg availability may be realized. For example, Figure 4.14 illustrates a search for certified organic, free range eggs at Costco. As illustrated, no results are displayed. It could be that the data and information about the egg is currently not within the Egg SpiCE database, or that Costco does not have the specified egg for purchase. Thus, there exist opportunities for either the community to contribute, create, or modify the egg spime if it does not exist in the database but is available at Costco, or an opportunity for Costco to realize the desire and demand for the specified egg. Figure 4.15 illustrates how the community can request data or information about a specified egg that is either not represented in the database or no available for purchase. Figures 4.16 and 4.17 illustrate how the community can realize the desire and demand for said egg.
Figure 4.15: Screen capture of the egg request form, used if egg data and information is either not represented in the database or no available for purchase (accessed March 2013).
Chapter 4. Food Knowledge & SpiCE

Figure 4.16: Screen capture of the egg discovery and demand display (accessed March 2013).

Figure 4.17: Screen capture of the egg discovery and demand display for an individual community member (accessed March 2013).
4.3.7 Promoting Sustainable Happiness through Trust Metrics

Egg SpiCE uses trust metrics to enable ratings of community contributed egg knowledge. As illustrated in Figures 4.18 and 4.19, trust metrics are enabled through a rating platform that allows the knowledge community to attach quality indicators to contributed egg spimes. Trust metrics are visible and accessible by both the knowledge crowd and community within Egg SpiCE. However, only the knowledge community can make contributions to ratings for the benefit of transparency and quality.

4.4 Discussion

As it is argued, Egg SpiCE helps to illustrate how SpiCE can aid KM by providing a more concrete solution to balance people, process, and technology through its six innovations. In fostering a culture of participation, sustainability can be promoted through the continual responsibility of the knowledge culture to evolve contributed knowledge. SpiCE frames this responsibility through personalized and open access to social learning and knowledge creating tools and processes. As a knowledge culture is initiated and progresses through continual community contributions and interactions, knowledge experiences are grown. From these knowledge growing experiences, sustainable habits can be formed and (re)shaped through experiential and reflective decision making and knowledge generating practices.

In comparison to current/traditional frameworks in KM toward the development of egg KM, as illustrated, Egg SpiCE can provide a more detailed blueprint for KM success and sustainability. Tables 4.9 and 4.10 provide an illustration of the potential gaps and deficiencies in solely using some current/traditional frameworks in KM as opposed to using SpiCE for egg KM. For example, in developing egg KM using
Figure 4.18: Screen capture of an egg spime’s trust metrics (accessed February 2013).
Figure 4.19: Screen capture of the trust metric for the Pusch Brothers Farm contrived egg spime (accessed February 2013).

<table>
<thead>
<tr>
<th>Button</th>
<th>Votes</th>
</tr>
</thead>
<tbody>
<tr>
<td>The above egg information is truthful</td>
<td>1</td>
</tr>
<tr>
<td>The above egg information is useful</td>
<td>0</td>
</tr>
<tr>
<td>The above egg information is truthful and useful</td>
<td>2</td>
</tr>
<tr>
<td>The above egg information is &quot;not&quot; truthful</td>
<td>0</td>
</tr>
<tr>
<td>The above egg information is &quot;not&quot; useful</td>
<td>0</td>
</tr>
<tr>
<td>The above egg information is &quot;not&quot; truthful and &quot;not&quot; useful</td>
<td>0</td>
</tr>
</tbody>
</table>

solely ideas within the SECI framework, detail regarding how best to mobilize the transformation of explicit to implicit knowledge, as well as how best to develop Ba (a digital habitat to support interaction) is not clearly defined. Within Egg SpiCE, this was accomplished using the defined features and re-mixed innovations of SpiCE, specifically through createx and cyean wrangling to enable the knowledge culture to develop explicit egg knowledge, roset to enable socialization within the knowledge culture to enable explicit and implicit knowledge sharing, and through createx and bazaar/open thinking software development to define how best to build the CoP to support the creation and evolution of egg KM. Furthermore, in developing egg KM using only ideas within the cynefin framework, analysis of patterns within narratives provides a starting point to understand the types of egg knowledge. However, details on how best to categorize the different types of egg knowledge within the five habitats of knowledge, as well as what technology to use in support of enabling social interaction for egg knowledge creation, is not clearly defined. Within Egg SpiCE, all of these gaps and deficiencies are addressed through SpiCE’s provided features as stated above. There are similar gaps and deficiencies using solely KCS, as well as
SER, CoPs, and the idea of open thinking. Where SpiCE, as it was illustrated in the Egg SpiCE example, integrates these ideas and frameworks, re-mixing and building upon them to provide greater detail and clarity toward the successful and sustainable operationalization of egg KM.

Six months following the original research study described, a sub-set consisting of three of the twenty-one participants were contacted to provide a qualitative review of the utility of Egg SpiCE. The rationale for choosing such a small subset of participants was to emphasize the importance of an iterative approach to assessing design utility, quality, and improvement in any system using SpiCE. An iterative, formative, evolutionary approach to utility and usability assessments, one that spans the initial conception of a design through to its eventual archival or demise, is arguably more beneficial to a developing systems that are more satisfying [122, 12, 74]. In the original research study, when discussing SpiCE with participants, a majority (86 percent) responded favorably in their willingness to contribute to such a knowledge culture. Upon their utility-oriented evaluation with Egg SpiCE, the three participant reviews mirrored these results.

Upon asking the returning participants if Egg SpiCE provided a platform for learning and knowledge creation, all participants agreed that it did. The ability to ask questions and provide answers as well as review and evolve using TriM evaluative measures with trust metrics were highly regarded by all three participants. Although this was the general consensus, there was some initial concern from participants regarding the quality of community contributions, even with trust metrics applied. However, after illustrating how content could be flagged or marked for review through trust metrics, all agreed this concern was addressed. There was also some initial concern raised in the amount of information provided in the TriM evaluation matrix. Information overload may be a real concern if people are not equipped to handle the wealth of data and information that is possible [144]. One participant indicated that for eggs,
<table>
<thead>
<tr>
<th>KM</th>
<th>Component</th>
<th>+/−</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egg SECI</td>
<td>People</td>
<td>+</td>
<td>Egg knowledge can be created through individual and social interactions of egg shoppers</td>
</tr>
<tr>
<td></td>
<td>Process</td>
<td>−</td>
<td>Unclear process for tacit and explicit egg knowledge creation</td>
</tr>
<tr>
<td></td>
<td>Technology</td>
<td>−</td>
<td>Undefined description of technology to facilitate social interactions between egg shoppers</td>
</tr>
<tr>
<td>Egg Cynefin</td>
<td>People</td>
<td>+</td>
<td>Egg knowledge can be created through individual and social interactions of egg shoppers</td>
</tr>
<tr>
<td></td>
<td>Process</td>
<td>+/−</td>
<td>Egg knowledge is created through sharing stories/narratives (good). Sense-making activity is used to help analyze patterns within created egg knowledge. May be unclear how best to categorize egg knowledge</td>
</tr>
<tr>
<td></td>
<td>Technology</td>
<td>−</td>
<td>Undefined description of technology to facilitate social interactions between egg shoppers</td>
</tr>
<tr>
<td>Egg KCS</td>
<td>People</td>
<td>+</td>
<td>Egg knowledge can be created through individual and social interactions of egg shoppers</td>
</tr>
<tr>
<td></td>
<td>Process</td>
<td>−</td>
<td>Promotes explicit egg knowledge. Unclear process for tacit egg knowledge creation. Very difficult to make all egg knowledge explicit</td>
</tr>
<tr>
<td></td>
<td>Technology</td>
<td>−</td>
<td>Undefined description of technology to facilitate social interactions between egg shoppers</td>
</tr>
<tr>
<td>Egg SpiCE</td>
<td>People</td>
<td>+</td>
<td>Egg knowledge can be created through individual and social interactions of egg shoppers</td>
</tr>
<tr>
<td></td>
<td>Process</td>
<td>+</td>
<td>Very detailed process to guide development of explicit and tacit egg knowledge creation</td>
</tr>
<tr>
<td></td>
<td>Technology</td>
<td>+</td>
<td>Defined technology of open source so as to enable global knowledge sharing and expansion capabilities</td>
</tr>
</tbody>
</table>

Table 4.9: Egg SpiCE versus Egg SECI, Egg Cynefin, and Egg KCS and their stated strengths (+) and gaps (−).
<table>
<thead>
<tr>
<th>KM</th>
<th>Component</th>
<th>+/−</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egg SER</td>
<td>People</td>
<td>+</td>
<td>Egg knowledge can be created through individual and social interactions of egg shoppers</td>
</tr>
<tr>
<td></td>
<td>Process</td>
<td>−</td>
<td>Unclear process for tacit and explicit egg knowledge creation</td>
</tr>
<tr>
<td></td>
<td>Technology</td>
<td>−</td>
<td>Undefined description of technology to facilitate social interactions between egg shoppers</td>
</tr>
<tr>
<td>Egg CoP</td>
<td>People</td>
<td>+</td>
<td>Egg knowledge can be created through individual and social interactions of egg shoppers</td>
</tr>
<tr>
<td></td>
<td>Process</td>
<td>−</td>
<td>Unclear process for tacit and explicit egg knowledge creation</td>
</tr>
<tr>
<td></td>
<td>Technology</td>
<td>+</td>
<td>Defined description of technology to facilitate social interactions between egg shoppers</td>
</tr>
<tr>
<td>Egg OT</td>
<td>People</td>
<td>+</td>
<td>Egg knowledge can be created through individual and social interactions of egg shoppers</td>
</tr>
<tr>
<td></td>
<td>Process</td>
<td>+/-</td>
<td>Broad process for tacit and explicit egg knowledge creation</td>
</tr>
<tr>
<td></td>
<td>Technology</td>
<td>+/-</td>
<td>Broad description of technology to facilitate social interactions between egg shoppers</td>
</tr>
<tr>
<td>Egg SpiCE</td>
<td>People</td>
<td>+</td>
<td>Egg knowledge can be created through individual and social interactions of egg shoppers</td>
</tr>
<tr>
<td></td>
<td>Process</td>
<td>+</td>
<td>Very detailed process to guide development of explicit and tacit egg knowledge creation</td>
</tr>
<tr>
<td></td>
<td>Technology</td>
<td>+</td>
<td>Defined technology of open source so as to enable global knowledge sharing and expansion capabilities</td>
</tr>
</tbody>
</table>

Table 4.10: Egg SpiCE versus Egg SER, Egg CoP, and Egg OT and their stated strengths (+) and gaps (−). OT stands for open thinking.
the TriM evaluation matrix simply provided too much information about eggs alone, and that they would prefer having such information for other products, such as meat and pork.

All participants indicated that the ability to contribute new egg products, as well as extend an egg’s spime is beneficial to their general decision making activities. However, two of the three participants indicated that they would rather associate with the knowledge crowd than the knowledge community, consuming egg spimes and not producing them. There was an indication that participants would travel between the crowd and community as their use and interest evolved. This was a hypothesized behaviour as the author envisions that people would first grow their network and, through their evolved use, cluster accordingly. However, this is left for future analysis. As a possible evolutionary improvement, two of the three participants indicated interest in expanding the features of Egg SpiCE to also incorporate recipes, such as local, ethnic egg recipes.

All participants described the personalization component of Egg SpiCE as being highly useful and all indicated that it did help focus their exploration of egg data and information. When asked if personalized themes matched common shopping habits, all participants agreed. With two of the three participants, displayed TriM evaluation matrices prompted further curiosity and exploration. Two of the three participants also favoured the ability to expand their filter bubble, viewing additional search characteristics, evolving their learning, knowledge, and decision making activity. However, one participant did indicate that they would likely not stray from their defined personalized filter bubble. It is left as a future opportunity to further explore these situations.

Recall in the narrative analysis from the pre-configuration, the majority of participants preferred shopping for food in a medium-to-large supermarket. The rationale
provided by many participants was convenience (43 percent) and distance (20 percent). It may be that many people prefer to shop close to their residence while also having the convenience of available food choices. When evaluating the functionality of Egg SpiCE to allow for specification of interest for better access to a particular egg item (farm or brand), empowering discovery and opportunity for egg decision activity, all participants highly regarded this capability. This was promising. However, there was some concern about consumer and producer privacy with respect to the activity, such as providing addresses of consumers and producers online. One participant proposed a possible automated solution, where when an item or request became available, the system would send an automatic notification to producers and manufacturers with limited information, such as product requested and summarized demographics.

In the spirit of Fisher’s SER model, where knowledge is seeded, grown, and reseeded, the initial qualitative review of the utility of SpiCE provided good indicators for future iterative design experimentation. Initial indications illustrated that SpiCE could provide an acceptable basis for interaction, although additional, prolonged analysis is needed. As well, there was good discussion for its evolution.
Chapter 5

Conclusions and Future Work

This dissertation introduced a new framework for KM called SpiCE. The main purpose and goal of SpiCE was to provide a more defined and sustainable framework for learning and knowledge creation. The fundamental benefit of SpiCE over existing models and frameworks in KM is in its precise description of how to balance the interactions between people, process, and technology with the goal of aiding development of sustainable knowledge cultures.

5.1 Summary of Research and Contributions

To move toward providing a sustainable KM solution, SpiCE introduced six innovations:

1. Four guiding principles for KM interaction

2. TriM evaluation for enabling sustainable reflective decision making

3. The roset model for personalization to enable habitual experiential decision making, as well as to aid in building people connections within knowledge culture
4. Trust metrics to vet and evaluate contributed knowledge content

5. Cyean wrangling to guide learning and knowledge creating explorations

6. Createx to guide learning and knowledge creations and evolution

The four guiding principles of KM related to ideas of bazaar-style, open thinking learning and knowledge creation. They emphasized the idea of freedom to learn, create knowledge, and participate in KM toward the benefit of society. SpiCE integrated these ideas into its base understanding of KM toward a design that focuses on the transformation of data to information, and information to knowledge, as well as the building of individual and social learning capabilities. Through the people, process, and technology narrative that was described, learning and knowledge creation in SpiCE enabled a framework for sustainable KM that,

- Helped develop social connections
- Helped facilitate conversations
- Helped develop sustainable decision-making through praxis
- Helped evolve learning capabilities and knowledge creation

As was described and illustrated with Egg SpiCE, SpiCE helped to frame the precise KM activities to govern and guide interaction, learning, exploration, and knowledge creation. Although discussed separately, as it was illustrated throughout this dissertation, all six of the components that SpiCE has introduced have cross-cutting focuses within people, process, and technology components of KM. Thus, as it was argued, SpiCE provided a more clear and successful illustration of how to balance people, process, and technology.
5.1.1 A Focus on People, Process, and Technology

Through a people focus, SpiCE promoted prosumer-based, bazaar-style KM interactions. As described, SpiCE encourages an environment where people both contribute and consume data and information. The pros and cons of such an approach to KM were discussed, with further analysis recommended. Prosumer learning and knowledge creation were guided by four principles for KM interaction.

Through a technology focus, SpiCE utilized techniques in data science, human computer interaction, and education to help guide augmented technology interactions. SpiCE proposed the development of an open learning, rhizomatic inspired community of practice (CoP) to support spime-based exploration, learning, and knowledge creation. Interface personalization using roset was described to enable a CoP to focus on habitual spime-based explorations, as well as to enable community building. Free/libre open source software was also proposed as an underlying technology to enable portability, expandability, and sustainability of the technology solution.

Through a process focus, SpiCE introduced three fundamental ideas to guide KM interactions, namely cyean wrangling, TriM evaluation, and trust metrics. Cyean wrangling was described as a process that enabled exploration, learning, and knowledge creation. It was described as a combination of Snowden’s cynefin framework with lean 5S methodology to enable the exploration, creation, and evolution of spimes. To enable sustainable decision making, TriM evaluation was introduced as a framework for structuring practices in support of attaining praxis through cyean wrangling activity. The idea of sustainable happiness and trust metrics helped guide and structure ethical decision making through spime-based explorations, learning, and knowledge creation.
5.1.2 Egg SpiCE

The Egg SpiCE prototype and evaluation illustrated the use of SpiCE from its initial configuration stage, to the development of its knowledge crowd and community. As was described and illustrated, both quantitative and qualitative data was used in the configuration phase, with emphasis on qualitative narratives to help guide Egg SpiCE’s initial design. All six innovations were integrated within the design of Egg SpiCE. A user evaluation was described which indicated encouraging feedback for the use of SpiCE.

5.2 Future Work and Concluding Remarks

Future work will include a deeper evaluation of SpiCE. To truly evaluate the success SpiCE may take significant time as the nature of KM is an evolutionary activity.

A deeper analysis of the connections between a MOOC and SpiCE will be completed. MOOCs are currently seen as an educational facilitator for learning and knowledge creation. However, they still conform to a traditional educational course in the sense that they have start and end dates. It is hypothesized that there is a connection between MOOCs and KM, where KM can benefit from MOOCs and vice versa. One idea includes a restructuring of the term MOOC to massive open online culture of participation and interest, or just a presumption that a MOOC emphasize life-long learning.

Another plan for future work includes a more in-depth evaluation of reward structures. How to transform a consumer, interacting within a knowledge culture using SpiCE, into a prosumer may be a wicked problem. In some KM efforts, reward structures are integrated as part of their framework. GasBuddy, for example, offers people free gasoline. However, as Dave Snowden states, “people will achieve [a] measure even
CHAPTER 5.  CONCLUSIONS AND FUTURE WORK

if it’s the wrong thing.”¹ More analysis is required.

A full implementation and deployment of Egg SpiCE is envisioned, as well are
plans to work with local businesses and producers in Regina, Saskatchewan who sell
chicken eggs to incorporate their brands and products within the Egg SpiCE database.
Although initial indications of the Egg SpiCE example illustrated that SpiCE could
provide an acceptable basis for KM interaction. As mentioned, additional, prolonged
analysis is needed. Integrating and evolving evaluative models such as the Delone
and McLean model of Information Systems Success may help to provide a deeper
understanding of the potential success and sustainability of SpiCE [38, 71]. Future
work will include the idea of integrating and evaluating Delone and McLean inspired
KM health check-points within newly innovated process activities as they coincide
with the evolutionary growth phase of the SpiCE framework. An initial evaluation of
the new process innovation could be evaluated alongside the full implementation and
deployment of Egg SpiCE.

Research into how SpiCE can be integrated into organizational KM initiatives for
sustainable decision making is also currently being explored at eHealth Saskatchewan.
An advantage of SpiCE is in its broad schematic for KM. The true benefit of SpiCE is
that it can provide a more defined and sustainable balance between people, process,
and technology, with the fundamental goal of enabling sustainable decision making
for any domain or topic of interest.

¹Dave Snowden at LeanKanban 2011. Online: http://vimeo.com/30596502 (accessed April
2013).
Glossary

5s A process in the lean manufacturing methodology to sort, set in order, shine, standardize, and sustain knowledge.

augmented HCI The design idea that computer technology can control what people would typically have difficulty dealing with, such as rationalized decision activity, and the people would control what the technology would typically have difficulty dealing with, such as bounded rational, unpredictable behaviour.

Ba A shared interactive space for emerging relationships as defined by Ikujiro Nonaka and Hirotaka Takeuchi.

bounded rationality As defined by Herbert Simon, the idea that people generally have difficulty in acting on fully rationalized decisions.

cognitive loading As inspired by Bruce Sterling, the amount of energy and time needed to become knowledgeable on a given thing.

compensatory A decision making strategy where a person applies a strict, fully rationalized thought process based on predefined preferences, ratings, or rankings to formulate a final decision.

Cooked data Structuring data to help derive relevance and meaning, such as applying metadata, categories that help to better understand the data.

CoP A concept developed by Etienne Wenger to describe an interactive space for individual and social KM, learning and knowledge creation. CoP is an acronym for
community of practice.

**Createx** One of the innovations introduced by SpiCE. A hybrid framework that helps people build and evolve created knowledge. Createx is an acronym for creating knowledge and extending, or evolving knowledge.

**critical consciousness** As inspired by Paulo Freire, the ability to empower praxis by enabling critical thinking and actions beyond experiential habit and reflection within a current environment.

**crowdsourcing** As inspired by Jeff Howe, an activity where people create content, solve problems, and collaborate.

**culture** As defined by Dorothy Leidner and her colleagues, the definition of culture used in this dissertation refers to the attitudes and behaviour that characterize a group or organization.

**culture of participation** A concept defined by Gerhard Fischer that describes an interactive space where prosumer activities take place, the individual and social learning and creation of knowledge that results through spime wrangled explorations.

**Cyean wrangling** One of the innovations introduced by SpiCE. A hybrid framework for learning and the creation of knowledge, combining Dave Snowden’s cynefin framework, the lean 5s methodology, and Bruce Sterling’s idea of spime wrangling.

**Cynefin** A framework for KM defined by Dave Snowden. Cynefin is comprised of five states for learning and knowledge creation, simple, complicated, complex, chaos, and disorder.

**data** As defined by Thomas Davenport and Laurence Prusak, data is a subjective grouping of distinct and objective facts.

**decision support systems** Technology facilitated tools that aid in decision making activities.

**digital habitat** Define by Etienne Wenger as an interactive space where a knowledge culture can grow. a digital habitat encompasses tools that support the activities of
KM, platforms which package the tools for use by people within a community, features that give tools and platforms utility and usability, and a configuration that sustains and evolves the habitat.

**ETMOOC** A MOOC, massive open online course, that was offered by the University of Regina which focused on learning and knowledge creation for Educational Technology.

**experience management** As defined by Nancy Dixon, the era of experience management is characterized by learning and knowledge that is created and shared by individuals within specialized groups or teams.

**expert systems** A variant of augmented decision support systems that aid in expert-guided, rationalized decision making activities.

**Explicit knowledge** Simple or repeatable knowledge that can be easily captured, expressed, and transmitted.

**filter bubbles** As defined by Eli Pariser as a type of narrowed and focused stream of knowledge that can be the result of specialized and personalized interactions, such as only seeing knowledge based on history of preferences.

**HCI** Acronym for human-computer interaction, the study of people and their interactions with computer technologies.

**idea management** As defined by Nancy Dixon, the era of experience management is characterized by learning and knowledge that is created and shared by a global citizenry.

**information** As defined by Peter Drucker, Thomas Davenport, and Laurence Prusak, data endowed with relevance and purpose, data that transmits a message between a sender and receiver.

**information management** As defined by Nancy Dixon, the era of information management is characterized by an individual’s ability and capacity to create knowledge
through the collection and storage of repeatable information processes.

**Internet of Things** A term used to describe storage of data, information, and knowledge about all known objects.

**IoT** Acronym for Internet of Things.

**KCS** A methodology for KM developed by The Consortium for Service Innovation. KCS is an acronym for knowledge centered support.

**KM** The acronym for Knowledge Management. In this dissertation, KM refers to the activity of transforming data to information, and information to knowledge. KM is also discussed as emphasizing the building of capabilities through learning; how KM can help people learn individually and collaboratively toward an individual or shared outcome.

**Knowledge** As defined by Thomas Davenport and Laurence Prusak, knowledge is a fluid mix of framed experiences, values, contextual information, and expert insight that provides [a way] for evaluating and incorporating new experiences and information.

**knowledge community** A group of people interacting within a knowledge culture who participate at a higher level of involvement.

**knowledge crowd** A group of people interacting within a knowledge culture who participate at a lower level of involvement.

**knowledge culture** A group of people participating in an interactive space for learning and knowledge creation.

**knowledge worker** As defined by Peter Drucker, someone who continually questions, has a willingness for life-long learning, strives to innovate, has a willingness to teach, and is focused on quality.

**linked data** As defined by Tim Berners-Lee, linked data is a model for web standards to help deal with the quality, utility, and general complexity of cooking raw data.
Linked data enables a standard way to explore, reuse, and modify data. One of the main benefits of linked data includes its ability to replicate modifications of data from a single source to all sources that are accessing the data. For example, if three databases are accessing the same data, if the data is altered in any one of the three databases, the changes are replicated to the other two.

**metadata** unique identifiers to add value or meaning to data or raw data, such as version numbers, author names, and modification dates on documents.

**MOOC** An acronym for Massive Open Online Course.

**non-compensatory** A decision making strategy where a person narrows the scope of knowledge-aided decisions based on values and preference.

**open thinking** A concept developed by Alec Couros to describe an open space for learning and knowledge creation, inspired by Eric Raymond’s idea of the cathedral and the bazaar, and ideas of open source software.

**opportunity costs** As inspired by Bruce Sterling, he lost amount of time and energy needed to learn about something.

**praxis** As inspired by Paulo Freire as the social transformation of the world through action and reflection.

**principle of continuity** As theorized by John Dewey, our experiences, and thus, decision actions, are founded on the habits people form throughout their lifetime.

**principle of interaction** As theorized by John Dewey, learning is an individual, as well as a social process.

**prosumer culture** As defined by Gerhard Fischer, a knowledge culture where people consume and contribute to the exploration, learning and creation of knowledge.

**rational choice** As defined by Robert Davis, a person’s behaviour such that under the proper interpretation it can be said to satisfy their complete decision making
requirements.

**Raw data** As defined by Tim Berners-Lee, raw data is data that is not defined by an existing data model or structure, such as the addresses of houses on a street, or the number of occupants in each residence.

**reflection** As defined by Steen Hoyrup, careful or long consideration or thought.

**rhizomatic learning** An interconnected learning theory that states that learning has no centre, nor boundaries that constrain exploration and knowledge creation. As described by Dave Cormier, the theory was inspired by a rhizome plant that has the ability to grow organically, is adaptable to multiple growing environments, and can flourish with minimal care.

**roset** One of the innovations introduced by SpiCE. A hybrid personalization framework that helps connect people with similar learning interests, as well as to enable more efficient habit-based decision-making that combines techniques in Zdzislaw Pawlak’s classical rough sets theory with the eclat algorithm as described by Christian Borgelt.

**SECI** A framework for KM defined by Nonaka and Takeuchi. SECI is an acronym for socialization, externalization, combination, and internalization which emphasizes the transformations between tacit and explicit learning and knowledge creation.

**SER** A framework for KM defined by Gerhard Fischer. SER is an acronym for seeding, evolutionary growth, and re-seeding. It illustrates the evolving nature of learning and documentation in KM.

**SpiCE** The new framework for KM introduced in this dissertation. SpiCE is an acronym for spime wrangling, culture of participation, and ethical decision making.

**spime** A concept defined by Bruce Sterling as a type of data representation that enables historical tracking of an object in space and time (also an acronym of space and time).

**spime wrangling** A concept defined by Bruce Sterling as a type of interaction for
data and information exploration using spimes.

**sustainable HCI** The idea of sustainable human computer interaction (HCI), design of an item that utilizes sustainable construction or design of an item to encourage sustainable ideas and decisions. The concept of sustainability *in* design can be used to emphasize the sustainable nature regarding the physical qualities of a technological artefact. The concept of sustainability *through* design can be used to describe design of technological augmented digital habitats for sustainability.

**Tacit knowledge** Knowledge based on a person’s own technical skills and abilities in connection with their previous experiences, beliefs, ideals, values, and emotions, individual or shared. Because of these factors, tacit knowledge can be hard to capture, express, and transmit.

**technium** As inspired by Kevin Kelly, the space that defines the entirety of the technology that supports people and process, such as a pencil, a computer, a hammer, and a car.

**TriM evaluation** One of the innovations introduced by SpiCE. A hybrid decision-making framework that emphasizes sustainable decision making through culture and community building that combines William McDonough’s and Michael Braungart’s triple top line model for sustainable development and Ben Mepham’s Ethical Matrix.

**Trust metrics** One of the innovations introduced by SpiCE. A hybrid personalization framework that helps people understand the truthfulness, usefulness, and/or ethicalness of created knowledge that uses ideas from Socrates and the theory and research of sustainable happiness as described by Catherine O’Brien.

**UFFA** KCS mantra for KM. An acronym for using, flagging, fixing, and adding knowledge.

**xenophile** Define by Ethan Zuckerman as a person who actively seeks connection with other people, those with both similar and divergent ideas, beliefs, and opinions to
engage in knowledge creating experiences that aim to build upon their own experience and knowledge.
List of References


Appendix A

Initial Information Gathering Files
DATE:   June 26, 2012
TO:   Timothy Maciag
       Computer Science
FROM:   Dr. Bruce Plouffe
       Chair, Research Ethics Board
Re:   Analysis of Food Purchasing Attitudes and Habits (File # 76S1112)

Please be advised that the University of Regina Research Ethics Board has reviewed your proposal and found it to be:

1.   APPROVED AS SUBMITTED. Only applicants with this designation have ethical approval to proceed with their research as described in their applications. For research lasting more than one year (Section 1F), ETHICAL APPROVAL MUST BE RENEWED BY SUBMITTING A BRIEF STATUS REPORT EVERY TWELVE MONTHS. Approval will be revoked unless a satisfactory status report is received. Any substantive changes in methodology or instrumentation must also be approved prior to their implementation.

2.   ACCEPTABLE SUBJECT TO MINOR CHANGES AND PRECAUTIONS (SEE ATTACHED). Changes must be submitted to the REB and approved prior to beginning research. Please submit a supplementary memo addressing the concerns to the Chair of the REB. ** Do not submit a new application. Once changes are deemed acceptable, ethical approval will be granted.

3.   ACCEPTABLE SUBJECT TO CHANGES AND PRECAUTIONS (SEE ATTACHED). Changes must be submitted to the REB and approved prior to beginning research. Please submit a supplementary memo addressing the concerns to the Chair of the REB. ** Do not submit a new application. Once changes are deemed acceptable, ethical approval will be granted.

4.   UNACCEPTABLE AS SUBMITTED. The proposal requires substantial additions or redesign. Please contact the Chair of the REB for advice on how the project proposal might be revised.

Dr. Bruce Plouffe

Cc: Dr. Daryl Hepling – Computer Science

** supplementary memo should be forwarded to the Chair of the Research Ethics Board at the Office of Research Services (Research and Innovation Centre, Room 109) or by e-mail to research.ethics@uregina.ca

Phone: (306) 585-4775
Fax: (306) 585-4893
www.uregina.ca/research
Call for Research Participants: Analysis of food purchasing attitudes and habits

The goal of this project is to better understand how citizens relate to current food culture, from purchasing and consumption to food production. This project focuses specifically on eggs. It is a goal of this project to discover concerns and decision patterns of consumers as they relate to egg purchasing. Another goal of this project is to discover how consumers and producers view product data and information that of which is contributed by manufacturers/producers and that contributed by other consumers.

If you agree to participate in this study you will be asked to complete a background questionnaire, participate in an informal interview concerning your egg purchasing experiences, and complete a final questionnaire concerning your preferences and attitudes as they relate to purchasing eggs (and other foods).

If you are interested in participating, please contact Timothy Maciag: maciagt@cs.uregina.ca. If applicable you may be eligible for a bonus mark in one of your University of Regina classes. Please inquire upon emailing.

This project has been approved by the University of Regina Research Ethics Board.

Hello - My name is Tim Maciag and I am a PhD student at the University of Regina.

I am currently conducting research into how local consumers are purchasing eggs - where they buy most of their eggs, what types of things they think and care about when buying eggs (price, local, ethical, environmental, etc.). I am hoping to gather an understanding of such towards the goal of building better connections between consumers and producers (and the stores selling product).

I am interested in speaking with some of your customers regarding their egg purchasing decisions. I am wondering if you know of interested individuals who might be willing to participate (yourself included). Or, if possible, I can arrange some form of advertisement with you to hand out to consumers on purchase, and/or possibly setting up a booth to engage interested customers (these are some possible ideas). I would also be interested in chatting with the producers you acquire eggs from (if possible).

The added benefit of this study would be for you to have a better understanding of how your customers are buying their eggs (the "why" of it all). This may enable you to better promote the egg items you have available - acknowledging the added benefits of purchasing the eggs from you specifically. This would benefit your customers as well by having access to information leading to a heightened awareness about the products (eggs) you have for sale.

To help support this study and to get your customers interested in participating I am wondering if there is a "INSERT NAME gift certificate/voucher" that I can (purchase myself and) give to the people I chat with (as compensation for participating). This could be part of the "advertisement" handed out to your customers. I would appreciate your thoughts in this regards.

I would like the opportunity to chat with you in-person if you like. Please let me know and I'll arrange to come to the store sometime that is most convenient for you. Please know that this project has been approved by the University of Regina Research Ethics Board.

I look forward to hearing back.
Best regards,
Tim
Participant Consent Form (Producer & Market-Owners)
Analysis of Food Purchasing Attitudes & Habits

Principal investigator: Timothy Maciag, PhD Candidate
Department of Computer Science
University of Regina
306-585-4005, maciagt@cs.uregina.ca

Research Study Supervisor: Daryl Hepting
Department of Computer Science
University of Regina
306-585-5210, hepting@cs.uregina.ca

Purpose(s) and objective(s) of the research:
This project aims to gather a better understanding of how consumers relate to current food culture, from purchasing and consumption to food production. Focusing specifically on eggs, it is a goal of this project to discover decision patterns and related concerns of consumers as they relate to their egg purchases. Another goal of this project is to discover how consumers and producers view product (egg) data and information that is provided/contributed by manufacturers/producers and contributed by other consumers.

Procedures:
You will be asked to participate in a survey and narrative inquiry activity: Meeting at a time and location previously arranged (via phone/email), you take part in an informal interview concerning your experiences farming chickens/hens and/or selling eggs (audio recorded). This may take up to 1 hour.

Potential Risks:
This project contains no known or anticipated risks.

Confidentiality/Anonymity and participant rights:
All assurances to maintain confidentiality of the participants and provided information will be taken. All research materials, documents, and recorded audio files will be stored in a secure location/device on the University of Regina campus.

Participation in this study is voluntary and you may answer only those questions that you are comfortable with. As well, you may withdraw your participation for any reason, at any time without explanation or penalty of any sort. Should you wish to do so, and if you deem necessary, all records of participation will be deleted/destroyed.

Questions or concerns:
If you have any questions/concerns you may contact the researcher(s) using the information at the top of this page. This project has been approved on ethical grounds by the University of Regina Research Ethics Board on June 28, 2012. Any questions regarding your rights as a participant may be addressed to the committee at (306-585-4775 or research.ethics@uregina.ca). Your signature below indicates that you have read and understand the description provided and consent to participate in this project.

Name of Participant ________________________ Signature ________________________ Date ________________________
Researcher’s Signature ________________________ Date ________________________

You will receive a copy of this consent form.
**Participant Consent Form (Consumers)**

*Analysis of Food Purchasing Attitudes & Habits*

**Principal investigator:**
Timothy Maciag, PhD Candidate  
Department of Computer Science  
University of Regina  
306-585-4005, maciagt@cs.uregina.ca

**Research Study Supervisor:**
Daryl Hepting  
Department of Computer Science  
University of Regina  
306-585-5210, hepting@cs.uregina.ca

**Purpose(s) and objective(s) of the research:**
This project aims to gather a better understanding of how consumers relate to current food culture, from purchasing and consumption to food production. Focusing specifically on eggs, it is a goal of this project to discover decision patterns and related concerns of consumers as they relate to their egg purchases. Another goal of this project is to discover how consumers and producers view product (egg) data and information that is provided/contributed by manufacturers/producers and contributed by other consumers.

**Procedures:**
You will be asked to participate in a survey and narrative inquiry activity: Meeting at a time and location previously arranged (via phone/email), you will complete a background questionnaire, take part in an informal interview concerning your experiences shopping for eggs (audio recorded), and complete a final questionnaire concerning current preferences and attitudes as they relate to purchasing eggs (and other foods). This may take up to 1 hour.

**Potential Risks:**
This project contains no known or anticipated risks.

**Confidentiality/Anonymity and participant rights:**
All assurances to maintain confidentiality of the participants and provided information will be taken. All research materials, documents, and recorded audio files will be stored in a secure location/device on the University of Regina campus.

Participation in this study is voluntary and you may answer only those questions that you are comfortable with. As well, you may withdraw your participation for any reason, at any time without explanation or penalty of any sort. Should you wish to do so, and if you deem necessary, all records of participation will be deleted/destroyed.

**Questions or concerns:**
If you have any questions/concerns you may contact the researcher(s) using the information at the top of this page. This project has been approved on ethical grounds by the University of Regina Research Ethics Board on June 28, 2012. Any questions regarding your rights as a participant may be addressed to the committee at (306-585-4775 or research.ethics@uregina.ca). Your signature below indicates that you have read and understand the description provided and consent to participate in this project.

<table>
<thead>
<tr>
<th>Name of Participant</th>
<th>Signature</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Researcher’s Signature</td>
<td>Date</td>
<td></td>
</tr>
</tbody>
</table>

*You will receive a copy of this consent form*
Free eggs in your next bin?

Would you like to receive a free carton of eggs from the store in your next bin?

Tim Maciag, a graduate student at the University of Regina, is conducting research into how people choose the eggs they buy. He is seeking 5-10 participants to complete a survey and participate in an interview relating to eggs (could take up to 1 hour of time). In exchange for participation, Tim will ensure you receive a free carton of eggs (12 eggs) in your next bin purchase.

If you are interested in participating, please email him: maciagt@cs.uregina.ca or contact him by phone: 585-4005.

Please know that this project has been approved by the University of Regina Research Ethics Board.

University
of Regina
Would you like to receive a free carton of eggs from Eat Healthy Foods?

Tim Maciag, a graduate student at the University of Regina, is conducting research into how people choose the eggs they buy. He is seeking 5-10 participants to complete a survey and participate in an interview relating to eggs (could take up to 1 hour of time). In exchange for participation, Tim will ensure you receive a free carton of eggs (12 eggs) from Eat Healthy Foods.

If you are interested in participating, please email him: maciagt@cs.uregina.ca or contact him by phone: (306)585-4005.

Please know that this project has been approved by the University of Regina Research Ethics Board.
Free carton of eggs?

Would you like to receive a free carton of eggs from Nature's Best Market?

Tim Maciag, a graduate student at the University of Regina, is conducting research into how people choose the eggs they buy. He is seeking 5-10 participants to complete a survey and participate in an interview relating to eggs (could take up to 1 hour of time). In exchange for participation, Tim will ensure you receive a free carton of eggs (12 eggs) from Nature's Best Market.

If you are interested in participating, please email him: maciagt@cs.uregina.ca or contact him by phone: (306)585-4005.

Please know that this project has been approved by the University of Regina Research Ethics Board.
Part 1: Analysis of food purchasing attitudes and habits

In this part of the analysis you will be asked to provide general personal information. This information will be used to keep track of the demographic and diversity of our participants.

Please circle the most appropriate response below (or fill in your answer)

Background questions

1. Please indicate your sex:
   a) Female
   b) Male

2. Please indicate your age:
   a) 18 – 24
   b) 25 – 30
   c) 31 – 35
   d) 36 – 40
   e) 41 – 45
   f) 46 – 50
   g) 51 – 55
   h) 56 – 60
   i) 61 – 65
   j) 66+

3. What is the highest level of education you have completed?
   a) Elementary school graduate
   b) High school graduate
   c) Some post-secondary
   d) Post-secondary degree
   e) Masters degree
   f) Doctorate degree

4. Please indicate your current occupation: __________________________
5. Please indicate your monthly income (after taxes):
   a) < $1000
   b) $1000 - $1500
   c) $1501 - $2000
   d) $2001 - $2500
   e) $2501 - $3000
   f) $3001 - $3500
   g) $3501 - $4000
   h) > $4001

6. How many people are in your household?
   a) 1
   b) 2
   c) 3
   d) 4
   e) 5
   f) 6
   g) 7+

7. Are you responsible for most of the food purchasing decisions in your household?
   a) Yes
   b) No ---- who in your household is?: ____________________________
      ---- may I contact this person? (please circle and provide contact details):  yes  /  no

8. Do you own or have access to a vehicle?
   a) Yes
   b) No

9. How often do you shop for food (visit a grocery store and purchase a food product)?
   a) Daily
   b) Bi-daily
   c) Weekly
   d) Bi-weekly
   e) Monthly
10. Do you prefer purchasing food:
   a) In a large/medium supermarket (chain store)
   b) In a small local convenience store
   c) At the farmers market
   d) Directly from the farmer
   e) Other _____________________________

11. On average, how much do you spend per week on groceries?
   a) < $50
   b) $51 - $100
   c) $101 - $150
   d) $151 - $200
   e) $201 - $250
   f) $250 - $300
   g) > $300

12. On average, how much do you spend per month at restaurants?
   a) None
   b) $1 - $50
   c) $51 - $100
   d) $101 - $150
   e) $151 - $200
   f) $201 - $250
   g) $250 - $300
   h) > $300

13. On average, how much do you spend per month on entertainment (movies, music, concerts)
   a) None
   b) $1 - $50
   c) $51 - $100
   d) $101 - $150
   e) $151 - $200
   f) $201 - $250
   g) $250 - $300
   h) > $300
Part 2: Narrative analysis:

For this part of the evaluation you will be asked to relate a narrative about your experiences dealing with eggs (farming and/or selling).

Interview (semi-structured, responses will be audio-recorded):

1. Please relate your experiences in farming chickens/hens and/or selling eggs

   1. (producer), where do you sell your eggs (farmers' market, work with local store)?

   2. (producer/market-owner) Are you certified organic (why?/why not?)

   3. (producer/market-owner) How do you view yourself as being competitive with the large retail chains?

   4. (producer/market-owner) What distinguishes your eggs from those available at other markets/locales?

   1. What is the one thing that distinguishes your eggs from others?
Part 2: Narrative analysis

For this part of the evaluation you will be asked to relate a narrative about your last food shopping experiences, specifically relating to the last time you purchased eggs.

Interview (semi-structured, responses will be audio-recorded):

1. What influences you when purchasing food (in general, grocery or restaurant)?

Egg specific questions:

2. Thinking about the last time you purchased eggs, what do you remember or recall that guided (or influenced) your choice?

   1. What egg attributes did you consider (price, organic, free range, etc.), and why?

   2. What store/market did you purchase the eggs at? - How did (does) this influence your choice?

   3. Did others play a role in the eggs you purchased, i.e. kids, parents, etc. with unique eating requirements?

3. If there is one (or more) thing(s) you would say about the eggs you last purchased, what would it be?

4. Thinking about all of the times you have purchased eggs, what are the things that stick out?

5. If there is one (or more) thing(s) you would say about the eggs you generally purchase, what would it be?
Part 3: Specific analysis of food purchasing attitudes and habits

In this part of the analysis you will be asked about how you perceive certain aspects of food, specifically eggs. As well, you will be asked to provide insight into your food preferences and food shopping experiences.

Definitions and preferences:

1. How would you rate the following attributes as they relate to the egg products you typically purchase (please place an X in the most appropriate box below):

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Not important</th>
<th>Important</th>
<th>Critical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brand</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Appearance of product packaging (e.g. Special packaging, etc.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduced packaging</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Egg container made of recyclable packaging</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Egg container/packaging can be recycled after use</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost (environmental, economic, societal, etc.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taste (personal, perceived)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taste (family – with kids, perceived)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nutrition – calories specifically</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nutrition – added vitamins</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nutrition – amount of lutein</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nutrition – amount of sodium</td>
<td></td>
<td></td>
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<tr>
<td>Nutrition – amount of cholesterol</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nutrition – amount of DHA-Omega 3</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Nutrition – low in fat</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Canada Heart&amp;Stroke Health Check(TM) (on label/ packaging)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ingredient usage (eggs that do not contain artificial colours, flavours, sweeteners)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Local (eggs from across Canada)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Local (eggs from Saskatchewan)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Local (eggs from a city/town – within approximately 100km of residence)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not important</td>
<td>Important</td>
<td>Critical</td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
<td>----------</td>
<td></td>
</tr>
<tr>
<td>Ethical behaviour of producer (treatment of company/farm workers, diversity, human rights)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethical treatment of hens (housing of hens/free range - “Eggs laid by free range hens”)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fair trade eggs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chicken feed (e.g. “Chickens fed with grains”)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seasonal (in-season)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organic (global)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organic (local, Canada)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Organic (local, Saskatchewan)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food miles (distance eggs travel from producer to consumer)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Egg grade (on label)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Eggs are selected from young hens (first 6 months in lay)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amount of double yolks in package/carton</td>
<td></td>
<td></td>
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</tbody>
</table>

2. Of the above attributes, please pick the top 5 attributes you most use in a typical visit to a grocery store while purchasing food items. Please order them according to importance (1 being most important, 5 being least important) and also please briefly explain why the attribute is important to you in the food you buy. If there are attributes missing from the above list that you use, please use those to answer this question.

1. (most important) ___________________________________________

2. ___________________________________________

3. ___________________________________________

4. ___________________________________________

5. (least important) ________________________________________
General shopping experiences:

1. Where do you see food as being in your list of life priorities and why?

2. Briefly describe a typical grocery store visit (what time of day do you go, for how long, what do you focus on, etc.)

3. At what stores do you typically shop for eggs (please be specific) and why do you typically choose to shop at these stores?

4. Do you feel there is: not enough, about the right amount, or too much information regarding your egg selections/options? Please explain.

5. Do you trust information provided by egg manufacturers (on product packaging, company website)? Please elaborate your response.
6. Would you trust information about food items from other consumers? Please elaborate on your response.

7. What would your degree of willingness be toward contributing your own knowledge regarding the eggs (and other food items) that you purchase (price paid, rationale for purchasing, product ratings, etc.). Please elaborate on your response.

8. How do you see the connection, if any, between your food choices and your health?

9. How do you see the connection, if any, between your egg purchases (and other food items) and the notion of social responsibility/ethical consumerism? (e.g. Do you buy eggs from companies/farmers that provide a decent wage of living for their workers?, etc.)

10. How do you see the connection, if any, between your egg purchases (and other food items) and the environment? (negative and/or positive impacts on the natural environment)
11. What is your willingness to purchase eggs (and other/seasonal/canned food items) from local producers (producers local to your province)? Please explain your response.

12. Do you feel that you would benefit from having access to an online community to help in purchasing food (eggs and other food items) as it relates to Sustainable, Organic, Local, Ethical food alternatives? If yes, what food attributes would interest you most? If no, please elaborate.

13. Would you be willing to work with the producer(s) in better understanding demand for eggs (and other food items), e.g. How many dozens of eggs you would be willing to purchase from them and over what period of time, etc.
Appendix B

User Interaction with Egg SpiCE Files
OFFICE FOR RESEARCH, INNOVATION AND PARTNERSHIP
MEMORANDUM

DATE: November 20, 2012

TO: Timothy Maciag
1254 James Cr.
Regina, SK S4N 6A5

FROM: Dr. Larena Hoeber
Chair, Research Ethics Board

Re: User Interaction with the SpICE Framework (File # 265123)

Please be advised that the University of Regina Research Ethics Board has reviewed your proposal and found it to be:

☐ 1. APPROVED AS SUBMITTED. Only applicants with this designation have ethical approval to proceed with their research as described in their applications. For research lasting more than one year (Section 1F), ETHICAL APPROVAL MUST BE RENEWED BY SUBMITTING A BRIEF STATUS REPORT EVERY TWELVE MONTHS. Approval will be revoked unless a satisfactory status report is received. Any substantive changes in methodology or instrumentation must also be approved prior to their implementation.

☐ 2. ACCEPTABLE SUBJECT TO MINOR CHANGES AND PRECAUTIONS (SEE ATTACHED). Changes must be submitted to the REB and approved prior to beginning research. Please submit a supplementary memo addressing the concerns to the Chair of the REB.** Do not submit a new application. Once changes are deemed acceptable, ethical approval will be granted.

☐ 3. ACCEPTABLE SUBJECT TO CHANGES AND PRECAUTIONS (SEE ATTACHED). Changes must be submitted to the REB and approved prior to beginning research. Please submit a supplementary memo addressing the concerns to the Chair of the REB.** Do not submit a new application. Once changes are deemed acceptable, ethical approval will be granted.

☐ 4. UNACCEPTABLE AS SUBMITTED. The proposal requires substantial additions or redesign. Please contact the Chair of the REB for advice on how the project proposal might be revised.

Dr. Larena Hoeber

cc: Dr. Daryl Hepting – Computer Science

** supplementary memo should be forwarded to the Chair of the Research Ethics Board at the Office for Research, Innovation and Partnership (Research and Innovation Centre, Room 105) or by e-mail to research.ethics@uregina.ca

Phone: (306) 585-4775
Fax: (306) 585-4893
www.uregina.ca/research
Hello - My name is Tim Maciag and I am a PhD student at the University of Regina. You recently took part in my research project about how you purchase eggs - where you buy most of your eggs, what types of things you think and care about when buying eggs (price, local, ethical, environmental, etc.).

I have developed a web-based tool with the goal of building an online community around food (starting with eggs of course) and require 5-10 people to do a few activities on the tool and rate its usability. If you are interested in participating, please respond to this email and I will arrange a time and location. Please note that this can be done in-person, over the phone, or over skype/google chat if needed and that this project has been approved by the University of Regina Research Ethics Board.

I look forward to hearing back
Best regards,
Tim
Participant Consent Form
User Interaction with the SpiCE Framework

Principal investigator:
Timothy Maciag, PhD Candidate
Department of Computer Science
University of Regina
306-585-4005, maciagt@cs.uregina.ca

Research Study Supervisor:
Daryl Hepting
Department of Computer Science
University of Regina
306-585-5210, hepting@cs.uregina.ca

Purpose(s) and objective(s) of the research:
This project aims to gather usability patterns regarding a web-based tool for supporting food culture, from purchasing and consumption to food production (focusing specifically on eggs)

Procedures:
You will be asked to participate in an interactive interview and online activity: Meeting at a time and location previously arranged (via phone/email), you will complete a number of activities on a web-based interface called SpiCE that highlights the environmental sustainability of egg selections. Through your interaction you will comment on the ease of use/interaction, providing comments and suggestions for future revisions if applicable. This may take up to 1 hour.

Potential Risks:
This project contains no known or anticipated risks.

Confidentiality/Anonymity and participant rights:
All assurances to maintain confidentiality of the participants and provided information will be taken. All research materials, documents, and recorded audio files will be stored in a secure location/device on the University of Regina campus. When interacting with the web-based interface you will be provided with a temporary user login and password. In doing such, your specific interaction with the web-based tool will not be tracked. This is done to ensure the confidentiality of your interaction with the web-based interface. Although the data and information on the SpiCE framework web-based interface is publically available you can be assured that no connection to you, your interaction, and the data and information on the SpiCE framework can be made.

Participation in this study is voluntary and you may answer only those questions that you are comfortable with. As well, you may withdraw your participation for any reason, at any time without explanation or penalty of any sort, at any time until May 2013 when some research dissemination may have occurred. Should you wish to do so, and if you deem necessary, all records of participation will be deleted/destroyed.

Questions or concerns:
If you have any questions/concerns or to obtain a summary of the results you may contact the researcher(s) using the information at the top of this page. This project has been approved on ethical grounds by the University of Regina Research Ethics Board on November DATE 2012. Any questions regarding your rights as a participant may be addressed to the committee at (306-585-4775 or research.ethics@uregina.ca). Your signature below indicates that you have read and understand the description provided and consent to participate in this project.

Name of Participant ________________________ Signature ________________________ Date ________________________

Researcher’s Signature ________________________ Date ________________________

You will receive a copy of this consent form
User interaction activity

For this part of the evaluation you will be asked to perform a series of interactions with the system, commenting on them when appropriate. Your interaction may be screen and audio recorded.

The following questions will be used to guide the interview and activity. They may be expanded upon as interaction takes place.

Support personalized recommendations:

1. Click on “Personalize your egg search” tab in the navigation and follow the instructions
   1. After reaching the “Search page” read the “Filter Instructions”
      1. Do you agree with what it says?
      2. What would you change (if any)?

2. Do the search attributes on the right-hand side match the attributes you typically use when buying eggs (the ones preselected and the ones available for selecting)?
   1. Please elaborate your response

3. Using the default, pre-selected search attributes is there an egg product you would consider buying displayed?
   1. If yes, which one and which attributes do you really care about?
2. If not, please add to the search attributes and try to find an egg you would consider buying.
   1. Which attributes here did you really use/care about?
   2. Do you like to have the option to search using more egg attributes “Expand your search options/attributes” link on the lower right-hand side

4. Do you find value in the personalized search? Please explain

Enhance capacity to learn:

5. Click on “View all eggs” tab in the navigation and choose an egg selection (i.e. Pusch Brothers). Is the information provided about your selection useful?
   1. Is there too much information, or too little?

2. What improvements (if any) could be made?

3. Click the “Edit” tab. Do you like that you can change the attributes?
   1. Click back and then on “Revisions” - This tracks the changes made to the egg attributes. Do you like that you can track changes based on people who make them?
6. Click on the “Voting results” tab. This provides an indication of how the other members of this site have rated the quality of the information (whether it is truthful, good/positive, and useful)
   1. Are these helpful in determining the quality of information?

7. Click on the “View all eggs” tab in the navigation and select and egg (do not click on the egg link for now). How does your egg product selection rate with respect to environment, economy, and social criteria (i.e. “tripham rating”)?
   1. If your selection rates well:
      1. How does this make you feel?
      2. Is there a better egg product?
         1. If yes, does this change your egg selection?

   2. If your selection does not rate well:
      1. How does this make you feel?
      2. Would you search for an alternative?
         1. If yes, can you find an alternative among the list of more eco-effective egg products?

3. Click on egg link and then click on “View Tripham rating” in the left-hand side
   1. Does the rating system provide good information about the egg, farmer, brand?
   2. Would you change (add, remove, modify) anything?
Provide ability to create and extend:

8. Add a new egg item by clicking on the “Add eggs” navigation tab
   1. How would you rate the ease of adding a new egg product? (difficult, ok, easy)
      1. If difficult or ok:
         1. What could be changed to make the process easier?

9. Add a new attribute (one will be provided) to an existing egg product
   1. How would you rate the ease of adding a new egg product? (difficult, ok, easy)
      1. If difficult or ok:
         1. What could be changed to make the process easier?

Collaboration and innovation

10. Click on “Brand/producer surveys” in the navigation tab
    1. Click on “The Pusch Brothers Farm”
    2. Click on “Results” | “Analysis”
        1. Is it useful to see Farmer/brand ratings (as provided by other users like yourself)
11. Click on “View all eggs” tab in the navigation. Try to search for a product with the following attributes (“Superstore” | “Certified organic”)
   1. Is it useful to be able to “specify” your interest in a certain product that is not available
   2. Would you find it useful that a farmer/manufacturer can contact you indicating what you were searching for was available (just not in the system yet)?

12. Let's assume you were curious about (egg colour for example – this may be different for each participant), click on “Ask” in the navigation tab:
   1. Is having the capability to ask questions to other consumers useful?
   2. Do you think the responses to your question would add value to your decision-making
   3. Do you think the responses to your questions increase your knowledge about the question asked?

Open-ended interactions

13. Do you find a system like this would be useful? Please explain (what you liked, what you didn't like, what you would add, what you would remove, etc.)

14. Open-ended interaction questions (may differ from participant to participant)