

Collaborative Wellness through Dynamic Role  
Alignment.

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## Certificate of Original Authorship

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I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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Date: 10<sup>th</sup> December 2015

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## Motivation and Vision

The motivation for my research arose from my experiences in addressing complex social problems associated with group knowledge creation collaborations involving IT process and product innovation (Rose 2009, 2010). In the years between 2002 and 2008, I was involved in helping to improve outcomes of IT knowledge creation collaborations. Later, my focus moved to the issues encountered with the introduction of carbon abatement strategies into large organisations and Commonwealth Government agencies.

When addressing problems associated with introducing carbon abatement strategies, I found problem-solving using sequential or waterfall approaches to be unsuitable. Such approaches could not address the situation where implementing solutions adversely affected other areas related to the problem and often changed the very nature of the problem, thereby forcing a re-start to the sequential problem solving approach. To counter this situation, I formed a group of knowledge creators who could adapt to changing circumstances by using iterative, learning-by-doing techniques to devise and apply solution strategies. Outcomes were functionally acceptable, but the adaptations associated with learning-by-doing consumed valuable project time and required additional resources. Over time, I developed a series of perspectives that brought a focus to the learning-by-doing investigations by putting situations in a new light to reveal previously hidden aspects of the problem. These experiences motivated my desire to not only improve collaborative outcomes but also do it in such a way as to consume fewer resources.

My vision was to create a theory-informed system for studying knowledge creation collaboration for use in improving collaborative outcomes in product and process innovation. The system would inform improving the process of dynamic alignment of roles to the collaboration's purpose. Business designers and knowledge researchers could deploy the system in the form of adaptable customised architectures to track, assess and adjust improvement strategies. Experience teaches the importance of socialising improvements, incorporating feedback from stakeholders to ensure value is realised through use, and that improvement outcomes receive business endorsement. In this light, the system should inform the socialisation of collaborative outcomes with stakeholders. My conviction is that enhancing innovation collaboration leads to improved outcomes and the strengthening of the competitive position of organisations.

## Abstract

The pressures to solve the complex social problems of our modern interconnected society have placed an emphasis on the use of knowledge creation collaborations to devise process and design innovations for tackling complex social problems. Despite extensive discussion in the literature, a theory for collaboration in meta-organisations that would inform improving product and process innovation has yet to emerge. To address this situation I treated a knowledge creation collaboration as a human centric, complex, adaptable social system that organisations use to solve problems in product or process innovation. Progress is monitored by assessing the gap between the current state and the state if the purpose of the collaboration was fulfilled. I call this gap "Collaborative wellness (CW)".

Collaborative processes are characterised by communications in social networks created by the interactions of knowledge creators. A knowledge creator will only participate in such a collaboration if they have the confidence to meet their assigned responsibilities. In deciding to participate, a knowledge creator interprets their responsibilities to create and perform a role-in-use which they dynamically adapt and align to the collaboration's purpose as circumstances change. In collaboration, knowledge creators negotiate compatibility between their roles-in-use and thereby form a shared sense of purpose to fulfil the collaboration's responsibilities. The concept of role-in-use alignment is central to my research.

I devised the "Collaborative Wellness System (CWS)" as a theory informed system of collaborative relationships in a framework with measures to support the evaluation and application of improvement strategies to existing collaborations. CWS may also inform the design of new collaborations. CWS is deployed as a customised architecture to suit a particular collaboration using perspectives developed from my practical experience. Improvement has the goal of enhancing both sustainability (doing more with less) and the value derived from using the created knowledge in process and product innovation. The measures of CWS form a tree structure that provides a detailed assessment across selected perspectives of a collaboration at a particular point in time. CWS relates measures to structures, processes and relationships. Four case studies validated CWS and provided a basis for a collaborative wellness scale to compare collaborations and their processes. The research has application in business process restructuring, logistics and disaster relief.

**Keywords:** Collaborative Wellness System, Role-in-use, Role-in-use Alignment, Knowledge Creation, Organisational Knowledge Creation Theory;

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## Chapter 1 Introduction

Rapid change is a feature of our modern world. To survive and prosper organisations must adapt to this dynamic change by introducing new ways of doing things and doing more with less. However, in my practical experience, I have found introducing “new processes into well-established organisations to be problematical” (Rose, Hawryskiewycz & Kang 2014, p. 210). Despite this, a comprehensive theory of knowledge creation collaboration capable of informing both devising and applying improvement strategies has yet to emerge from the literature. My research aims to provide the means for organisations to tackle this problem.

This introductory chapter begins by describing the background and context of my research. The collaborative wellness system with its framework of measures that I devised for fine grained evaluation, tracking and improving knowledge creation collaborations is introduced. The chapter ends with a content guide to each chapter.

### 1.1 Background

The research was practice-based, that is, “research undertaken by a practitioner” in “his or her own practice” (Ginsborg 2014, pp. 77-8); and the practice was based on my product and process innovation (Rose 2009, 2010). When addressing the problems associated with introducing innovations, I found solution approaches using sequential or “waterfall” methods (Royce 2000, p. 116) were unsuitable as they could not address the situation where implementing solutions adversely affected other areas of the problem. In fact, my experience showed implementing solutions often changed the very nature of the problem. To counter this predicament, I formed a group of knowledge creators who could adapt to changing circumstances by using iterative “learning by doing” techniques (Batie 2008, p. 1184) to develop, implement and assess solutions. Although outcomes were functionally acceptable, the adaptations associated with learning-by-doing consumed valuable project time and required additional resources.

In attempting to reduce project costs and time overheads, I developed the empirical dimensions of collaboration as shown in Figure 1 below. These dimensions formed perspectives that helped experts within my group to focus on selected aspects of the problem and compare experiences with others. The experience from using these dimensions suggested that to improve outcomes required balancing the relationships between the dimensions, rather than focusing exclusively on any one dimension. The dimensions and approaches arose over a decade of experience in knowledge creation collaborations using the same core group within a context of the same client organisation.

The close-knit group was co-located and emphasised face-to-face communication with a great reliance on tacit knowledge (McAdam, Mason & McCrory 2007; Polanyi 1966; Polanyi & Prosch 1975). Although using the dimensions helped to some degree in reducing the time and resource requirements, it was evident that further improvements would not be realised unless a theory informed system was devised that supported a consistent method of evaluating, comparing and learning from collaborative experiences.

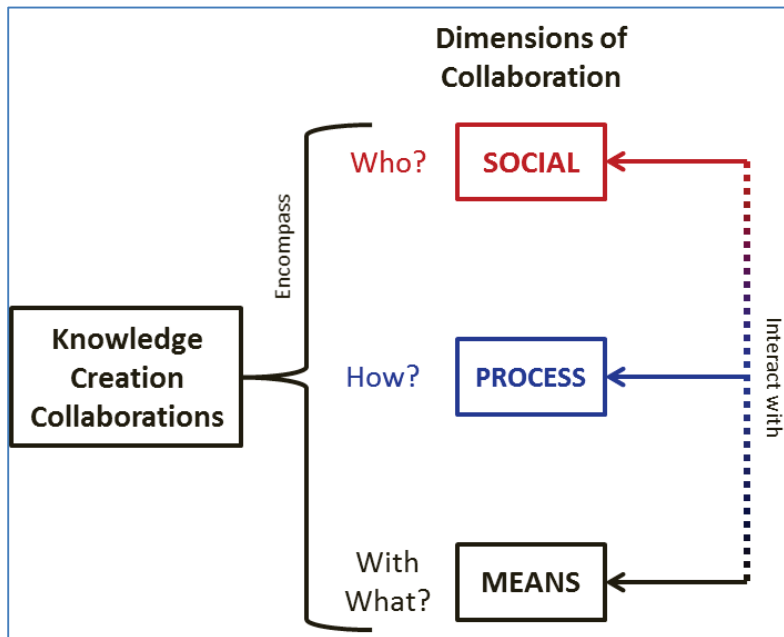


Figure 1 Empirical Dimensions of Collaboration

## 1.2 The Research Theme.

One of the first issues encountered in this research was the need to establish a theme to serve as a guide and provide structure to my work. I have noted that my practical experience prompted the question as to "why implementing new processes into well-established organizations has proven to be problematical" (Rose, Hawryskiewicz & Kang 2014). My intention was not only to understand why and how these problems arose, but also devise and apply improvement strategies. In this regard, the above question was changed into two related questions: firstly, how can new idea implementations needing remediation to improve outcomes be identified and evaluated? Secondly, how can these implementations be improved and the results of applying the improvements be validated?

The intention was that the research case studies would be informed by my experience and this led to the case studies having a dual collaboration structure. There was a research collaboration formed by myself and host stakeholders. The research collaboration interacted with organizational entities to devise and verify improvement strategies. These entities ranged in size from individuals through to collaborations



with one or more groups and scaled up to business units. In this light, investigating the theme would involve characterizing the research collaboration, the host's collaboration and the interactions between and within these two collaborations. This necessitated devising a theory informed system and measures for assessing the progress of the case study collaborations.

### 1.3 The Collaborative Wellness System (CWS)

An organization responds to change by creating, disseminating and using knowledge for product and process innovation. In this situation, knowledge is a "competitive resource" (Nonaka & Takeuchi 1995, p. 6) that is crucial to the organisation's survival and prosperity. Organisational knowledge creation may be characterized by collections of groups such as the one shown in Figure 2 where four groups are working towards the same goal and each contributes to the general goal by socialising their created knowledge. I devised the concept of "Collaborative Wellness (CW)" (Rose 2013, p. 423) to track the progress of a collaboration towards its goal. CW is a "qualitative assessment of the gap between the current state of the collaboration and its desired state as outlined in the collaboration's purpose" (p. 423). Characterising and assessing the state of a collaboration was a central endeavour of my research.

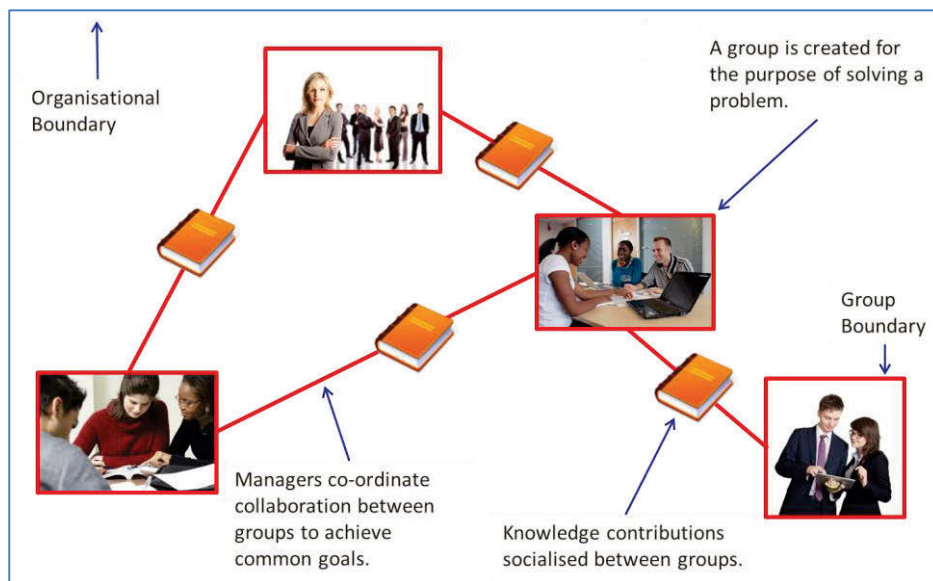


Figure 2 Groups within an Organisation

The example groups of Figure 2 above are part of an organisation's "core activity layer" (Von Krogh, Nonaka & Rechsteiner 2012, p. 259) within a structure that "uses the dichotomy between centralized and distributed leadership and proposes their connection to context, process and knowledge assets" (p. 258 Fig 1) . Creating new knowledge in the "core activity layer" (p. 259) is through human-centric multi-level collaborations in social networks created by interactions between knowledge creators, their groups, and stakeholders. This raised the question as to how these collaborations are implemented, guided and their created knowledge assessed for

value. My answer rested on the relationship between a collaboration's purpose and value realised from using outcomes.

The research started from the observation that an organisation creates a collaboration for a purpose. Following my practical experience, the purpose is to create knowledge for use in an organisation's process and product innovation. Purpose is expressed by stakeholders when they collaborate to create a joint value proposition (Osterwalder & Pigneur 2003). Users of the created knowledge both "perceive and determine value on the basis of use, this is value-in-use" (Lusch & Vargo 2006, p. 284). Furthermore this "value-in-use" was realised through "value co-creation" (Vargo, Maglio & Akaka 2008, p. 149) which placed the joint value proposition at the centre of knowledge creation collaborations.

There were two vital aspects of my case studies, firstly to understand and measure the progress of executing the joint value proposition and secondly engaging with stakeholders and participants to explain the progress, issues encountered and recommendations. From my research perspective, I had to establish a research context across all case studies to support analysis and answer the research question. These considerations led to the Collaborative Wellness System (CWS) shown in Figure 3 on page 5. At the heart of CWS is the value proposition. The entities and their relationships are determined by the action plan detailed in section 4.4.1 on page 143.

CWS encompasses the "Collaborative Wellness Unit (CWU)" and the "Collaborative Wellness Framework (CWF)". CWU is composed of the relationships formed by a knowledge creation collaboration performing a joint value proposition. CWF provides the structure and technology that supports collaboration. CWF is based on Miller's Living Systems Theory (1978). CWS maintains the context of knowledge creation by linking "Collaborative Wellness (CW)" (Rose 2013, p. 424 Fig. 1) to concepts of Organisational Knowledge Creation theory (OKC) (Nonaka & Takeuchi 1995; Nonaka, Toyama & Hirata 2008) for tracking and improving outcomes.

CWS was devised, revised and refined over the period of the case studies and theory development and presented at the 19th Pacific Asia Conference on Information Systems (PACIS 2015) (Rose, Hawryszkiewicz & Kang 2015). It enabled a consistent and rigorous way of explaining issues, contexts, origins and impacts to individual case studies and also in exploring commonalities between study outcomes (Rose, Hawryszkiewicz & Kang 2015, p. 9 Fig. 6). A full discussion of the case study experiences is found in section 5.3 on 168.

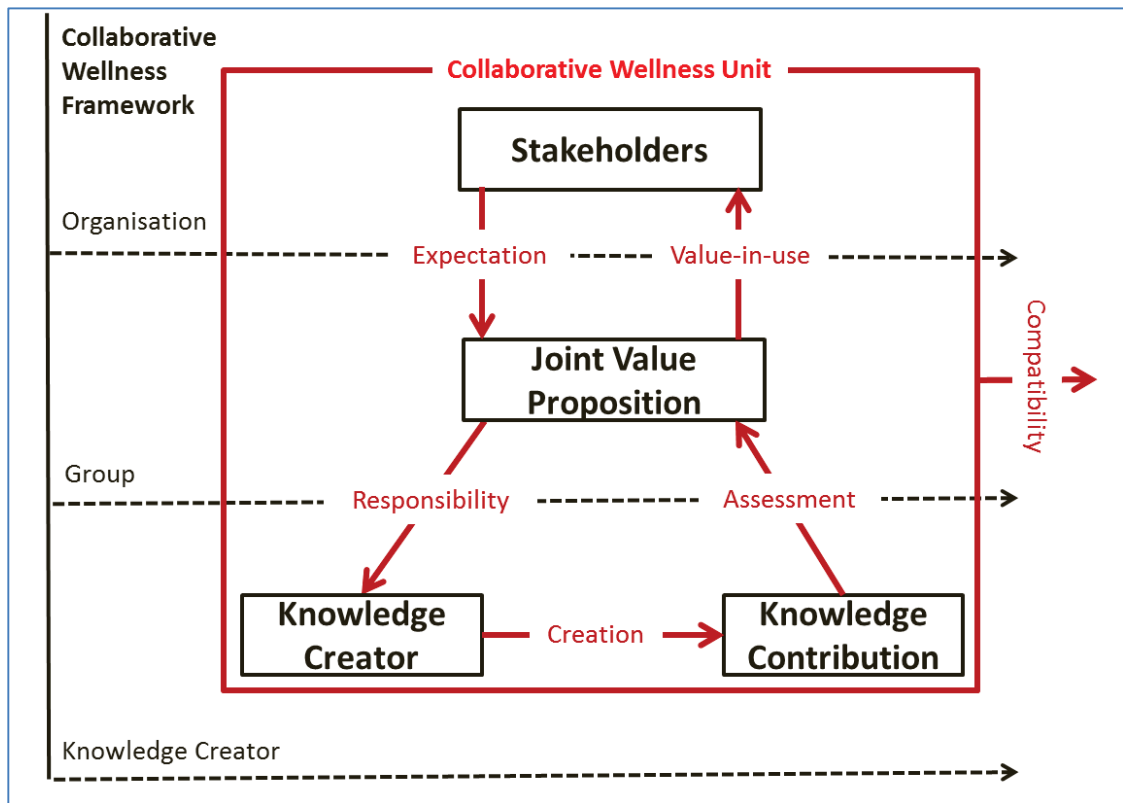


Figure 3 Collaborative Wellness System (Rose, Hawryskiewicz & Kang 2015).

CWS development was informed by feedback from the experiences of three case studies. One at a State Government Agency (SGA) involving the implementation of an inter-group on-line reporting system (Rose 2013). The remaining two case studies were hosted by Woolworths Limited with a focus on the implementation of new ideas in their logistics business (Rose, Hawryskiewicz & Kang 2014). The case studies hosted by Woolworths Limited showed that knowledge creation and “value co-creation” (Vargo, Maglio & Akaka 2008, p. 149) utilising this knowledge occurred simultaneously on multiple levels and indeed between levels in the Woolworths’ organisational structure. A fourth case study to refine CWS was funded by a grant from the Industry and Innovation Project Scheme of the University of Technology, Sydney. This last case study had the purpose of characterising issues in existing into-department information systems of a Commonwealth Government Agency (CGA). At the conclusion of the study, CWS was verified using outcomes from all of the studies combined. The case studies demonstrated that Collaborative Wellness requires the existence of the relationships in the collaborative wellness unit as depicted in Figure 3 above.

The CWU in Figure 3 is shown in the context of the case studies in a business organisation. Although the collaborative wellness framework (CWF) is depicted as having a hierarchical structure, there is no reason why it cannot take other forms such as a community structure created through on-line collaboration in social

## Collaborative Wellness Through Dynamic Role Alignment

networks like Facebook (Berger-Wolf, Tantipathananandh & Kempe 2010). Knowledge creators in distributed collaboration could work in different CWF structures. In my research, I adopted the CWF structure based on my practical experience as that of a hierarchical organisation as shown in Figure 3.

The discussion around the linked groups can now be viewed from the CWS perspective as collaborative wellness units (CWU) linked by commonality in their joint value propositions as shown in Figure 4. CWU's may share physical resources and/or have knowledge creators and stakeholders in common. Indeed, a knowledge creator in one CWU, may be a stakeholder in another CWU and vice-versa. The boundary and characteristics of the CWU's depend upon the scope of the research study and discovered relationships that affect collaborative wellness. I call this discovered network of linked CWU the "Collaborative Wellness Network (CWN)". The components of CWS will now be discussed in greater detail.

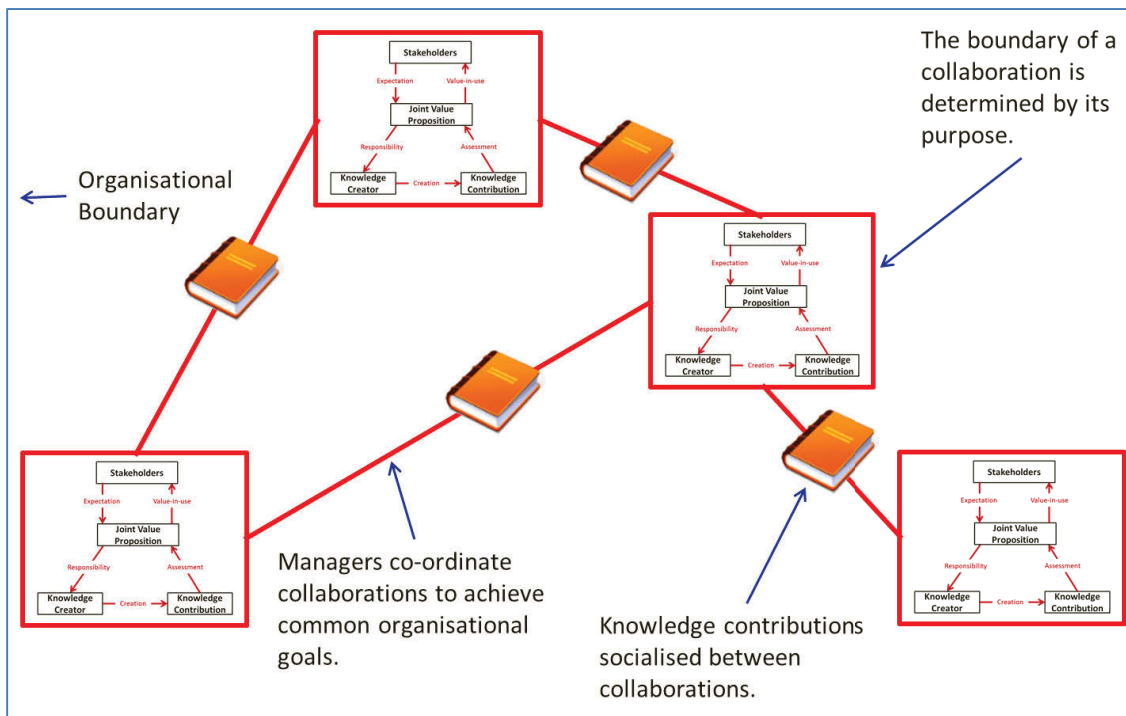


Figure 4 Linked Collaborative Wellness Units in an Organisation.

### 1.3.1 Stakeholders and the Joint Value Proposition

My starting point for CWS was the observation that organizations create collaborations for a purpose. The purpose may be stated as answers to the questions "Who?", "How?" and "With what?" posed in Figure 1 above. The purpose includes the implicit context of the organization such as commitment to organizational identity and culture, external laws and cultural behavioral norms. In a knowledge creation collaboration, purpose determines the kind, structure and knowledge creators in the collaboration, the knowledge contributions required to fulfil the purpose, and how value is to be co-created through use of the created knowledge. Progress is measured

by assessing the gap between the current and desired state of collaboration required to fulfil its purpose. This gap is called "Collaborative Wellness (CW)" (Rose 2013, p. 423).

Central to a collaboration's purpose is its joint "value proposition" (Osterwalder & Pigneur 2003, p. 430), that is created jointly by a collaboration of stakeholders that include vendors, clients and authorities. This joint value proposition "is a request from one service system entity to others to run a procedure or an algorithm" (Maglio & Spohrer 2013, p. 667). When actioned, a joint value proposition is at the centre of a network of relationships binding stakeholders and knowledge creators in "value co-creation" (Vargo, Maglio & Akaka 2008, p. 149). As stakeholders experience the "strengths and weaknesses of joint value propositions, they may reconsider, refine, adapt or abandon the service request" (Maglio & Spohrer 2013, p. 667). The collaboration formed to fulfil the joint value proposition with its network of relationships is dynamic, changing and adapting as the joint value proposition changes. The size varies according to membership dynamics, and activities vary according to the needs of current knowledge creation. This social network is complex and best characterised as a "network-in-use" (Merali 2006, p. 217).

### 1.3.2 The Collaborative Wellness Unit.

In Figure 4 on page 6, collaborative wellness units are linked together. But, how are they linked and identified in a collaboration? The focal point of a CWU is the joint value proposition. A joint value proposition may be successively deconstructed to "describe different aspects of a value proposition" (Osterwalder & Pigneur 2003, p. 431). Similarly, a CWU may also be deconstructed. In this perspective, a knowledge creation collaboration is a network of interconnected collaborative wellness units by virtue of the commonality in their joint value propositions.

A collaborative wellness unit is not only across organisation levels, but can also be across multiple collaborative spaces called "Ba" by Nonaka et al. (2014, p. 139). Reflecting modern communications, these Ba range from the physical with co-located knowledge creators to collaborations conducted in virtual world simulations. Knowledge creation within Ba and in the context of an organisation is "very sensitive to social context" (Nonaka & von Krogh 2009, p. 640).

### 1.4 CWS Components, Knowledge Creators and Measures.

The case studies leveraged my practical experience. The research collaboration of each case study was composed of myself as a participant-observer and study stakeholders that interacted with host organisation collaborations. In view of this, CWS was studied in the context of the research's collaboration with results being generalised to the collaborations of the case study's organisations.

#### 1.4.1 The Knowledge Creator and the Knowledge Contribution.

In my research I distinguished a knowledge creator as being a type of knowledge worker who is engaged in product and/or process innovation. Drucker (1994) characterised participants in knowledge collaborations as “knowledge workers” (pp. 5-6) who “bring their expertise to develop products and services. They require flexible work environments to come up with ideas, evaluate them and put them into practice” (Hawryszkiewicz 2010a, p. 8). In the view of Drucker, “knowledge workers are not ‘subordinates’ but ‘associates’” (2001, p. 78). These characteristics “manifest themselves as a requirement for autonomy, ... attaching importance to commitment ... and a reluctance to share knowledge” (Davenport 2005, p. 15).

Knowledge creators collaborate by occupying one or more roles and interact through these roles. A role is “a responsibility within a business model” (Hawryszkiewicz 2010a, p. 335) and the “Extended Social Network (ESN)” (p. 49 Fig. 3.3) nomenclature may be used by designers to define their interpretation of the roles necessary to fulfil the collaboration’s purpose expressed as a joint value proposition. I took the view that knowledge creators in these collaborations exercise free will to interpret their responsibilities and create, occupy and perform a dynamic role-in-use, which they adapt to align with changes in the joint value proposition and circumstances of collaboration.

During collaboration, knowledge is created and refined through the “SECI” process of organisational knowledge creation theory (Nonaka, Toyama & Hirata 2008, p. 18). A participant-observer with expertise in the joint value proposition uses phronesis, that is, practical wisdom, to assess the usefulness of the knowledge relative to the joint value proposition. Once assessed, I say this knowledge becomes a knowledge contribution. The usefulness of a knowledge contribution varies according to its relationship to other knowledge contributions, changes in the joint value proposition and according to the dynamics of the collaborative wellness network. Accordingly, usefulness may need to be frequently re-assessed. Keeping track of the usefulness assessments is key to studying the progress of collaboration.

#### 1.4.2 The Role-in-use

Discussion has been confined to a static interpretation of responsibility incorporated in a defined role. However, mobilising and creating knowledge to tackle a problem is “through a dynamic ‘entangling’ of the different modes of knowledge conversion in a process which will be referred to as a ‘spiral’ model of knowledge creation” (Nonaka 1994, p. 20). Nonaka and Toyama considered the knowledge creation process as a dynamic synthesizing process in which dialectic thinking was emphasized (Nonaka & Toyama 2003). In this dynamic process, knowledge workers must quickly adapt to changing circumstances. Adaption may include a re-assessment of commitment to

the collaboration's purpose, their approach to occupying roles, the skill sets they bring, their interpretation of the role's requirement and the way they perform assigned roles.

To cater for dynamic adaptation, I introduced the concept of the role-in-use (Rose, Hawryszkiewicz & Kang 2015). Here, a knowledge creator considers their responsibilities and exercises free will to accept the role in the confidence of possessing the skills necessary for meeting the requisite variety determined by the collaboration's joint value proposition, that is, its purpose. The knowledge creator interprets their part in the collaboration's purpose and formulates a role-in-use which they occupy and perform. The knowledge creator negotiates with others to ensure compatibility between their roles-in-use. The role-in-use is discussed in detail in section 3.9 on page 116 and summarised in Figure 18 on page 117.

The joint value proposition determines the "requisite variety" (Nonaka & Takeuchi 1995, p. 82) of the collaboration and the knowledge creator determines the requisite variety of their role-in-use. At the start of collaboration, I consider the requisite variety to be satisfied. The emphasis therefore is on tracking changes in requisite variety relative to the joint value proposition as the collaboration progresses. The role-in-use is a dynamic construct that is changed by the knowledge creator as he or she adapts to changing circumstances.

### 1.4.3 Role and Role-in-Use Alignment

Knowledge creators collaborate in an "energised Ba" (Nonaka, von Krogh & Voelpel 2006, p. 1191) and have a shared sense of purpose aligned to the objectives of Ba. In CWS, this shared sense of purpose is assessed using the concept of role and role-in-use alignment. Business designer's in specifying a role must ensure they align the designed role's responsibilities to the purpose mandated by organisational leadership and stakeholders. Furthermore, they have to consider the requisite variety of the designed role relative to the pool of available knowledge creators.

On the other hand, role-in-use alignment is a dynamic process with two inter-related components. The first component is an assessment of a knowledge creator's capacity and capability to perform their responsibility through their role-in-use. This assessment concerns the knowledge creator's available traits relative to the requisite variety of the role-in-use and a wellness assessment as to how they can and do bring these traits to their role-in-use to satisfy its requisite variety. Together, I call these assessments the knowledge creator's degree of requisite variety.

The second role-in-use alignment component is the performance of the knowledge creator in their role-in-use. This is an assessment of the effect of the knowledge creator's wellness upon the application of their traits in performing their role-in-use

## Collaborative Wellness Through Dynamic Role Alignment

and their relationships with other knowledge creators. The assessed usefulness of the knowledge contribution is considered an indicator of this second component. Role-in-use alignment is assessed relative to the joint value proposition.

All collaborative wellness assessments are made at a particular point in time. They are subjective, qualitative and concerned with tacit knowledge and “tacit knowing” (Polanyi & Prosch 1975, p. 34). The implication is that neither the required requisite variety of the role-in-use nor the knowledge creator’s available traits can be precisely described. Requisite variety may change as the collaboration adapts to new situations, such as a change in purpose. Furthermore, there may be a mismatch between the requisite variety of the role-in-use and that required in the designed role owing to misinterpretation by the knowledge creator and/or a lack of clarity in setting out the responsibilities of the designed role, that is, the designed role might not be aligned to the purpose of the collaboration.

There is a chain of dependencies in alignments. Firstly, the purpose must be clearly stated. Secondly, the designed role must align with this purpose. Thirdly, in accepting their responsibilities in the designed role and creating a role-in-use the knowledge creator’s degree of requisite variety has to satisfy the requisite variety of their role-in-use. Lastly, the created knowledge must be useful relative to the collaboration’s purpose. Based on experience, I posit that a problem found in the usefulness of the created knowledge indicates an alignment issue for investigation starting with evaluating role-in-use alignments.

### 1.4.4 Collaborative Wellness

The concept of collaborative wellness is concerned with comparing the current state with the desired state expressed in the joint value proposition. A precise definition of collaborative wellness requires a pragmatic answer to the question of how can a state be described with sufficient precision to be both useful and performed in a timely manner. The question then arises as to how states may be compared.

The solution adopted was to conceive the state of collaborative wellness as being the synthesis of three gap assessments namely the degree of requisite variety bought by knowledge creators to their roles-in-use, the alignment of the roles-in-use with the joint value proposition and finally the usefulness of knowledge contributions to fulfilling the joint value proposition. These assessments do overlap to a certain extent and are interdependent; further, they are made at a particular point in time. To overcome issues of objectivity, Davenport (2005) suggests that several peer groups may be involved in the assessments to increase the number of responses in the process and introduce other perspectives into the process.



## 1.5 The Research Focus

My research purpose was to address the questions posed in the research theme. This required understanding how to measure outcomes of knowledge creation collaborations. If an outcome is less than that expected in the joint value proposition then how can improvement strategies be applied and their effects assessed in terms of improved knowledge outcomes? The role-in-use, its alignment, and the knowledge contribution are key concepts and gave rise to the research question and research propositions shown below in Figure 5.

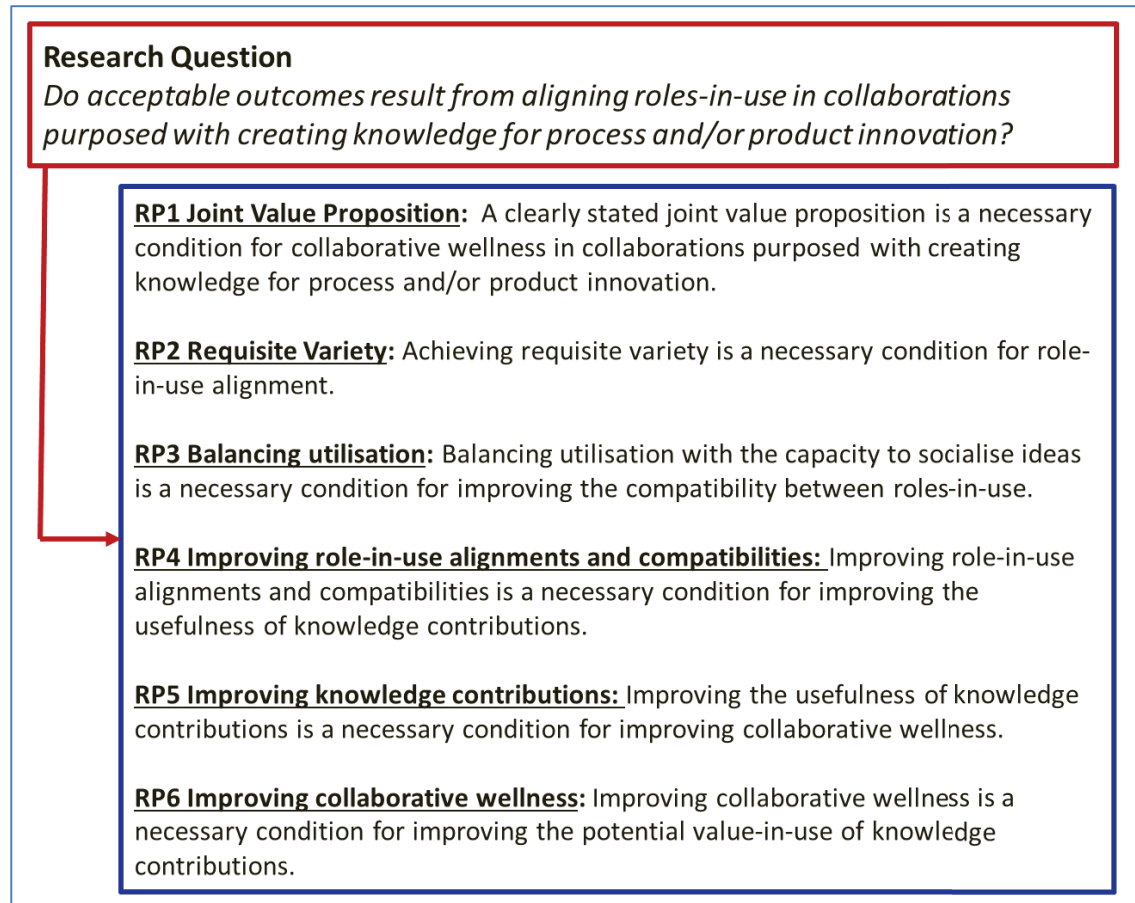


Figure 5. The Research Question and Research Propositions

The research case study was designed as a trial of a collaboration engaged in knowledge creation for product or process innovation with myself as a participant observer. In this light, the case studies were examples of “participatory action research” where “participants take an active role in formulating, designing, and carrying out the research” (Neuman 2011, p. 31). Role alignment would either be varied or observed as it changed under causality from the collaboration. Any changes in collaborative wellness would be observed and investigated. The same trial was performed in each of the four case studies within different organizational contexts. This strategy provided a degree of data triangulation that helped in the subsequent assessments of results. Where possible, assessments were sought from other

knowledge creators and stakeholders in the hosting organizations to help overcome the potential bias introduced by myself as a participant-observer

The Collaborative Wellness System presented in my research has been used on all data and assessments of the case studies to show not only its practical application in remediation but also as a means of explaining concepts, problems and proposed solutions to stakeholders.

### 1.6 Expected Outcome.

The expected outcome of my research was a validation of the concept of collaborative wellness and its use in assessing and tracking the progress of knowledge creation collaborations.

#### 1.6.1 Theoretical Contribution

The outcomes of this research contribute to the information systems of knowledge. A key contribution to theory was the concept of the role-in-use (see sections 3.9 on page 116 and 3.3 on page 96) for studying the dynamics of knowledge creation and socialisation. A role-in-use is created by a knowledge creator using their free will to accept and interpret their responsibilities in a knowledge creation collaboration. I devised role-in-use alignment to assess how well a knowledge creator occupies and performs their role-in-use to align with the purpose of the collaboration. The experience of the case studies informed theory development and led to my concept of the collaborative wellness unit (see section 3.9.7 on page 124) which is the collection of relationships necessary to perform a joint value proposition in a knowledge creation collaboration.

Researchers conceive Ba as a collaborative space that ranges from a physical space such as a meeting space to a virtual space. Ba is a "shared context in motion" (Nonaka, Toyama & Hirata 2008, p. 34). I devised the collaborative wellness framework (CWF) to provide the structure for supporting knowledge creation in Ba. CWF is based on Living Systems Theory (Miller 1978; Miller & Miller 1995a) with updated definitions of the group (see section 3.6 on page 103).

I addressed the criticism of Organisation Knowledge Creation theory (Nonaka & Takeuchi 1995). Knowledge creation theory (Nonaka & Takeuchi 1995) that it is at the level of the organisation without detailed explanations of knowledge processes at the individual or group level (Gourlay 2006) by conceptualising Ba as an innate human attribute resulting from tacit knowing and that the knowledge created in Ba is either "tacit or rooted in tacit knowing" (Polanyi & Prosch 1975, p. 61). This reconceptualization underpinned devising the theory supporting the Collaborative Wellness System (CWS).

### 1.6.2 Methodological Contribution

CWS enables innovation and knowledge researchers to design trials to investigate and compare the complex activities of knowledge creation collaborations using the rigorous and validated methodologies of the collaborative wellness assessment process. Researchers can devise cross-level research propositions between the levels of the knowledge creator, group and organisation. Furthermore, in-level proposals can be developed. Researchers can apply perspectives to the discovered collaborative wellness network (section 3.9.8 on page 125) to examine relationships, knowledge flows and effects of applied causality from a coarse-grained level of the organisation or group to the fine granularity of individual knowledge creation.

### 1.6.3 Substantive Contribution

The validation of the Collaborative Wellness System (CWS) with its concepts of role and role-in-use alignment by four case studies has provided researchers with the precision required to study human centric knowledge creation processes. CWS supports storing, profiling and comparing research experiences and could be utilised to benefit the research design of new case studies.

CWS may also be utilised in business analytics reporting applications for tracking and modelling knowledge creation systems. CWS would be effective in comparing business system performances for diagnosing issues, helping identify processes areas for remediation and acting as input into designing enhanced collaborative systems.

## **1.7 Structure of the Thesis**

This chapter provides a summary of the research concepts and its objectives. The next chapter is a literature review of how researchers define and classify knowledge creation collaborations in the context of an organisation, with the objective to identify knowledge gaps in the application of theory to studying and improving collaborations that create knowledge for product and process innovation activities. The collaborative dimensions, namely SOCIAL, PROCESS and MEANS were used as relevance filters. Characterising socially complex problems determined the scope and depth of the literature review. The investigation inevitably created additional questions to answer and required a re-appraisal of previous material, which in turn generated new questions to follow-up. This iterative discovery process used in the literature review was similar to a snowball sampling methodology (Atkinson & Flint 2001).

Theory is developed in Chapter 3 to fill the relevant knowledge gaps identified in the literature review. The collaborative wellness system (CWS) and the key concepts of role and role-in-use alignment, and the knowledge contribution are discussed. The concepts introduced are explained in terms of their application to collaborations tasked with creating knowledge for product and process innovation. Theory development culminates in a formal statement of the research question and research

proposals. The chapter concludes with collaboration scenarios to aid in discussion of the research propositions.

Chapter 4 begins by laying down the foundation of the research design based on the concepts of “participatory action research” (Neuman 2011, p. 31). The approach used the collaborative wellness system (CWS) to build on a characterisation of collaborations creating knowledge for process and product innovation. CWS enabled the deployment of architectures and measures customised to the particular situation of each case study. Following the research approach, the research design of the case studies is elaborated with explanations of what and how to measure, analysis perspectives, and the detail of investigations for collaborative wellness assessments.

The experiences of undertaking the four case studies are discussed in Chapter 5, which begins with a summary of the case studies. The summary incorporates case study experience contrasted with expectations and a comparison with the action plan developed in Chapter 4. The discussion then moves to synthesize these experiences to provide a basis for verifying the six research proposals and answering the research question. Finally, using the findings of the case studies, the basis of a collaborative wellness rating scale is developed and discussed. A compendium of questions was devised to guide assessments and investigations for applying the scale.

In Chapter 6, the principles arising from the experience of applying CWS to the four case studies is employed to verify the research proposals. The discussion highlights that the synthesis and development of theory supporting CWS have addressed the issues around the lack of precision and inability to track knowledge creation by knowledge creators in Organisational Knowledge Creation theory. The discussion underscores the importance of the joint value proposition and value co-creation in CWS. The final section of the chapter details the limitations associated with the case studies

Chapter 7 is the conclusion of my thesis. The contributions to research and application of outcomes to business organisations are discussed. This is followed by details of opportunities for further research. The chapter concludes with a summation of outcomes.

## Chapter 2 Literature Review

The literature review's objective is to identify knowledge gaps in the application of theory to studying and improving collaborations that create knowledge for product and process innovation required to tackle complex social problems. The questions "Who?", "How?" and "With what?" of the collaborative dimensions (Figure 1 on page 2) are used as relevance filters.

Characterising socially complex problems determines the scope and depth of the review and this work inevitably creates additional questions to answer and often requires a re-appraisal of previous material, which in turn generates new questions to follow-up. The iterative discovery process used in the review is similar to a snowball sampling methodology (Atkinson & Flint 2001). The literature review concludes with a discussion of the discovered knowledge gaps.

The idea for the Collaborative Wellness System (CWS) postdates the literature review. CWS encapsulates the collaborative dimensions and builds on the literature review and subsequent theory development and case study experiences. References are included to aid in establishing the context of the literature review in the subsequent work on CWS.

### 2.1 Introduction

The empirical dimensions of collaboration (see Figure 1 on page 2) indicate that the literature review is complex as it reflects the breadth, depth and connectedness of published research concerned with human collaborations, their context and the knowledge they create to fulfil diverse purposes. The research vision mandates the study of how to improve sustainable collaborations in which knowledge creators exercise free will in creating knowledge to tackle problems of social complexity.

Given the width and depth of the review's scope, the research relies upon the principle of "Ockham's Razor" (Lazar 2010, p. 246), which is seeking the simplest explanation and avoid unnecessary assumptions in characterising the concepts necessary to support my research. My starting point for the review is characterising complex social problems because the nature of the problem determines the means of tackling it. The review is an unfolding iterative exploration of collaborative processes guided by the empirical dimensions of collaboration namely SOCIAL, PROCESS and MEANS.

The collaborative wellness system (CWS) (Rose, Hawryszkiewicz & Kang 2015) devised in 2013 built on research publications included in my literature review. This review includes cataphoric references to establish the review's context in devising CWS. CWS is depicted in Figure 3 on page 5.

## 2.2 Concept Map and Knowledge Gap Summary

This section begins with a concept map that links review sections to the empirical dimensions of collaboration and their aspects. In this map, sections in which knowledge gaps were discovered are marked with an asterisk. A discussion follows concerning possible explanations for these knowledge gaps.

### 2.2.1 Concept Map

Transposing the empirical dimensions of collaboration shown in Figure 1 on page 2 allows for mapping the dimensions and their aspects to the concepts discovered and explored in this review. Some section references are repeated, for example, section 2.3.1 is listed under both the SOCIAL and PROCESS dimensions. This particular section characterised wicked problems as being both complex and social in character and required a multi-disciplinary explanation. These multiple entries underscore the inter-connections of concepts where the explanation of one concept relies upon the understanding of related concepts.

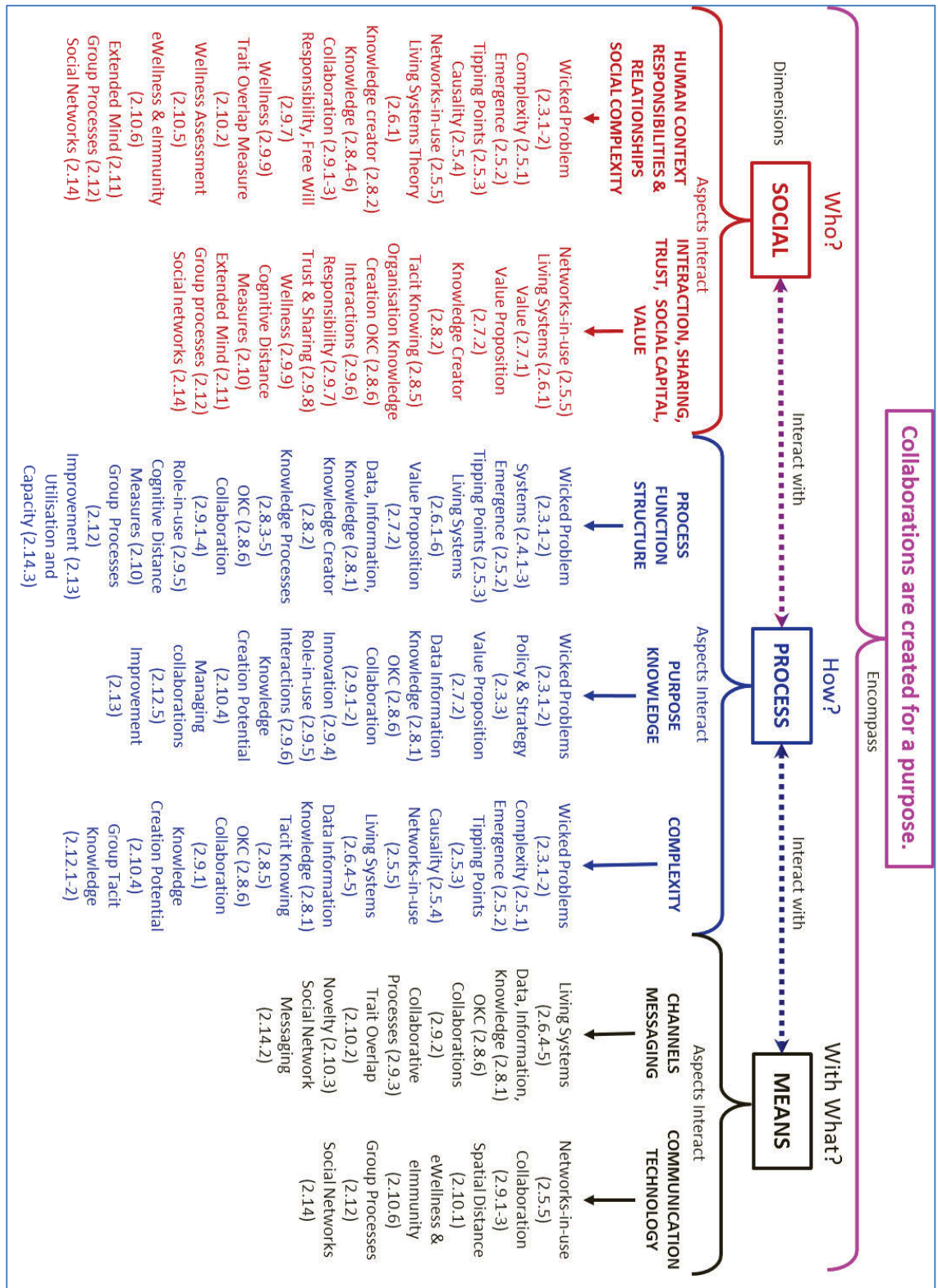


Figure 6 Concepts mapped to the empirical dimensions of collaboration.

Each section of the review has a concluding sub-section that summarises discovered knowledge gaps. These gaps set an agenda for subsequent sections of the literature review. The literature review will conclude with a summary of the knowledge gaps to be addressed in the theory development chapter.

### 2.2.2 Knowledge Gap Summary

My research is practice-based with a focus on collaborations tasked with creating knowledge for use in process and product innovation. An important focus is on tracking the socialisation of knowledge contributions. The objective is to understand how knowledge creators interact to create, socialise and synthesise knowledge, and use the knowledge in value co-creation. The approach is bottom-up with a fine granularity that precludes the simplifying assumptions of the higher level, coarse-grained studies found in the literature.

This granularity disjoint is one factor contributing to the knowledge gaps, as is the lack of detailed descriptions. Another factor is the width and depth of disciplines associated with creation of knowledge brings about a situation where researchers carefully define the scope of their publications to fit in the constraints of preparation time, article size and audience characteristics. The lack of commonality in the scope of research papers has contributed to the width of the discovered knowledge gaps.

## 2.3 Complex Social Problems

My experience shows that introducing ideas into established organisations is often problematical. Attempting to remediate these situations is a complex social problem. Understanding the nature of these problems determines the solution approach to addressing them and the forms that improvement strategies might adopt. In this light, characterising a complex social problem is a natural starting point for this review.

### 2.3.1 Characterising Wicked Problems

The term "wicked problems" was coined by Rittel & Webber (1973) describe a kind of complex social problem that "cannot be definitively described". There "is no objective definition of equity; policies that respond to social problems cannot be meaningfully correct or false; and it makes no sense to talk about 'optimal solutions' unless severe qualifications are imposed first. Even worse, there are no 'solutions' in the sense of definitive and objective answers." (p. 155). Wicked problems "can be considered the symptom of still another, 'higher level' problem" (p. 165).

The "higher the level of problem formulation, the more general it becomes and the more difficult it becomes to address" (p. 165). On the other hand, a solution applied at too low a level may exacerbate the issues because of increased difficulty in dealing with the higher problems. Sandra Batie (2008, p. 1176) used complexity science to describe wicked problems as "dynamically complex, ill-structured, public problems" that "always occur in a social context". Merali (2006) furthers the multi-level concepts of Rittel and Webber by exploring higher-level behaviours that emerge from the complex interactions of lower levels.



### 2.3.2 Addressing Wicked Problems

Wicked problems are not amenable to traditional policy development solutions (Briggs 2007; Morner & Misgeld 2014; Tatham & Houghton 2011). Briggs recommends an iterative, collaborative approach for allowing re-assessment of progress and adaptation to the changing circumstances caused by implementing policies that affect the nature of the problem (2007). Batie characterises this approach as “learning by doing” (2008, p. 1184) and this is emphasized by Morner and Misgeld in advocating “how governing collaborative arrangements can be aligned with consensus-finding and knowledge creation, sharing and use” (p. 17). Design Thinking researchers, in considering wicked problems, support the learning by doing approach (Jobst & Meinel 2014; von Thienen, Meinel & Nicolai 2014).

The part played by conflict, particularly between stakeholders in creating the complexity of wicked problems has been highlighted by Roberts (2000) and emphasized by Camillus (2008) who wrote that it is the social complexity or “wickedness” (p. 100) of a problem that makes it tough to manage. “Wickedness isn’t a degree of difficulty. Wicked issues are different because traditional processes can’t resolve them” (p. 100).

Three types of problem based on social conflict have been identified by Roberts (2000). Type one problems are “simple” because there is agreement on both problem definition (know what to solve) and solution (know how to solve it and what to deliver). I experienced type two problems which have an element of wickedness because although there is agreement on the problem definition (know what to solve), the solution strategy (how to solve it and what to deliver) is unresolved due to disagreements between stakeholders. Finally, in type three, there is no agreement on either the problem definition (what to solve) or the solution (how to solve it and what to deliver). Type three wicked problems are the toughest of all problems to manage.

Rittel and Webber’s idea of wicked problems being symptoms of higher-level problems invites a consideration of structure. In an organisation, type one problems are simple routine problems at the level of groups and individuals. Type two problems can occur at the level of groups and organisations where social networks are important. While type 3 problems are more likely to occur across the interface of an organisation with its constituent community (Hawryszkiewicz 2011).

Partial, provisional courses of action to address wicked problems may be devised, but each wicked problem is in some way unique and requires the development of approaches suited to particular circumstances (Head & Alford 2013). Increasing wickedness not only places greater emphasis on collaborations in bringing together a diverse range of knowledge perspectives to meet the escalating challenge of

devising solution strategies, but also, adds complexity to the task of managing collaborations through the need to adapt to social conflict.

Social conflict involves the exercise of power. Avekino and Rotmans describe a power framework in which power is the “capacity of actors to mobilize resources to achieve a certain goal” (2011, p. 798). In collaborations, power is exercised by stakeholders in framing and mobilising resources to implement collaborations. According to Jensen (2010), “managers should make decisions that take account of the interests of all the stakeholders in a firm. Stakeholders include all individuals or groups who can substantially affect, or be affected by, the welfare of the firm—a category that includes not only the financial claimholders, but also employees, customers, communities, and government officials.” (p. 32). The issue of many masters contributes to the social complexity of wicked problems. Ritchie discusses approaching wicked problems using morphological analysis and modelling (2011) to determine the relative positions and agendas of stakeholders in order to engender understanding of the issues and reduce stakeholder conflicts.

Wicked problems are best tackled in a learning-by-doing approach that involve an investigation to discover the nature of each dimension of collaboration (see Figure 1 on page 2). Discovery is by an investigation of “looking in detail at conversations, emails, manuals and other types of text.” (Underwood & McCabe 2012, p. 88) and finding who and what is active and how they are active at a particular point in time.

### 2.3.3 Policy and Strategy

In 1981, Michael Haines in dealing with policy, posited that policy is usually focused on “a statement of objectives and the strategy to be adopted to meet them, and neither can be studied in isolation since, in practice, the ends to be achieved are determined in relation to the means of achieving them, and vice versa” (p. 127).

Josling writes that policy is generated by “the gap between desires and reality” (1974, p. 236). A policy describes a desired set of future conditions and how to achieve it given the current reality. Changes in reality create tensions within the collaboration developing the policy as the gap between reality and the desired future fluctuates. These tensions exert causal influences on the collaboration’s complex interactions in the development process. Rotmans and Loorbach say that these complex processes have “a history; prior states have an influence on present states, which have an influence on future states. This creates path dependence, whereby current and future states depend on the path of previous states” (2009, p. 186). The process of balancing the tension between the now and future states in policy development is called “AND thinking – a highly complex kind of thinking that works with the inherent tension created by polarity” (Sloan 2014, p. 253).

Wicked problems are multi-level in nature and so the policy solution will also be multi-level in its application to the targeted domain (Haines 1981; Nechansky 2011; Roberts 2000; Tatham & Houghton 2011). Since all wicked problems are in some way unique, the strategies to implement and test policy solutions are pragmatic in nature (Nonaka & Zhu 2012) and from this pragmatic perspective, good policy is actionable. Pragmatic strategies are “rooted in situational particulars, local knowledge, entrepreneurial envisioning, alertness, communal judgement and political manoeuvring which can rarely be generalised or formalised” and implementing pragmatic strategies requires “on-the-spot experimentation” (Nonaka & Zhu 2012, pp. 73-4). The need for experimentation echoes Batie’s learning by doing strategy discussed earlier. Developing a strategy can be done by using scenario techniques that describe the desired future state (Ogilvy, Nonaka & Konno 2014).

### 2.3.4 Knowledge Gaps and Areas for Further Investigation

The review of wicked problems has included the terms “process” to describe interactions and “structure” in referring to the levels of wicked problems. Each wicked problem is in some way unique and requires a problem solving approach that is both iterative and tailored to set in the multi-level context of the wicked problem. The knowledge gap concerns how to tailor the iterative approach and knowledge created to fit the structure of the wicked problem and track the progress of applying the solution strategy.

In any iterative problem solving approach, there should be a review in each iteration in which a judgement is made concerning the product’s potential value, in terms of usefulness, relative to the project goals (Beck et al. 2001; Paulk 2002). The judgement informs a decision for action in the next iteration. To understand this iterative process requires an investigation of value. Value and the concept of complexity and its attendant causality become of increasing concern in situations of heightened disagreements between stakeholders. Knowledge of these concepts become important when devising an answer to the question: what is collaboration?

The discussion on wicked problems, the approach to addressing them, the iterative solution process and the involvement of complex system behaviours provides structure to continue the review and identify the extent to which reviewed theory can be used to understand and improve collaborations creating knowledge. The Collaborative Wellness System is intended for use in tracking progress of collaborations dealing with wicked problems and underpins the iterative assessments used in CWS (see section 3.9.9 on page 126).

## 2.4 System, Structure, Process and Function.

It is important to understand the relationships between structure and process. These two concepts are characteristics of systems, as is the concept of function. A review of systems and types of systems will inform an understanding of complexity concepts.

### 2.4.1 Introduction to Systems

Traditionally, the term system has many, often conflicting meanings and usages, for example, numbering system, railway system, or even solar system. Miller, in his Living Systems Theory provides a general meaning of system as "a set of interacting units with relationships among them" (1978, p. 16). Wicked problem collaborations are "human-centered" (Gumienny, Lindberg & Meinel 2011, p. 6. Table 2) and involve real people in physical locations relying on supporting concrete infrastructures. In this context, the meaning of system can be particularised and restated for a concrete or real system as "a non-random accumulation of matter-energy, in a region in physical space-time, which is organised into interacting, interrelated sub-systems or components" (Miller 1978, p. 17).

### 2.4.2 Structure, Process and Function

The primary aspects of concrete systems, namely structure, process and function interact in feedback loops (Miller & Miller 1982). At any time, "the parts of a concrete system, living or non-living, are arranged in space in a specific pattern. This spatial arrangement is the system's structure. As the parts of the system move in relation to one another, structure changes" (p. 304) and "all change in a system over time is process" (p. 304). "Process includes the on-going function of a system covering both reversible and irreversible actions" that create a history of change. When such "change is so great that it is essentially irreversible, a historical process has occurred giving rise to a new structure" (Miller 1978, p. 23).

Von Bertalanffy is credited with originating general systems theory (Miller 1976). General systems are composed of living and non-living systems. Human-centric systems, such as collaborations, are open (Von Bertalanffy 1950), dissipative structures (Prigogine & Nicolis 1977), which maintain their state through exchanges of energy, matter and/or information with their environment (Miller & Miller 1995a). Social Entropy Theory (Bailey 1990, 2006) describes the state of a living system in terms of entropy.

### 2.4.3 Types of Systems

Living Systems Theory (Swanson & Miller 1989) focuses on a subset of system processes by abstracting entities and processes from the concrete system to an "abstracted" and/or "conceptual" system (p. 18). The definitions for abstracted and conceptual systems are in Table 1 below.

Table 1 Types of Systems (Swanson & Miller 1989)

System	Definitions	Units	Relationships
<b>Concrete</b>	"A structured accumulation of matter, energy and information in a physical region of space organised into interacting, inter-related subsystems or components" (p. 18).	"Other concrete systems (components, parts or members)" (p. 18).	"Spatial, temporal, causal or result from information transmission" (p. 18).
<b>Abstracted</b>	"A limited set of relationships abstracted by an observer from a concrete system. Such systems are studied by conceptual systems" (p. 18).	"Roles abstracted or selected by an observer and filled by different (usually human) actors at different times" (p. 18).	
<b>Conceptual</b>	"A set of words, symbols, patterns, or numbers including those in computer simulations and programs, that has one or more subsets ordered in similar ways" (p. 18).	"Are composed of observations of concrete systems or abstractions from concrete systems" (p. 18).	"Observed relationships or abstracted roles" (p. 18).

In his book, Miller (1978) cites Campbell (1958) in advising how to recognise elements belonging to a concrete system. Table 2 shows the perceptions that an observer may use to identify a concrete system. The table juxtaposes relevant explanatory texts of Campbell and Miller to show how descriptions of perceptions such as common fate have changed in the 20 years between the writings of the authors. There is less emphasis on physical aspects in Miller’s text. With the advent of the internet (Hauben 2001) identifying systems by physical attributes became problematic. I regard knowledge creators of a collaboration as sharing a common fate determined by common purpose rather than their physical relationships.

Table 2 Identifying Elements of a Concrete System

<b>Identifying Concrete System Elements</b>		
<b>Perception</b>	<b>Miller (1978, p. 17)</b>	<b>Campbell (1958, pp. 17-8 cites Wertheimer )</b>
Common Fate	Common fate of its units.	"Elements that move together in the same direction, and otherwise in successive temporal observations share a common fate are more likely to be perceived as parts of the same system" (p. 17)
Pregnance	Distinct or recognizable patterning of units.	"Elements forming a part of a spatial pattern, as a line or more complex form, tend to be seen as a part of the same unit" (p. 18).
Proximity	Physical proximity of units.	"Elements close together are more likely to be perceived as parts of the same organization" (p. 17).
Similarity	Similarity of its units.	"Similar elements are more likely to be perceived as parts of the same organization" (p. 17).

**2.4.4 Areas for Further Investigation**

This section established understanding of using the collaborative dimensions as perspectives (Yoo, Hawryszkiewicz & Kang 2013) to abstract systems from in-situ collaborations. For example, the SOCIAL dimension acts as a perspective to abstract the social network of the collaboration. Abstracting allows the maintenance of the context of the abstracted system entities (human and non-human) with the original collaboration. Maintaining contexts allows for the study of causality and other interactions between the dimensions of collaboration. This understanding will need to be explored when devising measures of the collaboration’s progress.

A simple means of identifying system components has been given by their common fate in Table 2, above. In group collaborations, the common fate is the shared purpose of the group. The question of what is meant by a collaboration’s purpose will need to be addressed. Reference has been made to complex processes and the next section will explore complexity and its role in group collaborations. In addition to the context of complexity, the review will need to discover how to identify complex behaviour and lay the basis for devising measures to track identified complex behaviours.

In CWS, the collaboration’s purpose is detailed in the joint value proposition (see section 3.8.4 on page 110). The joint value proposition is central to CWS as all measures of knowledge contributions are about their usefulness in fulfilling the joint value proposition (see section 3.8.5 on page 112).

## 2.5 Complexity.

Wicked problems have been characterised in terms commonly associated with complexity. However, there is no agreed definition of “complexity” and no single science of complexity. Merali states that the terms “complexity theory’ and ‘complexity science’ do not refer to a clear-cut scientific paradigm” (2006, p. 219). In her book, Mitchell lists nine ways of describing the concept of complexity (Mitchell 2009, pp. 94-111). Maguire opined that “attempts to do so quickly encounter difficult ontological and epistemological questions which are made all the more intractable because they overlap” (2011, p. 83). The task here is to characterise behaviours so that complex system behaviour can be recognized and taken into account when studying and improving group collaborations.

### 2.5.1 Complexity Terms

Complexity terms such as “emergence” (Ellis 2006, p. 2) are ubiquitous in the literature and lack clear, consistent definitions. Obscureness in terminology is made worse by these terms being used freely in and across multiple disciplines, including systems engineering, knowledge and cognition, network theory, ecology, biology, management science, economics and the social sciences. Table 3 provides interpretations of commonly used complexity concepts in my research.

Table 3: Complexity Concepts

Concept	Explanation
<p><b>Complex or Complicated</b></p>	<p>In a complicated system, components “maintain a degree of independence from one another”. Removing a component reduces system complication but does not alter the system’s functionality. In contrast, a system becomes complex because of the importance of component dependencies and the interactions between components. Removing a component from a complex system alters the behaviour of the whole system. (Miller &amp; Page 2007, p. 9).</p> <p><b><u>Research Context</u></b></p> <p>Studying and improving a complex collaboration requires an iterative, learning by doing approach that in the researcher’s experience uses greater resources and time compared to</p>

Concept	Explanation
	<p>traditional waterfall problem solving approaches. It is desirable to know beforehand if a system should be treated as complex so that an appropriate strategy can be selected for studying it.</p>
<p><b>Demergence</b></p>	<p>Occurs “where larger scale structures not only lack the properties that their components have, but are somehow constitutionally incapable of having those properties. Consciousness is a demergent property, one that pops into existence at a certain level of organizational structure, but then disappears from higher levels of organization except insofar as it is found in the parts.” (Theiner, Allen &amp; Goldstone 2010, p. 383).</p> <p><b><u>Research Context</u></b></p> <p>The implication of demergence is that it cannot be assumed that the characterising one type of group collaboration applies to all types of group collaborations or collaborating organisations.</p>
<p><b>Effective Complexity</b></p>	<p>“The effective complexity of an entity is the length of a very concise description of its <i>regularities</i>, as distinct from features treated as random or incidental. Complexity does not mean randomness.” (Gell-Mann 2011, p. 53; Gell-Mann &amp; Lloyd 1996, p. 48).</p> <p><b><u>Research Context</u></b></p> <p>Improving a collaboration often requires a choice between alternative processes to determine the best outcome for least use of resources and time. How can complex processes be compared? Although general in nature, effective complexity does provide a basis for devising a comparative measure based on process steps. Effective complexity is a qualitative assessment and therefore contains an element of uncertainty as it relies on the expertise of the observer. The implication is that the effective complexity will be subject to re-evaluation as a collaboration progresses and the observer’s knowledge of the collaboration increases.</p>
<p><b>Emergence</b></p>	<p>“Emergence refers to the phenomenon whereby the macroscopic properties of the system arise from the microscopic properties” (Merali 2006, p. 220). “Emergence is characterised by hierarchical structures with different levels of order and descriptive languages (levels of phenomenology), plus a</p>



Concept	Explanation
	<p>relational hierarchy at each level of the structural hierarchy” and “higher level structures cannot be described in terms of lower level languages.” (Ellis 2006, p. 2).</p> <p><b><u>Research Context</u></b></p> <p>Emergence at the group level creates an issue in tracking causality and events. Events can be tracked up to an emergence or back to the immediate period following the emergence. However, it is not valid to infer causal links across the emergence because the human knowledge creators would have recognised and adapted to the emergence thus changing the collaboration. This is referred to as “level 5 emergence” (Ellis 2006, p. 15) and failing to detect it could invalidate measures and analyses of the collaboration.</p>
<p><b>Qualitative Test for Emergence</b></p>	<p>Ronald, Sipper &amp; Capcarrère (1999) based their test for emergence on the work of Turing (1950). Consider an observer who although being fully aware of the system’s components, observes and describes the global performance of the system. Emergence has taken place when there is “a cognitive dissonance between the observer’s mental image of the system’s design ... and his contemporaneous observation of the system’s behaviour” (p. 228). That is, the well-informed observer is surprised at the behaviour of the system and is unable to reconcile this behaviour with their expectations based on their knowledge of the system.</p> <p><b><u>Research Context</u></b></p> <p>Adopting a qualitative test for emergence has implications in designing research case studies. The test requires an observer with sufficient system knowledge to make an informed assessment. This assessment is subject to uncertainty since achieving the level of knowledge required by the test may be problematical. Opinions of emergence are therefore subject to re-evaluation as the particulars of the system are studied in greater detail (Ronald, Sipper &amp; Capcarrère 1999). Given the necessity of the presence of the observer, it is reasonable to expect that knowledge creators’ awareness of, and adaptation to observation will influence the course of the collaboration</p>

Concept	Explanation
	(Silverman 2010; Yin 2009) and thereby add to the uncertainty of emergence detection.

### 2.5.2 Emergence

Wicked problems are intractable and unpredictable in their responses to applied solution strategies (Briggs 2007; Camillus 2008; Head & Alford 2013; Rittel & Webber 1973; Tatham & Houghton 2011). The heart of this issue is emergence. "Emergence refers to the phenomenon whereby the macroscopic properties of the system arise from the microscopic properties" (Merali 2006, p. 220). The macro-level properties are distinct from those displayed by any subset of its components. Put simply, "the whole is more than and certainly different in kind to the sum of its parts" (p. 220). Given the theoretical difficulties associated with prediction and detection of emergence in wicked problems (Johnson 2009; Smith & Johnson 2008), a qualitative test was adopted and based on a test proposed by Ronald, Sipper & Capcarrère (1999) to assess if a system's behaviour could be described as complex (see Table 3 on page 25).

Notwithstanding the issues surrounding prediction of emergence, there has been much work on characterising emergence and the events and causes leading up to and beyond the discontinuity created by emergence. Five levels of emergence are summarised in Table 4 below based on the work of Ellis (2006, pp. 14-5). The characterisations from Goldspeak and Kay (2008, p. 4) are summarised for each of Ellis' levels of emergence. Levels move from the simple property or variable emergence to level five which highlights the conscious design, selection and decision processes of humans in the knowledge of prior emergence using abstracted cognitive systems.

Table 4 Levels of Emergence.

Level of Emergence (Ellis 2006)	Description from Ellis (2006)	Characteristic Organisation (Goldspink & Kay 2008, p. 4 Table 1)
<b>1</b>	"Bottom up action leads to higher-level generic properties but not to higher-level complex structures or functions" (p. 14).	"Property Emergence" (p. 4).
<b>2</b>	"Bottom up action plus boundary conditions (top-down causation) lead to emergent higher-level structures not directly implied	"Self-organization, Far from Equilibrium, Weak autonomy" (p. 4).

Level of Emergence (Ellis 2006)	Description from Ellis (2006)	Characteristic Organisation (Goldspink & Kay 2008, p. 4 Table 1)
	by the boundary conditions" (p. 14).	
<b>3</b>	"Adaptive behaviour according to pre-set rules" (p. 14).	"Self-production metabolism with strong autonomy" (p. 4).
<b>4</b>	Level 3 plus "adaptive behaviour influenced by specific events in the individual's history" (p. 14)	"Autonomous sensory-motor loops" (p. 4).
<b>5</b>	Humans only. Level 4 plus "conscious design, selection and decision. The transcendence in the creation of ideas and abstracted systems" (p. 15). [See also dynamic knowledge creation (Nonaka & Toyama 2003; Nonaka, Toyama & Konno 2000; Nonaka & von Krogh 2009)]	"Semiotic autonomy (strong autonomy)" (p. 4).

The gap between lower levels of emergence and level five emergence is created because it is only in level 5 emergence that decisions made by the conscious human mind play an important part in the emergence. In collaborations that depend upon communication technology it is important to distinguish between level five emergence and other levels. For example, if there was a delay in communication was it caused through another knowledge creator adapting to a situation and deciding to cease communication or was the delay caused by a communication system failure.

To aid in distinguishing between types of complex systems and levels of emergence, three types of complex systems are given in the table below according to occurrences of particular levels of emergence. The dimensions and aspects of collaboration (Figure 6 on page 17) can be used as perspectives to identify the system types.

Table 5 Types of Complex Systems

System	Level of Emergence	Dimension of Collaboration	Explanation
<b>Complex System</b>	Levels 1-2 Emergence	MEANS	Emergence is response to causation: bottom-up, same level or top down (Auletta, Ellis & Jaeger 2008; Ellis 2008)
<b>Complex Adaptive System (CAS)</b>	Levels 3-4 Emergence	MEANS and COMPLEXITY aspect of the PROCESS dimension.	"Complex adaptive systems are special cases of complex systems. They are adaptive in the sense that they have the capacity to change and learn from experience" (Rotmans & Loorbach 2009, p. 186).
<b>Complex Adaptive Social System (CASS)</b>	Level 5 Emergence	SOCIAL	CASS adds the "social" to complex adaptive systems to denote human-centric processes. "Complex adaptive social systems are composed of interacting thoughtful (but perhaps not brilliant) agents." (Miller & Page 2007, p. 94). Agents are able to construct an abstraction of their own environment and use that to inform their behaviour. Furthermore, Boisot and Li state that "all social systems are complex adaptive systems and operate far from equilibrium" (Boisot & Li 2007, p. 78).

A summary of the terms of emergence found in this literature review is in Table 6, together with a map to Ellis' levels of emergence.

Table 6 Characteristics of Emergence

Level of Emergence (Ellis)	Terms of Emergence	Characteristics	Field of Study	Researcher
<b>1</b>	Transformational emergence	Sub-systems of LST take on new characteristics in higher LST levels	Living Systems Theory (LST)	(Bailey 2005; Miller 1978)

Collaborative Wellness Through Dynamic Role Alignment

Level of Emergence (Ellis)	Terms of Emergence	Characteristics	Field of Study	Researcher
<b>1</b>	New variable emergence	New variables occur at higher levels of LST sub-systems	Refer to section 2.6 on page 36.	
<b>2</b>	Epistemically emergent	"Phenomena that cannot be deduced from underlying laws" (p. 503).	Bio complexity and Informatics	(Kauffman & Clayton 2005)
<b>2</b>	Ontological emergence	"New 'higher' levels of entities arise and have causal powers not possessed by the parts" (p. 503).		
<b>2</b>	"Part-whole emergence" (p. 36).	"A whole is identified as being made up of parts and the whole's outside set of properties is not <i>causally</i> reducible to the inside set of parts" (p. 36).	Philosophy.	(Gulick 2003)
<b>2</b>	"Transformational emergence" (p. 38).	"Newly emerged entity has unique features different from its predecessor" (p. 38).		
<b>3</b>	"Self-organizing emergence" (p. 39).	"The emergent structure operates according to rules different in type from the rules governing its various components, and there is a causal decoupling between the system as a whole and its		

## Collaborative Wellness Through Dynamic Role Alignment

Level of Emergence (Ellis)	Terms of Emergence	Characteristics	Field of Study	Researcher
		contributing parts" (p. 39).		
<b>1-4</b>	Discovered Emergence	Emergence detected by an external observer at the level of emergence. The properties of the whole cannot be viewed as the aggregation of the parts.	Social Systems and Management Theory.	(De Haan 2006)
<b>5</b>	Discovered Emergence in collaborations.			
<b>2</b>	Mechanistic Emergence	An observer cannot completely describe the emergence in terms of the higher level. (De Haan 2006, p. 296).		
<b>4-5</b>	Reflective emergence	The knowledge creators in the system are aware of the emergence and adapt accordingly. The awareness of emergence is itself an emergent phenomenon.		

De Haan (2006) discusses reflective emergence where the awareness of emergence is itself an emergent phenomenon. This reflects the notion that the performance of a human cognitive process to derive meaning from observations is complex emergence (Polanyi & Prosch 1975).

The notion of wicked problems being symptoms of higher-level problems introduces the idea of mapping wicked problems to social structures. Type 1 problems are simple routine problems at the level of groups and individuals in an organisation. Type 2 wicked problems can occur at the level of groups and organisations; and type 3

wicked problems are more likely across the interface of an organisation with its constituent community (Hawryszkiewicz 2011, p. 7). The observation by Rittel & Webber (1973) that there is “nothing like a natural level of a wicked problem” (p. 165) can now be considered in the light of complexity. Mapping of problem types to structure provides an insight into how “top-down causation” (Auletta, Ellis & Jaeger 2008, p. 1159) is applied from higher down to lower levels and thereby influences and affects the nature of the lower level problem. Conversely, the interactions in addressing lower level problems could result in higher-level complex emergence of new behaviours and structures in the wicked problem, this is “bottom-up causation” (p. 1159). The next sub-sections deal with tipping points that lead to emergence and the role of causality in emergence.

### 2.5.3 Tipping Points

Emergence takes place at a “tipping point” where “quantitative change (observable simply at the micro-level as the increase in the number of links per node) suddenly leads to qualitative change (observable at the macro-level as a change in the whole system’s state).” (Merali 2006, p. 222). In discussing complex adaptive systems (CAS), Holland states “All CAS that have been studied carefully exhibit lever points – points where a simple intervention causes a lasting, directed effect.” (2006, p. 6). These lever points are the same as tipping points.

The application of causation (Auletta, Ellis & Jaeger 2008; Ellis 2008) at a tipping point can activate it and result in emergence. In a paper concerning sustainability decision management, Browne and McPhail highlight the importance of shifting baselines and tipping points (2011). They characterize tipping points as thresholds where major irreversible changes of state of the system occur. These changes of state are the subject of transition analysis methodologies (De Haan & Rotmans 2011; Rotmans & Loorbach 2009) in organisations. The implication of tipping points, emergence and causation is that complex feedback loops and tipping point activation can occur simultaneously at multiple levels in a complex adaptive social system thereby creating irreversible or historic changes.

### 2.5.4 Causality

Knowledge creators in collaboration recognise emergence and in adapting to the new situation change their collaboration. In these circumstances, repeating the same causation will produce different results. The following test of causality may be problematical because of the reliability requirement. The test is that “causes are separated from effects by searching for correlations between phenomena such that the manipulation of one (‘the cause’) can be shown, in a specific context, to reliably result in changes in the other (‘the effect’) at a later time” (Ellis 2008, p. 1).

A similar caveat applies to this discussion on types of causation. Auletta, Ellis and Jaeger deal with “top-down causation by information control” (soft control) which they say is “the ability to use signals to attain or maintain a specific goal” (2008, p. 1161). They discuss two important concepts. Firstly, the idea of a “functional equivalence class of lower level operations” which are “sets of lower level operations that produce the same higher level outcome” (p. 1162). In the context of top-down causality, a goal set at a higher level can be achieved by information control of the lower level process selected from a set of operations that produce the same desired outcome. In effect this is Ashby’s law of requisite variety at work where information control is being applied to the “regulator” (1958, p. 3).

The second concept is that of “causal power” where the “causal agent can positively give rise to a certain effect through interactions at the same ontological level” (Auletta, Ellis & Jaeger 2008, p. 1161). A cause that has power, but no effectiveness can only influence an outcome. Bottom-up causation enables lower levels of a system to determine what happens at higher levels. Whereas constraints have causal power but no effectiveness.

All forms of causality function at a variety of levels simultaneously (Ellis 2008; Gulick 2003). Any one explanation based on a particular causal effect is at best a partial and incomplete explanation. “There are always multiple levels of explanation that all hold at the same time: no single explanation is complete, so one can have a top-down system explanation as well as a bottom-up explanation, *both being simultaneously applicable*” (Ellis 2004, p. 21).

Living systems strive to achieve a balance between opposing causalities (Miller 1978; Miller & Miller 1991). This balancing of paradoxes is seen as a useful tool in creative thinking. Boardman and Sauser discusses the role of balancing paradoxical requirements in designing systems (2008). The same concept is used by Sloan (2014) in her “AND” (p. 254) thinking in which paradoxes are utilised to form a “creative tension” (p. 254) to inform the search for new possibilities in strategic thinking. Ulieru & Doursat (2011) also employ a form of top-down causation through the application of a constraint in their explanation for guiding “emergent engineering” (p. 42) through the resolution of paradoxes by an adaptive process.

Causal maps are used to understand and visualise causality in complex system state changes. They are directed graphs showing means/ends (Eden, Ackermann & Cropper 1992) and represent a “complete causal structure” (Greenland & Pearl 2008, p. 1).



### 2.5.5 Networks-In-Use

Merali (2006) discusses the concept of a “network-in-use” (p. 217) that emerges from the complex interactions of physical network components. She broadens the scope of network-in-use by stating that the “realised internet-enabled information network (i.e. the *network-in-use*), comprises social, economic, political, legal, informational and technological dimensions. The information network-in-use can thus be viewed as an *informational representation* of the interactions of participating agents situated in their social, economic, political, informational and technological contexts.” (2006, p. 217).

### 2.5.6 Knowledge Gaps and Areas for Further Investigation

The importance of structure to understanding complex behaviours such as emergence has been stressed in the literature. Structure establishes a contextual framework relating individuals to groups and placing the group in its organisational environments. The concept of the network-in-use needs further investigation in relation to group collaborations because it could provide a basis for understanding the dynamic interactions of knowledge creators.

The action of free will on emergence has been acknowledged by researchers as being controversial and to be treated with caution (Ellis 2008; Merali 2006). Others have de-scoped free-will from their studies (Auletta, Ellis & Jaeger 2008; Merali 2002) or made simplifying assumptions to remove the effect of free-will in their deliberations (De Michelis 2001).

Activity is a prime determinant for membership in a network-in-use. However determining the collaboration’s network-in-use solely on an activity basis risks excluding causation such as passive observers whose presence during a collaborative session influences knowledge creator behaviours, therefore the sources of causation need to be accounted for in the network-in-use. Further investigation is required to address the problem of how to include causality in the study of a collaboration’s network-in-use.

In systems thinking, concepts used in modelling complexity in social behaviour such as free-will, intentionality and purposiveness have been criticised for their inadequacy (Merali & Allen 2011). Knowledge creation theory (Nonaka & Takeuchi 1995) is at the level of the organisation without detailed explanations of knowledge processes at the individual or group level (Gourlay 2006). Little information has been found on group collaborations dealing with social complexity. In summary, the review has found the literature focussed on complex behaviours associated with emergence levels of 1 to 4, but level five emergence covered in the previous section has not been found in the literature.

Complex emergence is a fundamental consideration in the collaborative wellness system (CWS). In particular, it determines the measure for assessing a knowledge contribution. This measure is called effective emergence of knowledge contributions and it is defined in section 3.8.9 on page 116).

### 2.6 Structure and Knowledge Creators

It is timely to review theories for establishing a structural framework to support relationships critical to understanding knowledge creation processes. This section addresses questions such as what is the difference between a group, an organisation and a community. How do knowledge creators, collaborations and organisations interrelate and interact with each other? How can complex behaviours be mapped to structural relationships? How can multi-level wicked problems mesh with the proposed framework?

#### 2.6.1 Miller's Living Systems Theory (LST)

Living Systems Theory (LST) (Miller 1978) has been applied to the measurement and interpretation of process flows in accounting (Swanson & Miller 1989) and other researchers have used LST in the fields of: marketing analysis (Reidenbach & Oliva 1981); human-computer interface (HCI) design (Letsu-Dake & Ntuen 2009); management; and organisational behaviour (Tracy 2006). In the case of the human-computer interface design, Letsu-Dake and Ntuen commented that "LST is mostly descriptive and requires rigorous modelling and analysis for effective application in engineering contexts" (2009, p. 20).

LST links non-living and living systems as it "identifies basic principles that underlie the structure and processes of living things and relates them to the non-living physical world, integrating and bringing order to the ever-growing mass of empirical data about them" (Miller & Miller 1995a, p. 19). Figure 7 below shows the 8 levels of LST, each of which has the same 20 sub-systems (Miller & Miller 1995a, p. 27 Fig.1), such that "the principle components of living systems at each level are systems at the level below" and "larger, higher level systems developed more, and more complex, components in each subsystem than those below them in the hierarchy of living systems" (Miller & Miller 1990, p. 157). This is the LST concept of "fray-out" and "describes an evolutionary specialisation by which higher order living systems evolve from lower order ones" (Swanson & Miller 1989, p. 55). Non-living systems can be a part of the LST hierarchy, but are not required to have all of the sub-systems of living systems and do not necessarily require matter/energy interchanges with

their environment in order to maintain their state (Miller & Miller 1982).

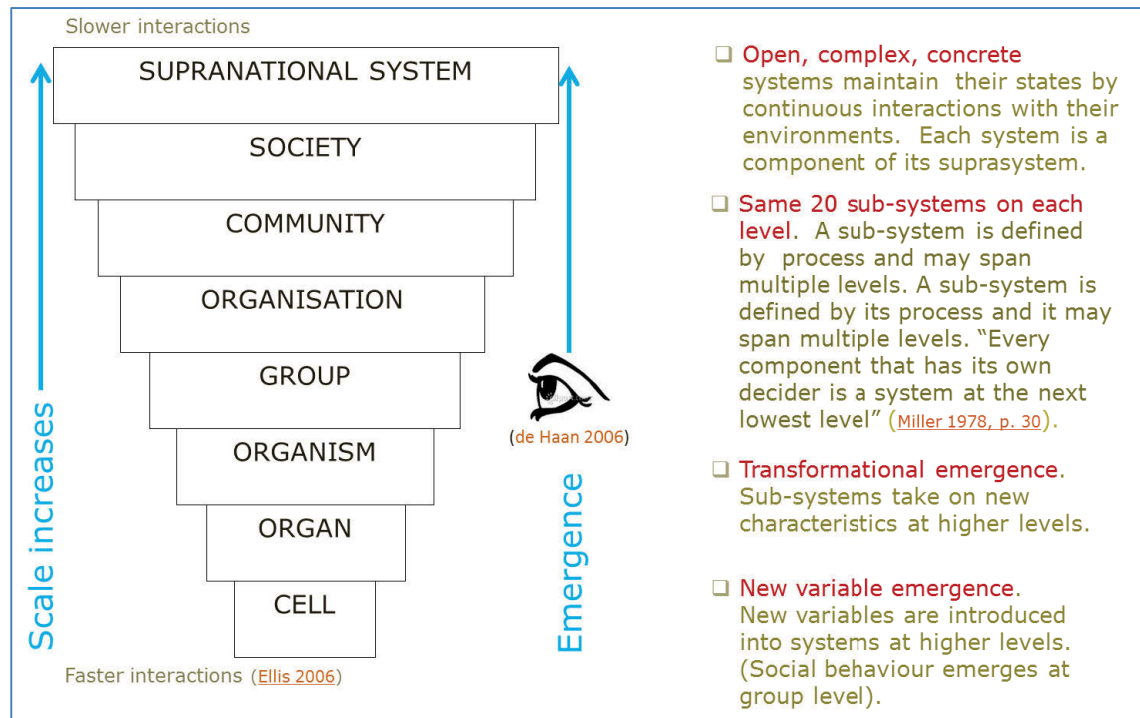


Figure 7 Structures of Miller's Living Systems Theory (1978)

Knowledge creation collaborations have been characterised as complex systems and LST supports complexity concepts. Miller stated that "the more complex systems at higher levels manifest characteristics, more than the sum of characteristics not observed at lower levels" and "these characteristics have been called *emergents*" (1978, p. 28). Furthermore, "higher-level systems have emergent structures and processes that are not present at lower levels" (Miller & Miller 1995b, p. 171). One significant example of LST emergence applicable to my research, is that of "co-operative activity, impossible at lower levels, emerges at the level of the group" (Miller 1978, p. 1037). Two forms of emergence are characterised in LST, the first form being transformational emergence in which the 20 sub-systems take on new characteristics as the hierarchy is ascended, and the second form is new variable emergence (Bailey 2005).

LST systems are complexly structured open systems that "maintain within their boundaries their thermodynamically improbable energetic states by continuous interactions with their environments" and the "total inputs are lower in entropy and higher in information than the total outputs." (Miller & Miller 1990, p. 157). Prigogine and Nicolis (1977) showed that the continued existence of emergent states requires input of matter-energy from the environment. The LST subsystem is defined as performing a particular purpose (Miller 1978). In my research, I am concerned with the decider subsystem, which coordinates and controls all other subsystems. The decider provides a way of unambiguously distinguishing between LST levels.

Organizations “always have at least two echelons in their deciders” (Miller 1978, p. 595), group “deciders have no formally designated echelons” (p. 595), and the community’s decider is disbursed (Miller & Miller 1982, pp. 304-5). Finally, a knowledge creator’s decider is their “cerebral cortex” (Miller 1978, p. 1029).

In Figure 7 above, the increasing physical scale of LST levels is based on Miller (1978, p. 1034). The direction of emergence is indicated and the eye represents de Haan’s observer (De Haan 2006). The proposed LST level of tissue (Bailey 2005, p. 38; Miller 1978, pp. 315, 1044) has not been included.

LST could provide the structural basis for my research’s collaborative framework. LST supports complex behaviours such as emergence of knowledge at the group level from the lower level interactions of knowledge creators. The following sub-sections examine this structure further and its fit with the group collaboration in an organisational context.

### 2.6.2 LST Systems

LST has 8 levels of systems, however I am primarily concerned with the organism, group, and organisation (for the context of the group). The community level is “ambiguous” and “ill-defined” (Bailey 2005, p. 38) and will need to be updated for this research.

Table 7 Living Systems’ Organisation, Group and Organism Levels.

Level	Interpretation
<b>Organisation</b>	“Organisations are systems with multi-echelon deciders whose components and subsystems may be subsidiary organisations, groups and (uncommonly) single persons” and organisations “always have at least two echelons in their deciders” (Miller 1978, p. 595)
<b>Group</b>	“A set of single organisms, commonly called members, which over a period of time or multiple interrupted periods, relate to one another face-to-face, processing matter-energy and information” (Miller 1978, p. 515). “Group deciders have no formally designated echelons” (p. 595).
<b>Organism</b>	Miller uses the term organism in its “usual biological sense” (1978, p. 361) and lists a structural taxonomy of organisms. As living systems, he emphasizes that they are “real, visible and discrete” and states that an “organism is a unity” (p. 499). A working definition for an organism is suggested as a “living individual” (Jagers op Akkerhuis 2010, p. 250) but there is “no

Level	Interpretation
	consensus exists on a definition of life or on the closely related and problematic definitions of the organism and death" (p. 245).

Miller's Living Systems Theory allows an observer to either concentrate on one level or examine simultaneously several levels of systems in and around the level of interest with the result of improving analysis of interactions between levels (Tracy 1993). Tracy points out that having the multiple levels each of which has the same sub-systems allows the research of processes that are difficult to access at one level by studying similar processes on another level. "Finally, LST is a fruitful source of hypotheses for further study, hypotheses about causal relationships and cross-level interactions" (Tracy 1993, p. 229).

### 2.6.3 LST Sub-Systems

LST has 20 sub-systems on each of the 8 levels of the LST hierarchy. They "are integrated together to form actively self-regulating, developing, unitary systems with purposes and goals" (Miller 1978, p. 18). Miller defines a subsystem as "the totality of all the structures in a system which carry out a particular process." (Miller 1978, p. 30). A summary of the 20 sub-systems is given in Swanson and Miller's book (1989, pp. 56-7 Table 4.1) and the original 19 sub-systems are found in Miller's book (1978, p. 3 Table 1-1). Miller gave examples of applications of the sub-systems in Miller & Miller (1995a, p. Tables 1A and B).

LST makes a clear distinction between the organism (that is, human knowledge creator), group and organization based on the decider sub-system as shown in Table 7 above. My interest is in knowledge creation, a function of the human brain that is the LST decider sub-system at the knowledge creator level. For my research, an abstracted system is synthesized from the decider and boundary sub-systems. For a knowledge creator, the decider is the brain and emergent mind. The knowledge creator's decider receives, saves into its worldview context, interprets, synthesizes, creates and transmits knowledge. The LST boundary sub-system is at the perimeter of the abstracted system and creates a permeable barrier between the system and its local environment. The boundary regulates the entry or exit of matter, energy and information. The boundary sub-system forms the cognitive link between the mind and other knowledge creators of a collaboration. It enables all cognitive interactions with other knowledge creators in the task of fulfilling the group's purpose.

### 2.6.4 How LST Systems Interact with their Environment.

In the previous section, the knowledge creators in collaborations were conceived in terms of an abstracted system based on LST Sub-systems. The question is how do

these knowledge creators, as LST abstracted systems, interact with their local environment? Living systems are open systems that are dissipative structures (Prigogine & Nicolis 1977) and maintain their state through exchanges of energy, matter, or information with their environment (Miller & Miller 1995a). Open systems dynamically co-adapt and co-evolve with their environment and have a causal relationship with their environment (Ellis 2008). In discussing the pathology of living systems, J.G. Miller and J.L. Miller state that a "system as a whole controls system wide variables by adjusting subsystem activities and interactions. Many adjustment processes involve feedback loops among components of the system and between the system and its environment." (1991, p. 239).

The environment, containing all living and non-living systems, can be considered as a complex adaptive system or indeed, a complex adaptive "system of systems" (Sauser, Boardman & Verma 2010, p. 805). Systems and sub-systems can occupy one or more loosely related niches in the environment. The niche provides the ability to connect to other systems and sub-systems in often, unexpected ways including "small world connections" that create communication "short cuts" (Watts & Strogatz 1998, p. 440).

### 2.6.5 Criticisms of Living Systems Theory

LST has been charged with being "reductionist ... because it finds formal identities across levels from cells to supranational systems." (Miller 1978, p. 1037). Miller refutes this claim and is strongly supported by Bailey (2005). Empirical studies highlight missing examples of subsystems at LST levels of cell, organ and organism (Bailey 2005; Miller 1978, p. 1028 Table 13.1 ). However, Bailey (2005) suggests the missing examples of sub-systems at lower levels and their presence at higher levels is evidence of LST's support of emergence.

Non-living components are also included as examples of sub-systems, for example, the heart pacemaker is used as an example of a timer in the organ level (Miller & Miller 1993 Table 2), while this is seen as a problem by Bailey (2005). Miller's book discussed the pacemaker as an example of an "artefact" that "replaced a pathological process with a healthy one" (Miller 1978, p. 33). Non-living systems in LST would not include all of the sub-systems of LST and may not be open systems (Miller & Miller 1982).

Bailey commented that LST is "badly in need of revision and extension" (2005, p. 45). Definitions of the group and community require amendment in the light of modern communication and virtualisation technologies. In a society with pervasive communications, there is no longer a need for face-to-face interaction as a pre-requisite for establishing a group. This foreshadows a need to devise a richer language to establish types of groups suitable for differing collaborative purposes.

### 2.6.6 Beer's Viable System Model as an Alternative to LST

The "Viable System Model" (Beer 1984, p. 7) (VSM) Theory was reviewed as a possible alternative to LST. It was formulated by Beer to explain "how systems are viable, that is, capable of independent existence." (p. 7). It is a recursive model and consists of five subsystems that interact through the performance of rules within an organism or organisation that is capable of maintaining an independent identity within a shared environment.

VSM fails to deal explicitly with the behaviour and motivation of people and this is seen as a drawback by Merali & Allen (2011). Furthermore, Nechansky investigated if a living system according to LST is a viable system under VSM and vice-versa. He found that a living system according to LST (taken from examples in biology, anthropology and economy) is a viable system but not according to VSM (Nechansky 2010). Despite VSM's drawbacks, it has been used in systems engineering applications, including: product driven manufacturing systems (Herrera, Belmokhtar & Thomas 2011); and a youth and sports information system (Fouzi 2011).

### 2.6.7 Knowledge Gaps and Areas for Further Investigation

LST provides key structural elements for studying a collaboration creating knowledge. However, the advent of ubiquitous world-wide communications has meant that the definition of the group has to allow for a richer description of group types such as disbursed and virtual types to be added to Miller's original face-to-face definition of a group.

In LST, measuring information follows ideas developed by Shannon where a message is a flow of units measured using a logarithmic scale. If "base 2 is used the resulting units may be called binary digits, or more briefly 'bits', a word suggested by J. W. Tukey" (Shannon 2001, p. 3. Reprinted for Bell System Technical Journal with corrections. Copyright 1948. Lucent Technologies Inc.). Shannon's work is from the perspective of an engineering problem and as such the "semantic aspects of communication are irrelevant" (p. 3). However, in tracking knowledge creation, the semantic content is of paramount importance. The abstracted system posited in section 2.6.3 on page 39 of a knowledge creator consisting of the decider and boundary sub-system would concentrate on measures of semantic content in messages rather than the lower level of bits and bytes used by LST. This requires further investigation to devise an assessment framework and measures of semantic content.

This section of the review underpins the development of the Collaborative Wellness Framework (CWF) that provides the supporting and enabling context of the collaboration. In the case studies, this framework was that of the organisation. See section 3.3 on page 96.

## 2.7 Value

One view of a collaboration tackling a wicked problem using a learning-by-doing methodology is that it is a network of “value co-creation” processes (Vargo, Maglio & Akaka 2008). In co-creation, stakeholder feedback is used by the collaboration to improve the usefulness of solutions. Stakeholders realise value through use of process outcomes. In this view, value judgements are crucial to managing a collaboration and assessing the value realised by stakeholders. This prompts the question: “What is value?”

### 2.7.1 Value Concepts

Value is the regard that “something is held to deserve; the importance, worth, or usefulness of something” (Oxford Dictionaries 2013). Value is complex, dynamic and subjective with many, often divergent, conceptualisations in the literature based on the adoption of either a supplier or a customer perspective (Landroquez, Castro & Cepeda-Carrión 2013). The supplier perspective is a goods-centred dominant (GD) logic, while the customer perspective is a service-centred dominant (SD) logic.

In GD logic, the supplier embeds value in the product that is determined by setting an exchange-value paid by the customer who then appropriates the embedded value. However, in SD logic, the customer both perceives and determines value on the basis of use experience, this is, “value-in-use” (Lusch & Vargo 2006, p. 284). In SD logic, service is defined “as the application of specialized competences (knowledge and skills) for the benefit of another entity, rather than the production of units of output” (Lusch, Vargo & Wessels 2008, p. 6).

Service is a process and what the customer receives is not a good, but rather resources for input into a continuing customer-centric value-creation process that could also include a co-creation process with the supplier. How may a customer assess the value-in-use? One way, described by Anderson & Narus (1995) is through “cost-in-use studies” (p. 77) that detail incremental cost savings associated with a customer using newly acquired products or services compared with their previous experiences.

Under SD logic, the traditional supply chain becomes a “value-creation network” (Lusch, Vargo & Wessels 2008, p. 7) or a “network of service systems” (p. 10). This re-conceptualisation acknowledges value-in-exchange (or exchange-value) as an important feedback mechanism for suppliers (Akaka, Vargo & Lusch 2012). In SD logic exchange value is considered to be an *expected* value-in-use (Lusch, Vargo & Wessels 2008). One motivation for value co-creation is the desire of the customer to work with the vendor so that the customer’s value-in-use meets or exceeds the exchange-value of the supplied services.



### 2.7.2 Value Proposition

A supplier alone cannot create value, in the marketplace, "they can only position themselves through value proposing" (Lusch, Vargo & Wessels 2008, p. 10). A value proposition is an "aggregation or bundle of benefits" (Osterwalder & Pigneur 2010, p. 22) that a business offers customers to help them "get either a functional, social, or emotional job done, or help him/her satisfy basic needs" (Osterwalder 2012, p. 1). The value proposition serves to differentiate the business from its competitors and to persuade a customer to buy from it rather than its competitors. Value propositions may be successively deconstructed into "elementary value proposition(s)" that "describe different aspects of a value proposition" (Osterwalder & Pigneur 2003, p. 431).

According to Akaka, Vargo & Lusch (2012) value is derived through an experience created in conjunction with or use of a value proposition in a particular context. Value co-creation is a collaboration mediated by networks of interconnected relationships and resources. Attention is drawn to the social context of value co-creation in their proposition of a "service eco-system" (p. 35 Fig.1) in which "every customer experience is unique based on a distinct collaboration of relationships and resources, as well as individual and shared knowledge" (p. 35). In this network, a value proposition is "a basic relationship of service" (Maglio & Spohrer 2013, p. 667). It "is a request from one service system entity to others to run a procedure or an algorithm and it specifies the pattern of shared access to resources among stakeholders (supplier, customer, authority and competitor) over time. As stakeholders experience the strengths and weaknesses of value propositions, they may reconsider, refine, adapt or abandon the algorithm" (Maglio & Spohrer 2013, p. 667).

In summary, researchers treat the value proposition as the fundamental connector of the network in the service eco-system. Osterwalder & Pigneur (2003) stress the importance of modelling and mapping value propositions, particularly for eBusiness applications. A value proposition canvass is available to aid business in conceptualising and standardising approaches to developing value propositions (Osterwalder 2012; Osterwalder & Pigneur 2010).

### 2.7.3 Knowledge Gaps and Areas for Further Investigation

The review has highlighted the interdependence of the concepts of value, value proposition and the service eco-system as a network of relationships. An organisation can devise a group collaboration to create knowledge in order to satisfy a value proposition offered by the organisation and accepted by the customer. Satisfying this value proposition is a crucial component of the purpose of collaboration.

The section raises the question as to how changes in value propositions affect knowledge creation. Synthesising the concept of the network-in-use with the service

eco-system could yield insights into the changing circumstances, decisions and motivations of knowledge creators in knowledge creation collaborations.

## 2.8 Knowledge

What is knowledge, how is it created by a knowledge creator and then refined in collaboration. This section leads to the exploration of human processes in collaborations. The review will then proceed to consider social networks.

### 2.8.1 Data, Information, Knowledge and Ideas

A working definition of data is that "data is a set of discrete objective facts about events" and in the context of an organisational, data can be described as "structured records of transactions" (Davenport & Prusak 1998, p. 2). By itself, "data does not have relevance or purpose. When a message is exchanged between a sender and a receiver, the receiver decides if the message is meaningful and therefore information" (p. 3). Quantitative measures of information include connectivity and transactions, for example the number of emails in a particular period transmitted on a network. On the other hand, qualitative measures are concerned with "informativeness and usefulness" (p. 4).

Davenport and Prusak provide a working definition of knowledge in the context of an organisation. "Knowledge derives from minds-at-work" and "is a fluid mix of framed experience, values, contextual information and expert insight that provides a framework for evaluating and incorporating new experiences and information". Knowledge "originates and is applied in the minds of knowers. In organisations, it often becomes embedded not only in documents or repositories but also in organisational routines, processes, practices and norms." (1998, p. 5).

Organisational Knowledge Creation (OKC) Theory defines knowledge as "justified true belief." (Nonaka 1994, p. 15; Nonaka, Toyama & Byosiere 1998, p. 493; Nonaka & von Krogh 2009, p. 636). Knowledge is "created by people in their interactions with each other and the environment.. It is subjective, process-relational, action-orientated and created in a practice." (Nonaka, Toyama & Hirata 2008, p. 7).

OKC emphasizes personal belief in creation as a "dynamic human process of justifying personal beliefs as part of an aspiration for the 'truth.'" (Nonaka 1994, p. 15). The difference between knowledge and information is that "information is a flow of messages, while knowledge is created and organized by the very flow of information, anchored on the commitment and beliefs of its holder." (Nonaka 1994, p. 15).

Table 8 Summary of Data, Information and Knowledge

Data	Information	Knowledge	
		Tacit	Explicit
(Davenport 2005; Davenport & Prusak 1998; Miller 1978)		(Nonaka & Takeuchi 1995, p. 61)	
"Set of discrete objective facts about events" (Davenport & Prusak 1998, p. 2).  By itself, does not have relevance or purpose	Message transmitted from sender to receiver.  Has meaning to the receiving system that processes it.  The receiver determines if the message is information.	"Knowledge of experience (body)	"Knowledge of rationality (mind)
		Simultaneous knowledge (here and now)	Sequential knowledge (there and then)
		Analogue Knowledge (practice)" (p. 61).	Digital Knowledge (theory)" (p. 61).
		(Polanyi 1966)	
		"we can know more than we can tell" (p. 4)	knowledge that is transmittable in formal, systematic language
		(Davenport & Prusak 1998, p. 70)	
		"Tacit knowledge is only teachable through demonstration.	"Teachable
		Not articulated	Articulated
		Not observable in use	Observable in use
		Rich	Schematic
		Complex	Simple
		Undocumented" (p. 70).	Documented" (p. 70).

Polanyi was the first to articulate the difference between tacit knowledge and explicit knowledge (Davenport & Prusak 1998, p. 71). The epistemological dimensions in OKC are "drawn from Michael Polanyi (1966)" (Nonaka & Takeuchi 1995, p. 59). The theory deals with two types of knowledge, firstly "explicit (or codified) knowledge can be expressed in words and numbers and easily shared", and secondly, "tacit knowledge, such as subjective insights or emotions, is non-articulated, and embedded in contexts and actions. It is highly personal and hard to verbalize or communicate. Tacit knowledge, such as bodily skills or mental models, is deeply rooted in individual's action and experience as well as in the ideals or values he or she embraces." (Nonaka, Reinmoeller & Senoo 1998, p. 673). Table 8 above shows a summary of the characteristics of data, information and Knowledge.

Vallayil believes that "separating tacit from explicit knowledge is meaningless" (2008, p. 15) because of Polanyi's statement that tacit thought is "an indispensable element

of all knowing and as the ultimate mental power by which all explicit knowledge is endowed with meaning” (1966, p. 60). This view is not well supported as evidenced in reviews by Nonaka et al which looked at the application of tacit and explicit concepts by researchers (Nonaka & von Krogh 2009; Von Krogh, Nonaka & Rechsteiner 2012).

The foregoing discussion shows that knowledge is a difficult concept to define. Gourlay provides a summary of knowledge definitions based on the distinction of two broad categories of knowledge “Knowledge-how” and “Knowledge-that” (2006, p. 1426 Table I) in Table 9.

Table 9 Knowledge Types. Reproduced from Gourlay (2006, p. 1426 Table 1)

Discipline	Knowledge-how	Knowledge-that
Artificial intelligence	Procedural knowledge	Declarative knowledge
IT studies	Knowledge as process	Knowledge as object
Knowledge management	Know-how	Know-what
Management studies; education	Tacit knowledge	Explicit knowledge
Neuroscience	Covert knowledge	Overt knowledge
Philosophy	Knowledge-how, procedural Knowledge, abilities	Knowledge-that, propositional knowledge
Philosophy (Polanyi)	Tacit knowing	Explicit knowledge
Psychology	Implicit knowledge, tacit abilities, skills	Explicit knowledge, declarative knowledge
Sociology of science	Tacit, encultured (forms of life)	Explicit/symbolic

The purpose of knowledge is considered by Boisot & MacMillan (2007, p. 50) when they conceived of “knowledge as comprising a set of beliefs which inform decisions by agents to take actions”. Nonaka and Zhu, complemented this concept in the context of pragmatic strategy when stating that knowledge “is our capacity to act; it is not representational, but performative. We act, therefore we are. Not all actions, however; only actions with a compelling purpose” (2012, p. 28).

The concepts of “idea” and “knowledge” are used interchangeably in the reviewed literature. They are certainly related and indeed their meanings overlap to an extent. An idea has been defined as a “thought or suggestion as to a possible course of action” (Oxford Dictionaries 2014). Boisot & MacMillan (2007) discuss how knowledge moves through phases from the possible to the actual. Actual is knowledge that is

justified true belief acceptable to Plato (p. 54 Fig 2.1). The knowledge moves between phases, as it is refined in the knowledge creation process. Using the Oxford definition, an idea is in the world of the possible, being neither constrained "by truth nor justification" (p. 55).

### 2.8.2 The Knowledge Worker and Knowledge Creator

The term "knowledge worker" and "knowledge work" was coined in 1960 by Drucker (1994, pp. 5-6). Davenport provides a general definition of "knowledge workers" as having "high degrees of expertise, education, or experience, and the primary purpose of their jobs involves the creation, distribution, or application of knowledge" (2005, p. 10). Hawryskiewicz (2010a) notes that the term knowledge worker is applied to people who "bring their expertise to develop products and services. They require flexible work environments to come up with ideas, evaluate them and put them into practice" (p. 8). Furthermore, "knowledge workers are not 'subordinates' they are 'associates'" (Drucker 2001, p. 78).

Organisational knowledge is created throughout the organisation and distributed by appropriate infrastructure and social networks. The role of a knowledge officer is to "provide the facilities to support such knowledge flows but not to generate the knowledge itself" (Hawryskiewicz 2010a, p. 83). The knowledge officer would be at the level of co-ordination of a collaboration of knowledge workers and the role would be seen as a bridge between the local group's knowledge pool and that of the larger organisation. Davis, Subrahmanian & Westerberg (2005) identified the following roles of knowledge practitioners:

- "High level synthesizer" who "looks for opportunities arising from various combinations of different types of knowledge" (p. 110) by exploiting their extensive social network;
- "Librarian" (p. 110) who "operates at the interface between materials, processes and product markets" (p. 110);
- "Knowledge Engineer" who "works closely with customers to adapt and create new products and applications" (p. 110) to meet customer requirements; and
- "Knowledge Operators" who "work at the interfaces between R&D and manufacturing or R&D and customer operations" (p. 110).

Knowledge workers "don't like to be told what to do" (Davenport 2005, p. 15), to understand this, a summary of basic principles and observations in characterising knowledge workers is provided by Davenport (2005) as follows:

- "Knowledge workers like autonomy" (p. 15).

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- “Specifying the detailed steps and flows of knowledge-intensive processes is less valuable and more difficult than other types of work” (p. 17).
- “You can observe a lot by watching ... systematic observation is often an effective way to understand how knowledge workers do their work” (p. 18).
- “Knowledge workers usually have good reasons for doing what they do” (p. 19).
- “Commitment Matters” (p. 20).
- “Knowledge workers value their knowledge and do not share it easily” (p. 21).

The measurement of knowledge worker performance, that matters, “is high-quality outputs per unit of time and cost” (Davenport 2005, p. 49). The judgement is, of necessity, subjective and the strategy used is to form a peer group for a particular knowledge worker and survey their opinions about the work under review. To overcome issues of objectivity, Davenport suggests several peer groups may be involved to increase the number of responses.

I distinguish a knowledge creator from a knowledge worker by saying a knowledge creator is engaged in creating knowledge for product and/or process “innovation” (Norman & Verganti 2014, p. 79; Tödtling & Grillitsch 2014, p. 338).

### 2.8.3 Knowledge Exploration versus Exploitation

A model of organisational knowledge was proposed by March (1991) based on mutual learning between the organisation and knowledge workers. “In particular, the trade-off between exploration and exploitation in mutual learning involves conflicts between short-run and long-run concerns and between gains to individual knowledge and gains to collective knowledge” (1991, p. 74). Exploration is a result of “organizational flexibility, research and development, risk management, experimentation, innovation and improvisation” whereas exploitation “consists of leveraging current routines to refine products, processes and pre-existing knowledge. In other words, the behaviours in support of exploitation include pursuing efficiencies of current operations, and maximizing the effectiveness and execution of current processes” (Curado & Bontis 2011, p. 1140).

The tension between exploration and exploitation drives the dynamics of March’s model. The performance of an organisation rests on its relationships with competing organisations in its environment and is a “trade-off between exploration and exploitation of assets” (March 1991, p. 73). March further explains, “the realization of returns is generally greater in the case of exploration than in the case of exploitation” and that an “emphasis on exploitation compromises competitive

position where finishing near the top is important". (1991, p. 85). Although March's model has been modified since 1991 (Curado & Bontis 2011) to include a knowledge cycle that has tacit and explicit knowledge, it remains as a means to explore management of knowledge. It is complimentary to Nonaka & Takeuchi (1995)'s Organisation Knowledge Creation (OKC) theory and Boisot (1995)'s I-Space.

### 2.8.4 Knowledge and Action

The discussion has highlighted the need to distinguish between different types of knowledge and to describe the contexts of these types in terms of an individual's beliefs. Dewey differentiates between reflective knowledge and non-reflective knowledge. Reflective knowledge is characterised by "the constant self-rectification of intellectual content and intent through the modification introduced by acting upon them in good faith" (1907, p. 314). Gourlay suggests that Dewey's reflective and non-reflective knowledge has an approximate correspondence to tacit and explicit knowledge and infers "that different forms of knowledge are created as a consequence of, and implicated in, different modes of experience/behaviour" (2006, p. 1417). Additionally, Gourlay cites Dewey when he states "reflection covers the whole action-reflection-action cycle and not just its cerebral aspect" (2006, p. 1427).

The linking of experience and behaviour to different types of knowledge is considered by Boisot & MacMillan (2007) from a knowledge management perspective when they "conceive of knowledge as comprising a set of beliefs which inform decisions by agents to take actions" (p. 50). The move from knowledge to action involves the matching of appropriate actions to held beliefs taking into account the uncertainty in situations. Such matching is an application of Ashby (1958)'s law of requisite variety.

Plato's definition of "knowledge to be justified true belief" (Boisot, MacMillan & Han 2007, p. 52) is a starting point to consider the types of beliefs and how they inform an agent's decision to act. This definition contains three conditions, namely "a truth condition, a justification condition and a belief condition" (p. 52). Figure 8 below is based on a Venn diagram showing the various relaxation of the constraints (p. 54 Fig 2.1).

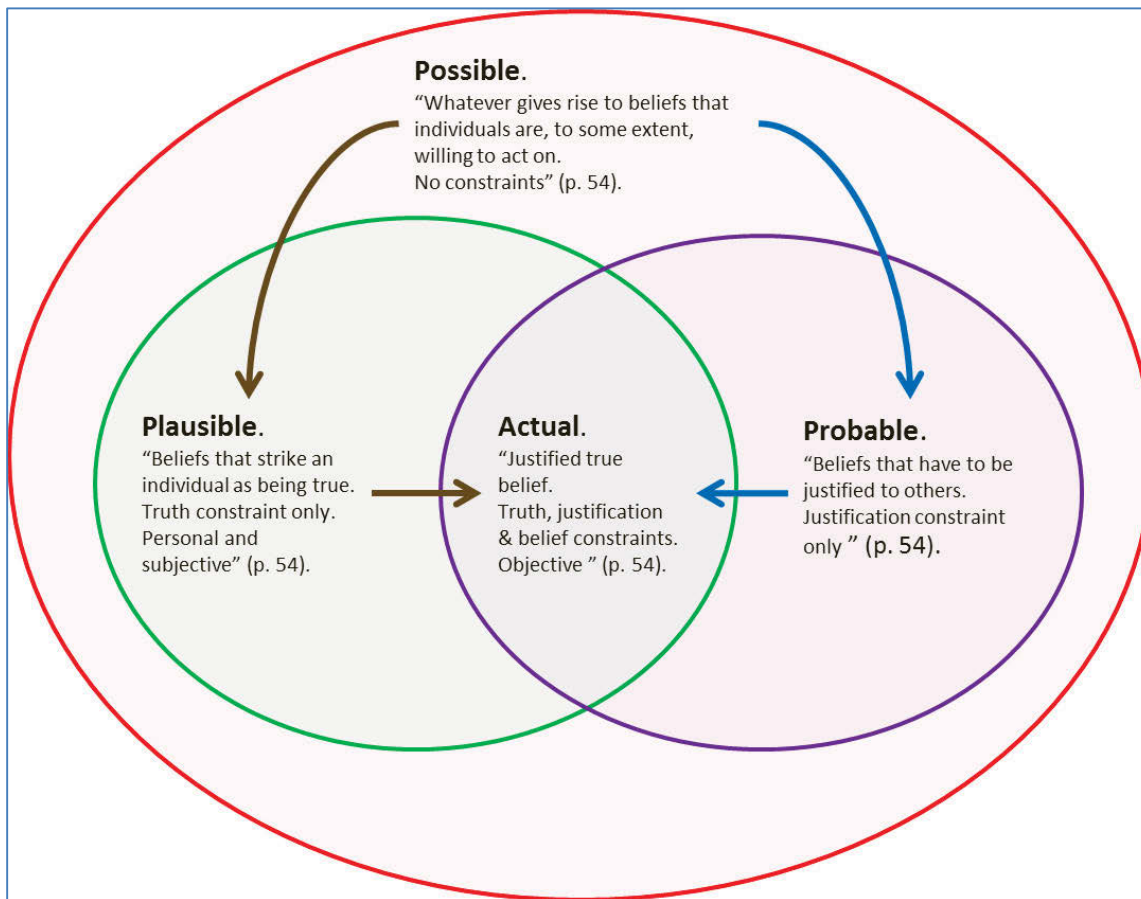


Figure 8 Types of Knowledge. (Boisot & MacMillan 2007, p. 54 Fig 2.1)

Each of the circles in Figure 8 shows knowledge that could inform action with the proviso that acting on uncertain knowledge introduces an element of risk as to achieving desired outcomes. The figure illustrates how knowledge can be refined along two paths to achieve knowledge that would be acceptable to Plato. The first path is “Possible” to “Plausible” and thence to “Actual” and the second is “Possible” to “Probable” and finally “Actual” (Boisot & MacMillan 2007, p. 54 Fig 2.1). Knowledge is a continuum of types in an iterative process of creation and refinement in which each iteration is judged by action decisions.

### 2.8.5 Tacit Knowing

The focus in Polanyi’s 1962 Terry Lectures was on the individual’s tacit knowing powers. He reconsidered human knowledge using the fact that “we know more than we can tell” (Polanyi 1966, p. 4) as a basis for discussing the structure and implications of “tacit knowing” (Polanyi & Prosch 1975, p. 34). Zwicky talks about “communicable truth” and “incommunicable truths” (1969, p. 40). He distinguishes two parts of incommunicable truth as “incommunicable truth, which by no means known to us can be transmitted from individual to individual and non-communicable truth, the communication of which among men is in principle possible, but may in



practice be impeded" (p. 40). Ryle refers to knowledge as both "'the knowing how' and 'knowing what'" (1945, p. 1).

According to Polanyi (1966), tacit knowledge is not capable of codification; it is passed on through personal experiences such as demonstrations to students. The student intelligently co-operates and participates in the demonstration in order to capture the essence of the knowledge. In turn, the student shows through mimicry and repetition that the knowledge has been absorbed. The student's effort is required to bridge a gap created by the teacher in leaving behind that which he could not tell. The transmission of the message relies on the student discovering, that which has not been told. This process of the teacher sharing knowledge through demonstration requires a level of trust and a willingness to share on the part of the teacher and the acknowledgement of the teacher's authority by the student.

The concept of "Intentionality" is discussed by Duranti (2000), who cites Husserl, as being "the property of the human consciences of being directed toward or being about something" and "Husserl distinguished between the intentional act... and the entity (or object) about which the act occurs". This focus on acts rather than entities was the basis of "Husserl's phenomenology: meanings are constituted in our consciousness through the different ways in which we engage with the world" (p. 134).

Intentionality involves our choice to be directed towards something, Polanyi provides an explanation of the mechanism of the engagement. Two terms of tacit knowing are described by Polanyi: the first term being "proximal" is our awareness of the particulars of an entity; and the second is called "distal" in which we "attend to" the meaning of the impact of the entity on us (1966, p. 13). Polanyi illustrates by the example of using of a cane as a probe. In using it for the first time our awareness is of the impact of the cane on the hand, with experience, our awareness is transferred to the point of the cane touching objects. The action of "attending to" transforms the meaningless feeling of the tool in our hands to a meaningful understanding of the effect on the tool with the objects it touches. Polanyi concludes that "all meaning tends to be displaced away from ourselves" (1966, p. 13).

Tacit knowing "establishes a meaningful relationship between the proximal and distal terms". We identify the relationship "with the understanding of the comprehensive entity which these two terms jointly constitute" (p. 13). The proximal term represents the particulars of this entity and "we can say, accordingly, that we comprehend the entity by relying on our awareness of its particulars for attending to their joint meaning" (p. 13). Perception is a form of Tacit Knowing (p. 15), we rely on the awareness of our contacts between our body and external objects for attending to

them, that is, we attend from our body. The argument is generalised to say that when we "make a thing function as the proximal term of tacit knowing we incorporate it in our body or extend our body to include it" (p. 16), a process known as "indwelling" (p. 17). This notion extends to teaching and knowledge, for example "to rely on a theory of nature is to interiorize it. For we are attending from the theory to things seen in its light, and are aware of the theory, while thus using it, in terms of the spectacle that it serves to explain" (p. 17).

Polanyi's use of awareness in describing the proximal term is significant. He maintains that by examining the particulars in themselves, we lose the link to the second term of tacit knowing and thereby destroy our understanding of the object. The damage can be undone by a repeat of the tacit knowing, but "this recovery never brings back the original meaning." (p. 19). He maintains that this destructive analysis can be overcome through the explicit statement of the relation between its particulars. An example is the skilled use of a tool versus an engineer's detailed knowledge of it. Polanyi states that the skill of using the tool cannot be replaced by the detailed knowledge of the engineer. He further discusses that the "tacit knowing of the entity must occur before the formalisation of its particulars" and "tacit thought forms an indispensable part of all knowledge" (Polanyi 1966, p. 20).

The foregoing discussion shows that tacit knowing may be thought of as a "triad" (Polanyi & Prosch 1975, p. 38). Firstly there is the proximal or from term which is referred to as the "subsidiary particulars". Secondly, the distal term being the "focal target" and thirdly, the act of the "knower" who "integrates the subsidiaries to a focal target" (p. 38) to create meaning. This triad may be dissolved "if the knower shifts his focal attention away from the focus of the triad to focus on the subsidiaries" (p. 38). Polanyi distinguished between "from-awareness" and "focal-awareness" (pp. 38-9) and shows the dynamism of tacit knowing.

In the act of knowledge creation, there are no existing particulars. Furthermore, "it is only the imagination that can direct our attention to a target that is as yet unsupported by particulars." (Polanyi & Prosch 1975, p. 57). In his book, Polanyi concluded that "tacit Knowing is shown to account (1) for a valid knowledge of a problem, (2) for the scientist's capacity to pursue it, guided by his sense of approaching its solution, and (3) for a valid anticipation of the yet indeterminate implications of the discovery arrived at in the end" (1966, p. 24). The scientist's act of knowing about impending discovery is an exercise of judgement "in relating evidence to an external reality, an aspect of which he is seeking to apprehend" (p. 25), that is, it is an act of exercising imagination. In pursuing the solution, the scientist sees a "range of potentialities" that are believed accessible and finally achieves innovation through the "actualization of certain potentialities" (1966, pp.

88-9). Tacit thought is seen by Polanyi "as an indispensable element of all knowing and as the ultimate mental power by which all explicit knowledge is endowed with meaning" (1966, p. 60).

Polanyi and Prosch observed that as tacit knowing processes become more complex, they require "an increasing measure of imaginative effort" (1975, p. 84) and for them, this imaginative effort culminates in the appreciation of a work of art. In essence, we do not have to know the artist's mind to appreciate his art; the art speaks to us not the artist. We read and appreciate Shakespeare's sonnets without understanding the poet. This is termed "framing" (p. 85). It is a conscious effort in tacit knowing to erect a frame around the entity being perceived and we sever the subject of focus (the work of art) from its subsidiary particulars (the artist). Hallahan (1999) explains framing in terms of a metaphor based on a "window or portrait frame drawn around information that delimits the subject matter and, thus, focuses attention on key elements within. Framing involves processes of inclusion and exclusion as well as emphasis" (p. 207). The picture frame metaphor is also used in explaining how people focus on the essentials and ignore irrelevancies when assessing a social situation (Silverman 2010).

Polanyi (1966) describes tacit knowing as emergence by positing that the two terms of tacit knowing occupy different "levels of reality, the proximal which includes the particulars of the entity is on a lower level. The distal, which includes the comprehensive meaning, is on a higher level". The upper level "relies for its operation on the laws governing the lower ones in themselves but the operations of it are not explicable in terms of the lower level" (Polanyi 1966, p. 34). There is a logical relationship between the two levels. These levels can be stacked to create a "panorama of stratified living beings" and emergence is the process that produces the next higher level. "Thus each level is subject to dual control; first, by the laws that apply to its elements in themselves; and, second by the laws that control the comprehensive entity formed by them." (p. 36). The organising principles of the upper level exert control on the lower level through the boundary layer on the "marginal conditions left indeterminate by the principles governing the lower one" (p. 55). The control is called "marginal control" (p. 40) and is comparable to the prior discussion of Ellis' "top-down" causation (2008, pp. 2-4) (see section 2.5.4 on page 33).

Polanyi's conception of tacit knowledge as "we know more than we can tell" (1966, p. 4) and his analysis of the emergent nature of knowledge underscores the need to recognize the uncertainty associated with knowledge. Allen & Boulton (2011, p. 173) provide a working definition of uncertainty as "that which cannot be known" or an "unknown unknown". Polanyi discusses how tacit knowledge may be communicated

through demonstration (1966, pp. 30,61) and language constructs such as the "metaphor" (Polanyi & Prosch 1975, p. 75). Knowledge uncertainty is that unknown part of tacit knowledge, which cannot be communicated by the teacher or is imperfectly understood by the pupil.

The act of tacit knowing in creating new comprehensive entities is an act of complex emergence. The human mind is an emergent outcome of an education process. The "growing mind recreates the whole conceptual framework and all the rules of reasoning bequeathed to it by its culture" (Polanyi 1966, p. 46). This conceptual framework is our worldview (Gabora 1997). The emergence from the simple to the complex "holds both for the development of the individual and for the evolution of living things" (Polanyi 1966, p. 55).

### 2.8.6 Organisational Knowledge Creation Theory (OKC)

In Nonaka (1991)'s knowledge creating company, knowledge creation begins with the individual creating tacit knowledge. The process of converting tacit knowledge to explicit knowledge is "first, by linking contradictory things and ideas through metaphor; then, by resolving these contradictions through analogy; and, finally, by crystallizing the created concepts and embodying them in a model, which makes the knowledge available to the rest of the company" (p. 28).

Four distinct modes of knowledge conversion are identified: socialisation - "creating tacit knowledge through shared experience", externalisation - "converting tacit knowledge to explicit knowledge", combination - reconfiguring "existing information through the sorting, adding, re-categorizing, and re-contextualizing of explicit knowledge" to create new explicit knowledge, and finally internalisation - "conversion of explicit knowledge into tacit knowledge." (Nonaka 1994, pp. 18-9). Mobilising knowledge is "through a dynamic 'entangling' of the different modes of knowledge conversion in a process which will be referred to as a 'spiral' model of knowledge creation ... The interactions between tacit knowledge and explicit knowledge will tend to become larger in scale and faster in speed as more actors in and around the organization become involved" (1994, p. 20). This was formalised as the SECI knowledge spiral (Nonaka & Takeuchi 1995, pp. 71 Figure 3-3) and has remained the cornerstone of the Organisation Knowledge Creation (OKC) theory.

OKC does not specify how to establish, monitor and assess a collaboration to create knowledge. Given that knowledge originates in the mind of the individual (Davenport & Prusak 1998; Polanyi 1966) then how does the SECI process change the nature of the created knowledge? If it does change the nature of the knowledge created by a knowledge creator, then how can the change be assessed? OKC relies on Polanyi's differentiation between tacit and explicit knowledge (Nonaka 1991, p. 28; Nonaka & Takeuchi 1995, pp. 59-60; Nonaka & von Krogh 2009, p. 637). Initially, Nonaka

distinguished two dimensions of tacit knowledge: technical skills or know-how, and cognition that includes mental models, beliefs and perspectives. OKC focusses on the technical dimension of tacit knowledge (Nonaka 1991, p. 28; Nonaka & Takeuchi 1995, p. 60). That is, OKC does not look at how the individual creates knowledge, a process that Gourlay (2006) describes in terms of "scientific knowledge creation" (p. 1429) and Dewey calls reflective thought (1922).

Nonaka, Reinmoeller and Senoo introduced the "Ba" concept, to explain the context of knowledge creation (1998, p. 675). In this conceptualisation, there were four types of Ba corresponding to the four modes of tacit to explicit knowledge conversion. Subsequently, the types of Ba merged as a knowledge creation platform in the SECI process (Nonaka & Nishiguchi 2001). Nonaka and Toyama revisited OKC from the perspective of a dynamic synthesizing process in which dialectic thinking was emphasized. In this perspective, tacit and explicit knowledge formed a continuum (2003). This was elaborated to apply process theory to the concept of knowledge creation (Nonaka, Toyama & Hirata 2008). In this later work, Ba is conceived as a physical (for example a meeting room) or a virtual space (virtual conference facility) and is a "shared context in motion" (Nonaka, Toyama & Hirata 2008, p. 34). The boundary of Ba dynamically changes as knowledge creators join or depart from it, so it can range from an individual to a group or multiple levels of group interactions (Von Krogh, Nonaka & Rechsteiner 2012). The shared context means that "through relationships in Ba, one can see oneself in relation to others and embrace others' views and values, enabling an understanding and sharing of viewpoints" (Nonaka, Toyama & Hirata 2008, p. 36). These interactions of knowledge creators enable emergence of new knowledge.

The importance of socialisation within Ba as a "space" is emphasized by von Krogh & Geilinger (2014, p. 156) in their review paper that calls for additional research in relationships between Ba in virtual and the physical world and between organisations acting in a knowledge creation ecosystem. The ecosystem in this context is "the environment as an ecosystem of knowledge and multi-layered Ba" (Nonaka & Toyama 2005, p. 423 Figure 1).

OKC mandates a carefully organised, researched and orchestrated Ba with clearly defined objectives (Nonaka & Toyama 2003; Nonaka, Toyama & Hirata 2008; Von Krogh, Nonaka & Rechsteiner 2012). Each Ba session requires a clear set of intentions and work objectives. Managers orchestrate Ba to ensure that each individual is synchronized with and aligned to the intentions of Ba. The knowledge creators in Ba must have a shared sense of purpose and lastly they should have different types of knowledge that enrich the SECI interactions with different perspectives. Ba requires commitment on the part of knowledge creators and this requires managers to

engender an atmosphere of mutual trust and respect (Nonaka, Toyama & Hirata 2008). Knowledge creation within Ba and in the context of an organisation "is very sensitive to social context, such as the organization of processes", "timing of activities", "physical proximity of people", and "people's use of technology" (Nonaka & von Krogh 2009, p. 640).

Knowledge emergence is not limited to individual knowledge creators but extends to the group by means of the group's tacit knowledge (Erden, von Krogh & Nonaka 2008). The notion of the extension of the mind outside of the body, group cognisance and group level emergence is examined by Theiner, Allen & Goldstone (2010). The degree of tacit and explicit knowledge within created knowledge depends upon the various emergent states within the Ba space (Nonaka & Toyama 2003). The distribution of knowledge is intimately connected with the emergent time/space points of knowledge creation within the Ba space.

A framework of three leadership layers was proposed to manage the SECI process and energise Ba in an organisation. In the core layer, leadership is distributed based on the situated activities of SECI. The next layer is a co-ordination and reporting layer that links to the outermost centralized leadership layer (Von Krogh, Nonaka & Rechsteiner 2012, p. 258 Figure 1). These concepts and that of the multi-layered Ba ecosystem were developed further by Nonaka et al. (2014) where they conceived of a "dynamic fractal organisation" (p. 140). These organisations realise their "requisite variety" (Ashby 1958, p. 3) in the "multi-layered networks of ba" of knowledge "triad" (tacit knowledge, explicit knowledge and "practical wisdom") relationships to make use of knowledge creation and exploitation dynamically (Nonaka et al. 2014, p. 140).

### 2.8.7 Knowledge Gaps and Areas for Further Investigation

The review found that OKC does not specify how to collaborate in order to create knowledge. Gourlay (2006) criticises the SECI process on the grounds that it is "not necessary to postulate tacit-to-tacit and tacit-to-explicit knowledge transformations when we can more simply refer to learning by doing on the one hand, and to designing new tasks on the other" (p. 1421). Furthermore, "no account is given of how information is 'constituted', 'processed', or 'combined' to yield knowledge or how it acquires 'high value'" (p. 1426).

Exception is taken to OKC's definition of knowledge by Gourlay (2006) in saying "for Nonaka and his colleagues 'knowledge' means that fraction of warranted beliefs about processes and their associated facts that passes through the filter of managerial evaluation of what is and is not practicable for the organization" (p. 1423). He highlights that "a realistic model of knowledge creation must also account for the production of scientific type knowledge" (pp. 1423-4). A defining characteristic of scientific work is that their "methods can be described, reflected upon and improved,

and ... replicated by others. Such knowledge, whatever its limits, is thus often more reliable, as well as more likely to be systematically corrected, than that of the everyday life-world." (Gourlay 2006, p. 1428). Nonaka & von Krogh (2009) discussed these controversies and outlined areas for further research, but the issues of individual knowledge creation (scientific knowledge creation) and lack of process detail remain to be resolved and is a subject of my research.

Another area that needs to be addressed concerns how the SECI knowledge creation process "emerges in Ba" (Von Krogh, Nonaka & Rechsteiner 2012, p. 242). A description explaining how Ba emerges "among individuals, in working groups, project teams, informal circles, temporary meetings, ..." and "... in virtual space" (Nonaka, Toyama & Hirata 2008, p. 34) has not been found in the reviewed literature. It is important to understand the relationship between knowledge creators and Ba in order to understand how Ba may be "energised" (Nonaka, Toyama & Konno 2000, p. 25) to improve the participation in the SECI process. Furthermore, von Krogh & Geilinger (2014) which called on research into the effect of Ba spaces on collaboration and the interactions between virtual and physical spaces. The authors highlight the need for research in the spaces created through cross-boundary collaborations between organisations in the ecosystem of Nonaka & Toyama (2005) and improved empirical observation and measurement of knowledge creation interactions in these collaborative spaces.

This section on knowledge provided the basis for understanding the knowledge creation processes and relationships in CWS. This section underpins the concept of the knowledge contribution discussed in section 3.8 on page 107.

### 2.9 Collaborations.

My practical experience was in small group collaborations creating knowledge for organisations involved in process and/or product innovation. The review found that a small group collaboration has between four and twenty members with a suggested optimum of five members for knowledge tasks. The review coverage include knowledge workers, cognitive processes, structures, knowledge and value. This section ties these elements together within the concept of collaboration. The question is now asked, what is a collaboration? The starting point in answering this question is to investigate the history of defining human-centric collaboration. The review seeks to understand not only collaborative structures but also how knowledge creators interact to create knowledge.

There are subsidiary questions to address, for example: what resources and skill sets do different classes of knowledge creators need; how do they interact with each other and their environment; what demands are made on them; how does technology

mediate interactions; and what is the nature of the knowledge they create to fulfil stakeholder expectations? There is also the task of characterising the collaboration's context. We start by considering the history of developing a definition of collaboration.

This section lays the basis for understanding how to abstract the collaborative wellness system (CWS) from the interactions, relationships and messaging within a knowledge collaboration. CWS is defined in section 3.3 on page 96. The knowledge creation collaboration is developed in section 3.7 on page 106. The idea of the role-in-use as a building block of collaboration is developed in section 3.9.2 on page 118.

### 2.9.1 The History of Defining Collaboration

Many researchers have devised collaboration definitions and frameworks to service their specific study discipline or to suit the context of case study experiences (Arenas, Sanchez & Murphy 2013; Bedwell et al. 2012; Montiel-Overall 2005). Wood & Gray (1991) devised a definition of collaboration by asking the question "who is doing what, with what means, towards which ends?" (p. 146). Their answer is that collaboration "*occurs when a group of autonomous stakeholders of a problem domain engage in an interactive process using shared rules, norms and structures, to act or decide on issues related to that domain*" (p. 146). This definition treats collaboration as a process (see Section 2.4). Their requirement for all stakeholders to participate has the potential to create a many masters situation that is one of the hallmarks of a wicked problem (see Section 2.3). The authors defer stakeholder issues, and therefore considerations of complexity to future research. Furthermore, they mandate a shared understanding of the problem as a pre-condition for collaboration, which excludes the issue of an ill-defined problem definition that characterises wicked problems.

Bedwell et al. (2012), from the perspective of human resource management and based on their review of the literature, defined collaboration as an "evolving process" of "interpersonal interactions and relationships that change over time" (p. 130) They limited their considerations to social participants, that is humans acting as individuals, groups, organisations and societies. Like Gray and Wood, they treat collaboration as a process but, in addition, they acknowledge the part played by complexity (Bedwell et al. 2012, p. 137 Fig.2) and conclude by calling for further research into measures to track the progress of collaborations. By excluding non-living elements from their considerations, especially in the light of modern communication capabilities, these researchers make the understanding and measuring of complex behaviour problematic. In technology mediated collaborations, technologies become a part of the collaboration, for example in the case of a human using a computer to read a document the technology is "necessary to the social



relationship between author and reader” (Law 1992, p. 382). Media Naturalness Theory provides measures to gauge the impact of the appropriateness of technology choices in human interactions (Peng & Sutanto 2012). Furthermore, the importance of including both human and non-human actors is recognised by both Merali in her “network-in-use” (2006, p. 217) and Ulieru in her conceptualisations of a cyber-physical ecosystems (Ulieru 2007).

De Michelis (2001) viewed collaboration as the performance of a co-operative process that “can be characterised by the communication relations binding its participants to each other and the actions they are performing” (p. 126). He observed that the value of the process lay in the knowledge created and used to inform action. These actions may be individual or collaborative in nature or performed by a group within an organisation or by the organisation in a community and so on. De Michelis’ view of value is that of a goods dominant logic in which value is embedded in the product and then appropriated by the consumer. By contrast, organisational knowledge creation theory (Nonaka & Takeuchi 1995; Nonaka, Toyama & Hirata 2008) describes how knowledge emerges from the interactions of knowledge creators in a managed social environment and the value of knowledge is recognised through use.

The goal in defining collaboration is to support the articulation of what attributes may be subject to improvement strategies and what to take into account during the application of improvement processes. The definition needs to cover all aspects of the human collaborative processes necessary to achieve mandated outcomes or capable of influencing those outcomes. This section has revealed some aspects that are required in a definition of group collaboration, namely treating collaborations as complex adaptive social systems created for a purpose, recognising the importance of including all relevant collaborative actors, and avoiding the imposition of constraints on the domain of the collaboration. There is a need to develop measures for collaborations that exhibit complex behaviours. The task now is to investigate the structural aspects of collaborations with a view to laying the basis for deriving a framework of measures.

### 2.9.2 Kinds of Collaborations

Miller’s Living Systems Theory (1978) provided only for face-to-face collaborations. Since that time, collaborations take advantage of our modern ubiquitous communications to lessen the dependence on face-to-face interactions. A richer definition of collaboration is necessary. This section of the review looks at the various kinds of collaborations found in the literature.

Complex social problems are multi-level in nature (see section 2.3.2) and require different kinds of collaboration for the level (individual, group, organisation and so on) at which the problem is to be addressed. Collaborations may range from an

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individual entrepreneur using their social network to devise strategies for launching a new enterprise (Mainela & Puhakka 2011; Martinez & Aldrich 2011) to collaborations within a single organisation through to joint venture collaborations involving multiple organisations (Pisano & Verganti 2008). Large disbursed joint venture collaborations, called “meta-organisations” (Gulati, Puranam & Tushman 2012, p. 7), take on the attributes of clusters that combine or co-operate with other collaborations to leverage internal skills, add much needed expertise and knowledge, and accrue the benefits of scale without its inefficiencies (Erden & von Krogh 2011; Porter 1998).

The four basic modes of collaboration identified by Pisano & Verganti (2008) are:

Table 10 Modes of Collaboration from Pisano & Verganti (2008, p. 1)

Mode	Description
Open, Hierarchical	“Anyone can offer ideas but the organisation defines the problem and chooses the solution” (p. 1).
Open, flat	“Anyone can solicit and offer ideas, but no single” knowledge creator “has the authority to decide what is or isn’t a valid innovation” (p. 1).
Closed, Hierarchical	“Organisation selects certain” knowledge creators “and decides which ideas get developed” (p. 1).
Closed, flat	“A select group is invited to offer ideas. But” knowledge creators “share information and intellectual property and make critical decisions together” (p. 1).

Table 11 Collaborative Options from Pisano & Verganti (2008, p. 1)

Dimension	Advantages	Challenges	When to Use
<b>Open</b>	“Attract a wide range of possible ideas from domains beyond your experience” (p. 1).	“Screening all the ideas is time-consuming and expensive. The best idea generators prefer closed networks, where their ideas are more likely to be implemented” (p. 1).	“You can evaluate proposed solutions cheaply. You don’t know what users want” (p. 1).
<b>Closed</b>	“You receive the best solution from a select knowledge domain” (p. 1).	“You have to know how to identify the right knowledge domain and pick the right parties” (p. 1).	“You need a small number of problem solvers and you know the correct knowledge domain and parties to draw on” (p. 1).

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Dimension	Advantages	Challenges	When to Use
<b>Hierarchical</b>	"Kingpins control the direction and value of the innovation" (p. 1).	"The right direction may be unclear" (p. 1).	"You have the capabilities and knowledge needed to define the problem and evaluate proposed solutions" (p. 1).
<b>Flat</b>	"Players share the costs, risks, and technical challenges of innovating" (p. 1).	"All parties must arrive at mutually beneficial solutions" (p. 1).	"No single player in the network has the necessary breadth of perspective or capabilities to solve the innovation problem" (p. 1).

The entrepreneur's use of their social network is an example of a "closed hierarchical" collaboration while a joint collaboration with peer stakeholders is an example of a "flat" collaboration that may be "open" or "closed" (Pisano & Verganti 2008, p. 1). Managing a collaboration tackling a wicked problem is itself a wicked problem (Camillus 2008).

A collaboration must have the required requisite variety of responses to meet the variety of demands placed on it (Ashby 1958). Boisot and McKelvey restated Ashby's law as the Law of Requisite Complexity "to be efficaciously adaptive, the internal complexity of a system must match the external complexity it confronts" (2011, p. 279). They propose an abstracted space they call "Ashby Space" (2011, p. 283) which is a space of adaptation responses, that could for example, be available to meet the demands of solving a wicked problem.

According to Nonaka, Toyama & Konno (2000), "there are two ways to realise requisite variety. One is to develop a flat and flexible organisational structure in which the different units are interlinked with an information network, thereby giving organisation members fast and equal access to the broadest variety of information. Another approach is to change organisational structure frequently or rotate personnel frequently, thereby enabling employees to acquire interdisciplinary knowledge to deal with the complexity of the environment" (p. 28). However, the collaboration may not be able to draw on its host organisation for expertise or knowledge. In this instance the collaboration must either seek to recruit external knowledge creators or establish a joint collaboration with an external entity.

Boundaries, both static and dynamic, are recognised as key considerations in complex systems (Merali 2002). The difficulty in type two and type three wicked

problems is the conflict between stakeholders in problem description and strategy development. Batie (2008) recommends that a collaboration tackling a wicked problem be structured as a boundary organisation that links different social and organisational perspectives required to address the wicked problem. Examples include linking knowledge creators and consumers, science and policy, and different social, political and cultural groups.

The characteristics of a joint-collaboration has a number of similarities to the work of Michael Porter in his discussion of the formation of industrial clusters. He defined clusters as “geographic concentrations of interconnected companies and institutions in a particular field. Clusters encompass an array of linked industries and other entities important to competition”. Clusters include institutions such as “universities, standards-setting agencies, think tanks, vocational training providers, and trade associations - that provide specialized training, education, information, research, and technical support” (1998, p. 78). Members of a cluster are competitors conducting arms-length marketing relationships (Porter 1998). The disadvantage to a cluster member arises when knowledge possessed by one member is accessed by small members through “spillover” (Erden & von Krogh 2011, p. 452). In this situation, Erden and von Krogh consider that there is a risk of loss of competitive advantage to the member originally possessing the advanced knowledge that was accessed by other members.

### 2.9.3 Classifying Collaboration Processes

Once the kind of the collaboration is known, the question of how to classify the processes in the collaboration must be considered. A classification structure for knowledge processes was proposed by Davenport (2005). He varies the process dimensions of work complexity (routine to complex interpretation and judgement) and the degree of collaboration required (individuals to collaborative groups) to yield four classifications of process models (2005, pp. 27 Fig. 2-1):

Table 12. Classification of Collaborative Processes (Davenport 2005)

Classification	Description
Transaction	Routine, individual actors.
Integration	Routine processes in collaborative groups.
Expert	Individuals, interpretative and judgment based.
Collaboration	Group, interpretative and judgment based.

My research is concerned with the expert and collaboration classifications. These classifications have knowledge creators in roles that require judgement calls to solve problems (Davenport & Manville 2012). In Davenport’s view knowledge creation “is

perhaps the most difficult knowledge activity to structure and improve” (2005, p. 29) and suggests “that the best primary basis for segmenting knowledge workers will be by the job roles they perform within the organisation” (2005, p. 36). This suggests that the assessment of role performance is key to measuring the state of collaboration.

### 2.9.4 Innovation

The focus is on collaborations creating knowledge for process and product innovation. This prompts the question what is innovation. Two categories of innovation are distinguished by Norman & Verganti (2014), namely “*Incremental innovation*: improvements within a given frame of solutions (i.e., ‘doing better what we already do’); and *Radical innovation*: a change of frame (i.e., ‘doing what we did not do before’)” (p. 82). The major difference between the two is based on human perception of whether the “innovation is a continuous modification of previously accepted or whether it is new, unique, and discontinuous” (p. 82). These categories may be distinguished from each other using the three criteria of Dahlin & Behrens (2005) during a study of inventions and their patenting. They are “Criterion 1: The invention must be novel: it needs to be dissimilar from prior inventions. Criterion 2: The invention must be unique: it needs to be dissimilar from current inventions. Criterion 3: The invention must be adopted: it needs to influence the content of future inventions” (p. 725). The third criteria may help to explain why radical innovation is often unsuccessful (Norman & Verganti 2014). The difficulty associated with adopting new ideas has been explored in an organisational context by Rose, Hawryszkiewicz & Kang (2014, 2015).

Studies of patenting activity have been used to differentiate types of innovation, such as product innovation in which organisations have introduced new products and applied for patents, and process innovation where organisations have introduced new processes and applied for patents (Tödtling & Grillitsch 2014). The authors also distinguish two types of non-technological innovation, that is “organisational innovation” and “strategic innovation” (p. 346).

### 2.9.5 Introducing the Role-in-use

Different kinds of collaboration in various contexts has been discussed. The focus becomes finer grained as it shifts from an organisation to a group and then to a small group and finally to a focus of individual knowledge creators. The question to be addressed now is how are knowledge creators organised in group collaborations? The first step in answering this question is to consider what are the basic building blocks or “basic concepts” (Osterwalder 2004, p. 6) that “must be chosen to provide a framework or what can be seen as a conceptual model” (Hawryszkiewicz 2014, p. 236) of group collaboration. Group collaborations are human centric, so the starting

point for investigating the answer is the knowledge creator occupying a role.

A role is “a responsibility within a business model” (Hawryszkiewicz 2010a, p. 335) and the “Extended Social Network (ESN)” (p. 49 Fig. 3.3) nomenclature is used by designers to define their interpretation of the roles necessary to fulfil a collaboration’s purpose. Responsibility and free will be discussed in a subsequent section. A “business model” is “an abstract conceptual model that represents the business and money earning logic of a company” and links “business strategy and processes” (Osterwalder 2004, p. 15); it expresses “what a company offers, who it targets with this, how this can be realised and how much can be earned by doing it” (Osterwalder & Pigneur 2003, p. 430). Knowledge creators are offered a value proposition to accept a role in a collaboration. The knowledge creator interprets their value proposition’s cost/benefit to themselves and subsequently exercises free will in a decision to occupy the role.

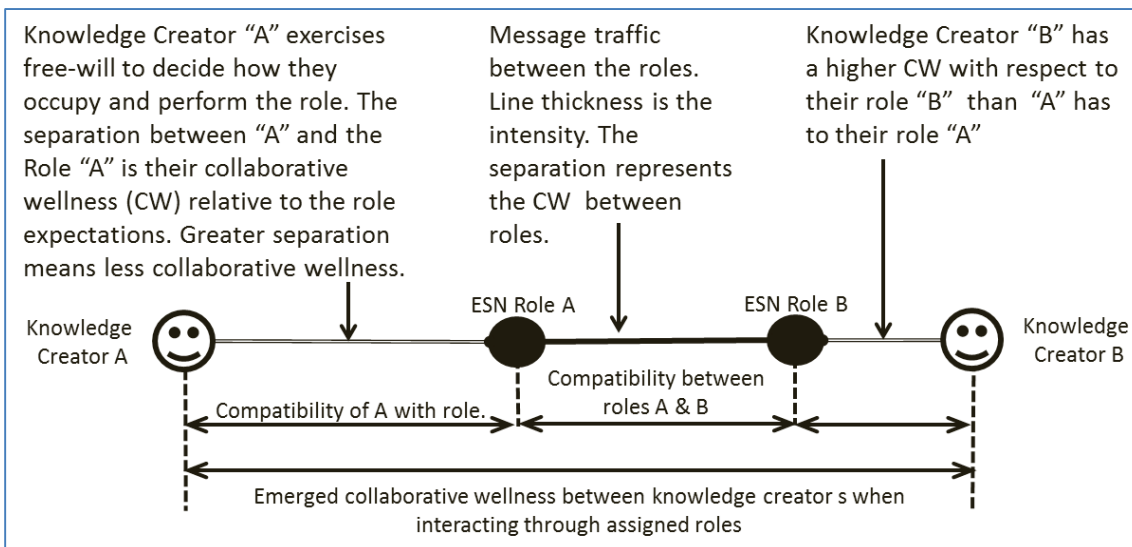


Figure 9 Roles as Collaboration Building Blocks

The building block of a collaborative structure is the knowledge creator who exercises free-will judgement to occupy and decide how to perform the role to meet the expectations of the collaboration’s purpose. Figure 9 above shows two knowledge creators within a collaboration and I have enhanced the ESN nomenclature to show compatibilities between knowledge creators and their roles, between roles and an emergent compatibility between knowledge creators (Rose, Hawryszkiewicz & Kang 2014). The role construct can be generalised to consider an entity, such as a group, to occupy one or more roles. All interactions are deemed to pass through roles.

Merali’s network-in-use “comprises social, economic, political, legal, informational and technological dimensions” (2006, p. 217). This network can be abstracted to yield the “information network-in-use”, that is “an informational representation of the interactions of participating agents situated in their social, economic, political,

informational and technological contexts” and in turn, the “active network-in-use” that “at any given time is defined by interaction of social actors with the technological network” (p. 217).

The concept of “-in-use” is applicable to the dynamics of group interactions. I introduced the concept of a “role-in-use” to study how knowledge creators interact through and adapt to cater for causality (Ellis 2008) resulting from changes in the collaboration’s circumstances. This adaption may include a re-assessment by the knowledge creator of their commitment to the group’s purpose because of changes in perceived value, their approach to occupying their collaborative role-in-use, their skill sets they need to bring, their interpretation of the role’s requirements, and finally the way they can perform the role-in-use. The knowledge creator occupying a role-in-use is the building block used in my research into collaboration.

The designed role (ESN) represents the organisation’s expressed requirements and expectations assigned to the knowledge creator and is relatively static. The role-in-use however is dynamic as the knowledge creator adapts to changing circumstances. The ESN role and role-in-use have a causal relationship. Furthermore, there are complex feedback loops between the group’s knowledge creators as they adapt their roles-in-use. It is conjectured that combining assessments of the state of the roles-in-use relative to the designed roles with assessments of the usefulness of knowledge relative to the collaboration’s purpose will be valuable in tracking progress and aiding a collaboration to achieve its goal. I regarded the role-in-use as a building block of the collaboration’s social network

The question that now arises is how can changes be categorised, compared and explored in a systematic way? Furthermore, what factors play a part in the knowledge creator’s decision processes in adapting their role-in-use? How does adapting the role-in-use affect the progress of the collaboration?

### 2.9.6 Describing Interactions

My practice-based research entails in-situ observation of collaborations involving knowledge creators. The in-situ observation employs ethnographic approaches to collecting and recording observations (Silverman 2010, p. 202). Observations are recorded in a narrative structure composed of scenes. A scene “defines a particular work context, which may involve a set of actors and events occurring in a particular time and space” (Antunes et al. 2013, p. 1468). Extending this concept, the authors define a “story as a sequence of scenes” and a process as “the sequence of scenes within a story that have events and/or actions” (p. 1469). The scene can be regarded as a business use-case which in a general sense documents a process (Cockburn 2000) and is about an actor achieving a goal. In this general description, an actor is anyone or anything capable of having a behaviour.

A use-case adds a validated structure to the narratives and describes part of a "system-in-use" (Cockburn 2000, p. 18), that is, it is a "description of interactions between a system and actors in its environment" (Some' 2006, p. 44). Furthermore, a "use case represents an agreement between the stakeholders in a system" and it "shows the different ways in which the actors act to either achieve the interests of each stakeholder, or fail in an agreeable fashion, under a specific triggering condition" (Cockburn 2000, p. 44). The collection of use-cases constitute the requirements for building a system and indeed inform testing of the system (Carniello, Jino & Chaim 2005).

### 2.9.7 Responsibility and Free Will

The literature shows knowledge creators as having autonomy and exercising free will in choosing to occupy roles, interpreting their responsibilities, and performing their roles to meet expectations. In performing their roles, knowledge creators make judgement calls (Davenport & Manville 2012) to solve problems in accordance with their responsibilities. Responsibility depends upon making a choice. Understanding responsibility requires the study of causality and attributability (King 2006 cites Goodin ).

Making a choice is an exercise of free will. The controversy surrounding free will rests with the argument that since free will is incompatible with determinism, it must be an illusion. However, Frith (2013) argues that, "even if it is an illusion, this feeling" of free will, of being in control of our actions, "is critical for the acceptance that we are responsible for our actions and can be held to account for them". Responsibility is "a mechanism that binds intentions to outcomes and is the process that enables us to think about what would have happened if we had performed a different action" (p. 3).

A working definition of free will can be based on the premise that a "necessary condition for someone's action to count as free is that the agent can do otherwise". (List 2014, p. 156). Like Frith (2013), List in seeking to reconcile free will and determinism concludes that we should recognize that "free will is not a physical phenomenon, but a higher-level phenomenon on a par with other familiar higher-level phenomena such as beliefs, desires, and intentions" (List 2014, p. 174).

Forthright support of free will is given by Ellis who states that a "reasoning mind able to make rational choices is a prerequisite for the academic subject of physics to exist. The proposal that apparent rationality is illusory, being just the inevitable outcomes of microphysics, cannot account for the existence of physics as a rational enterprise. But this enterprise does indeed make sense; thus one can provisionally recognise the possibility that free will too is an active causal factor, not directly determined by the underlying physics" (2008, p. 29). Likewise, Merali believes in the existence of free



when she states "human beings are endowed with free will, learn from experience and speculate about the future and associated risks, their position and role in the social system is defined by intent, purpose and utility" (2006, p. 227).

In reviewing responsibility, King (2006) suggests "that responsibility can in fact be seen in two distinct ways. One can be held to blame for a particular situation one has caused to come about, or one can be seen as the one tasked with its solution 'whose job it is to see to it that certain tasks are performed and that certain things are accomplished'" (p. 117). These views are interrelated as task responsibility has a "shadow of the past' ... in that one might want to look at how a situation came about in order to allocate tasks" (p. 117).

Responsibility does not solely lie with the individual, for example, improving sustainability within an organisation infers an acceptance of social responsibility. The literature refers to this as "Corporate Social Responsibility (CSR)". CSR is conceptualized as a "corporate-oriented phenomenon in which the focus is upon responsibility in the sphere of the corporation, including for its supply chain, for its own practices (e.g., employment, use of resources), and for the consumption and disposal of its products and services." (Rasche, Bakker & Moon 2013, p. 654).

In the light of experience in improving collaborations, for my research, I adopted the position that knowledge creators act in the belief that they possess and exercise free will in accepting responsibilities associated with roles and the manner in which they perform those roles.

### 2.9.8 Trust and Sharing Knowledge

The establishment of trust is a pre-condition to knowledge sharing. "It plays a major role within teamwork as people rely on each other to support them in their work and to contribute to the effort and knowledge needed to carry out their tasks" (Hawryszkiewicz 2010a, p. 111). Trust has been conceptualised and defined in a number of different ways (Lewicki & Brinsfield 2012). However the common themes in definitions of trust are "beliefs and expectations about the intentions of another party and the willingness to accept vulnerability" (p. 30). The authors provide examples of trust definitions including "trust is a willingness to be vulnerable to another party based on both the trustor's propensity to trust others in general, and on the trustor's perception that the particular trustee is worthy" (Lewicki & Brinsfield 2012, p. 31 cites Mayer et al.) and "trust is a belief in, and willingness to act on the basis of, the words, actions and deeds of another" (Lewicki & Brinsfield 2012, p. 31 cites McAllister). There are measurement issues concerning scales of trust, at one end of a trust continuum is high trust but there is no consensus at the low end of the scale as to whether it is low trust or perhaps mistrust. Furthermore, should trust and mistrust be considered separately (Lewicki & Brinsfield 2012)?

Trust is a fundamental enabler of a knowledge market (Davenport & Prusak 1998) and is to be established in three ways: "Trust must be visible" - workers must see that people receive recognition for sharing knowledge; "Trust must be ubiquitous" - mistrust spreads and the market becomes inefficient; and "Trustworthiness must start at the top. Trust tends to flow down the hierarchy of an organisation" (pp. 34-5).

Corporations may seek to establish co-operative relationships in the form of a cluster between collaborations for the purposes of sharing resources in joint research or other knowledge creation activities (Porter 1998). Porter states that a "cluster allows each member to benefit as *if* it had greater scale or *as if* it had joined with others formally-without requiring it to sacrifice its flexibility" (p. 80). In clusters of competing organisations, tacit and explicit knowledge spills over more easily to competing members (Erden & von Krogh 2011) which highlights the importance of trust and concerns around the loss of organisational identity.

Hawryszkiewicz highlights that the establishment of subcultures that carry out the same project activities creates conflict and mistrust and inhibits knowledge sharing (2010a, p. 113). This behaviour can be understood in terms of ecological niche theory applied to knowledge creators by BI, Wang & Sheldon (2009). Here, a knowledge creator, having a particular status and role occupies a knowledge niche. In ecology when two species compete for the same resources in a niche or overlapping niches then "one will usually be driven out or fail to survive. The rule seems to be one species to a niche" (Miller 1978, p. 465). In terms of knowledge sharing, "knowledge holders are willing to share knowledge which does not cause niche overlapping" and the expectation of niche overlaps inhibits sharing (BI, Wang & Sheldon 2009, p. 2002).

Knowledge sharing is a "decisional act founded on two different socio-cognitive actions: to *pass* knowledge and to *accept* knowledge" (Castelfranchi 2004, p. 304). It is a subjective attitude of a set of beliefs and expectations that creates a disposition towards others either in sharing or accepting and as such is a social relationship. Lack of trust is an inhibitor to sharing knowledge and is seen as a "friction factor" (p. 306). Trust "can also develop from messages received about individuals from others" (Hawryszkiewicz 2010a, p. 111) which is significant when considering virtual and disconnected environments. Davenport comments that for engineers to share knowledge, they must not only speak the same language, but they must speak engineering (2005).

Knowledge that is a "socially mediated resource , one that cannot be controlled by an individual member as she/he relies on the willingness of another party to share"

it is a form of social capital (Blumberg et al. 2012, p. 62). Furthermore, trust and social capital exist in a dynamic relationship in a social network (pp. 63-7). This relationship between social capital and trust is explored by Goode (2013) who uses a "social capital framework" (p. 4 Fig. 1) to examine the propensity of users to switch between suppliers of cloud services.

### 2.9.9 Wellness of Knowledge Creators

Understanding knowledge creators in collaboration requires empathy on the part of the researcher, that is, the researcher must put themselves, with sympathy, into the place of their subject. Using their "empathic understanding" (McDonagh & Thomas 2010, p. 461) I consider "human values that focuses on the needs" (von Thienen, Meinel & Nicolai 2014, p. 101) of the knowledge creators to ensure their "wellness" (Smith, Tang & Nutbeam 2006, p. 344) in performing their collaborative roles.

The World Health Organisation (WHO) explains the wellness of an individual as "the optimal state of health of individuals and groups. There are two focal concerns: the realization of the fullest potential of an individual physically, psychologically, socially, spiritually and economically, and the fulfilment of one's role expectations in the family, community, place of worship, workplace and other settings". (Smith, Tang & Nutbeam 2006, p. 344). The definition has two aspects, firstly the wellness of the individual and secondly, the concern of how well an individual fulfils their roles.

The assessment of how well an individual performs a role has been discussed in terms of requisite variety (Ashby 1958). In this section, Nonaka, Toyama & Konno (2000) suggest two strategies for improving requisite variety and by extension the responses an individual possesses to meet the demands of their collaborative roles. An individual's wellness and their wellness in performing their roles is a matter of self-evaluation and self-assessment with a responsibility to continually work on learning and on making changes that will enhance wellness (Pellegrino, Saffici & Pellegrino 2012). However, managers need to be able to assess the success of an individual's self-adjustment of their wellness and "qualitative methods may be an ideal way to help clarify the wellness construct, to assess individuals' levels of wellness" (Roscoe 2009, p. 224).

## 2.10 Cognitive Distance Measures

This section explores cognitive distance concepts that may be appropriate to use as measures for assessing how a role fits the purpose of a collaboration and the fit of knowledge creators to the roles they occupy and perform. Collaborations are complex open systems that exhibit emergence resulting from the complex lower level interactions and feedback loops. In this situation, care must be taken to decide the appropriateness of the measures and their relevance to the collaboration's current situation. Furthermore, the collaborations are human centric and much in the way of

information required for the measures in this section will be qualitative, dependent upon the expertise of the observer and subject to uncertainty.

In this section of the review characterises the types of measures that form the basis of assessing the current state of the collaborative wellness system. It provides the basis of understanding what and how to measure so as to assess the current state of the collaborative wellness system (CWS) (see section 3.9.9 on page 126).

### 2.10.1 Subjective Spatial Distance

The importance of cognitive distance as geographical proximity is highlighted in knowledge creation theory (Nonaka 1994; Nonaka & Toyama 2003; Nonaka, Toyama & Hirata 2008; von Krogh & Geilinger 2014) in the Ba spaces that support socialisation of tacit knowledge. In tacit knowing (Polanyi & Prosch 1975), the distance between the human and apprehended entity is capable of accurate measurement in face-to-face situations. By way of contrast, in virtual collaboration, the physical distance is between the individual and the technology to access the virtualisation, but the individual's conception of the cognitive distance to the apprehended entity is a subjective value depending on the feeling of presence in the virtualisation and the technology maintaining it. The subjective cognitive distance of the virtualisation does not relate to physical distance. In face-to-face situations, intense usage of mobile devices (tablets, smartphones, and so on) could result in the "rich interactions" of Lichtenstein & Plowman (2009, p. 622) that have the effect of decreasing the subjective cognitive distance (see Figure 10 on page 78).

Disparities between subjective representations and the objective world are well researched and have led to the conception of the "cognitive map" (Tolman 1948, p. 193) as a mental representation of our cognitive environment linked to our worldview. The notion of cognitive distance between entities in the cognitive maps and the difficulties in relating them to the physical world can be summed up as "people do not possess representations of the physical world that have the mathematical properties of a metric space" and "that any internalized spatial representation of the physical world will be highly complex" (Cadwalader 1979, p. 574). Dependency on technology to support knowledge creator interactions creates a situation where the appropriateness and performance of the technology affects the cognitive distance. For example, an intermittent network connection to a virtual environment has the effect of increasing the cognitive distance.

The cognitive distance as a subjective spatial measure is important for assessing the appropriateness of supporting infrastructure and media. In this sense, the measure is concerned about the ability to be connected and the appropriate support provided by technology. Technology support for collaboration may be assessable by applying media naturalness theory (Peng & Sutanto 2012). The term "media naturalness is

the ability of media to support a sense of collocated and synchronous interaction” (Peng & Sutanto 2012, p. 142). Furthermore, “the most natural medium is face to face for sharing knowledge interactions” (p. 149) as it involves language, facial expressions and body language. In a dispersed environment, media naturalness decreases as communication moves from synchronous technology such as video conferencing to asynchronous technology such as email and information repositories. “The lower the naturalness of the medium, the higher the mental effort involved in the knowledge-sharing process and the greater the possibility of misinterpreting the communication during the knowledge-sharing process.” (p. 145).

### 2.10.2 A Measure of the Influence of Novelty

Nooteboom (2012) conjectures that there is an “optimal cognitive distance” (p. 21) of the trade-off between the quality of novelty of knowledge that organisations seek to acquire and the difficulty of acquiring it. A high cognitive distance implies that people have less in common and an imperfect understanding of each other which limits their ability to collaborate. However, a large cognitive distance creates represents novelty and a desire to collaborate. A low cognitive distance implies a high degree of commonality with less novelty and less incentive to share.

In a collaboration, as knowledge is accessed or acquired, this cognitive distance will decrease to a point where there is insufficient novelty to continue the collaboration (Nooteboom 2012). Burt (2004) discussed the value of accessing and sharing novel ideas when bridging structural holes in a social network. The structural hole is an absence of direct links between entities and this implies a high cognitive distance. The act of a third party acting as a knowledge broker to bridge the structural hole will reduce the cognitive distance of the parties in the arrangement (Di Vincenzo et al. 2012).

### 2.10.3 Potential to Create Knowledge

Acts of creating and assimilating new knowledge lead to knowledge creators learning to handle increasingly complex concepts and improve their potential to create knowledge. Polanyi (1966, p. 25) deals with a scientist’s act of knowing of impending discovery as an exercise of judgement “in relating evidence to an external reality, an aspect of which he is seeking to apprehend” (p. 25). The scientist is exercising their imagination. In pursuing the solution, the scientist sees a “range of potentialities” that are believed accessible and finally achieves innovation through the “actualization of certain potentialities” (1966, pp. 88-9). Can the potentialities to be actualised be used to derive a cognitive distance measure for an individual knowledge creator’s capacity to create knowledge?

Balconi et al. (2012)’s trait measure may be used to derive a cognitive distance based on comparing the number of potentialities actualized in the course of knowledge

creation with the total number of potentialities required to fulfil the collaboration's purpose. This cognitive distance measure decreases as the scientist acquires and/or creates knowledge in their progress to solving the problem. The scientist's process of refinement is moving from ill-formed ideas which exists as a "state of potentiality" (O'Connor & Gabora 2009, p. 9) to a viable state of actualisation – the well-formed idea as a knowledge contribution.

There is uncertainty associated with a qualitative methodology to assess the potential to create knowledge. Like linkography, it would rely on the presence of an expert observer to make a qualitative assessment of a knowledge creator's potential to create knowledge and then assess the usefulness of the created knowledge. Furthermore, the observer must understand the effect of the designed role on the knowledge creator's ability to create knowledge. On the one hand, the designed role must have sufficient flexibility to give the knowledge creator leeway in their decisions concerning how to solve the problem. That is, the knowledge creator in accepting the role must have the capability of exercising their imagination to see a range of potentialities to pursue through their role-in-use that to solve the problem. If the knowledge creator's role-in-use aligns to the purpose, there is minimal constraint on the knowledge creator's imagination.

### 2.10.4 Wellness of a Knowledge Creator

Wellness can have a positive effect in improving the attitude of a knowledge creator towards collaborating. For instance, a "humorous perspective can create cognitive distance between yourself and circumstances in a way that can be psychologically protective" (Ayan 2009, p. 31) and thereby improve the willingness and capability to participate in the collaboration. A sense of humour applied to a group can relax and foster participation.

Mental wellness enables individuals to "enjoy intellectual wellness never stop learning. They seek out and relish new experiences and challenges... Social wellness requires participating in and contributing to our community and world" (Pellegrino, Saffici & Pellegrino 2012, p. 705). Knowledge creators with a high sense of occupational wellness "welcome opportunities for advancement and appreciate the recognition of achievement".

Spiritual wellness leads to individuals who rather than "fearing new experiences and life's changes, they welcome them as a time to grow. They do not allow prejudices or stereotypes to distort their perceptions" (Pellegrino, Saffici & Pellegrino 2012, p. 706). Spiritual wellness is considered to be a balance on the continuum between the extremes of a preoccupation with spirituality to the detriment of other wellness considerations, and the repression of spirituality (Chandler 1992). This conceptualisation of wellness is similar to that of Roscoe (2009) who proposed a

model of wellness as comprising "seven dimensions: social, emotional, physical, intellectual, spiritual, occupational, and environmental" (p. 222).

In summary, wellness exerts a causal effect on a knowledge creator's propensity to collaborate and their ability to meet the performance expectations of their role-in-use in the collaboration. Knowledge contributions from knowledge creators with high wellness are likely to be more useful compared with those of low wellness. As a knowledge creator's wellness increases, so the cognitive distance between the knowledge creator and the role decreases.

### 2.10.5 eWellness and eImmunity

The term eWellness has been used to refer to real-time networked body-attached sensors for monitoring selected parameters of a person's medical state (Angelidis & Psymarnou 2006; Fortino, Gravina & Guerrieri 2012; Takagi 2007). However, I interpret eWellness as a facet of overall wellness that is closely related to mental wellness. I conceive eWellness as a measure of an individual's willingness and capability to interact with technology in order to fulfil their responsibilities. An individual of high eWellness enjoys intense intuitive interactions with technology to access and manipulate knowledge stored in a variety of formats.

Conversely, a person of low eWellness experiences difficulty with using technology. Low eWellness may apply to all types of technology or only to specific pieces of technology encountered for the first time. A knowledge creator with high eWellness will have a lower cognitive distance in occupying a role dependent upon technology than a person with low eWellness.

Using the function of biological immune systems as a metaphor for protecting or shielding against disease we can say intuitive IT interfaces may be said to have high eImmunity since they shield the user from the IT system's underlying complexity. For roles requiring the use of IT technology, a high eImmunity decreases the cognitive distance between the knowledge creator and their role-in-use as they can concentrate on satisfying the demands of the collaboration's purpose rather than grappling with hard-to-use complex technology.

## 2.11 The Extended Mind Hypothesis

The work of Polanyi implies an extension of cognition from the body to the attended entity. Support of Polanyi's philosophical approach comes from Clark and Chalmers proposal of an "extended mind thesis" based on the "active role of the environment in driving cognition" (1998, p. 7). In this thesis, a human links with an external entity, such as a smart phone, "in a two-way interaction, creating a coupled system that can be seen as a cognitive system in its own right. All the components in the system play an active causal role, and they jointly govern behaviour in the same sort of way that

cognition usually does.” (p. 8). The authors see language as an enabler for extending cognitive activity and illustrate their point by considering a collaboration or learning situation where the brain “learns to play its role within a unified, densely coupled system” in which extended cognition is a “core cognitive process” (p. 12). Clark and Chalmers’ examples are reminiscent of Polanyi’s explanation of tacit knowing using the wooden probe or cane (1966) and this extended cognition is seen as an act of tacit knowing.

Cognition is extended by Clark and Chalmers when they propose that elements of our worldview, beliefs for example, also extend beyond the physical limits of the body especially in human interactions and the use of language (1998). Clark depicts “the biological brain as a master ... of ‘ecological control’. Ecological control is the kind of conscious control that does not micro-manage every detail, but rather allows substantial devolvement of power and (functional) responsibility”. It “allows (I claim) much of our prowess at thought and reason to depend upon the robust and reliable operation, in dense brain-involving loops, of a variety of non-biological epistemic devices (such as pen, paper and sketchbooks)” (Clark 2005, p. 9). Ecological control is opportunistic, exploitive and adaptive, it takes “whatever is around, and build it into problem-solving routines, exhibiting a management style delicately poised midway between anarchy and enslavement” (Clark 2005, p. 9).

Clark (2007) stated his hypothesis of organism centred cognition as “Human cognitive processing (sometimes) literally extends into the environment surrounding the organism. However, the organism (and within the organism, the brain/CNS) remains the core and currently the most active element. Cognition is organism-centred even when it is not organism-bound” (p. 49). Wilson and Clark posited situated cognition as a form of cognitive extension. Further, they cite Turner, who showed that biological boundaries can also extend beyond the animal (Wilson & Clark 2009). Since 2007, debate amongst researchers has continued on the extended mind concept and Clark’s view is that there appears to be no straightforward empirical resolution to his hypothesis (Clark 2011, 2013).

### 2.12 Group Level Processes

Up until now, the review has been concerned with individual cognitive processes such as tacit knowing. This section considers processes at the group level. The system levels of Miller’s Living Systems Theory (Miller 1978) emerge from lower system levels (Figure 7 on page 37). The prime difference between the levels is that social relationships “emerge only at the group level, and are undefined for cells, organs, or individuals” (Bailey 2005, p. 34). The first step is to consider how individual behaviours combine through interactions to create emergent processes at the group level.



In the context of the case studies, the collaborative wellness system spans multiple levels of an organisation. This section helps to characterise the context of CWS in an organisation (see Figure 13 on page 93) and how collaborative wellness units (see section 3.9.7 on page 124) are linked (see section 3.9.8 on page 125).

### 2.12.1 Group Tacit Knowledge

An individual has habits or “submerged repertoires of potential behaviour; they can be triggered or reinforced by an appropriate stimulus or context” (Hodgson 2011, p. 593) Habits enable humans to cope with large amounts of information, “habit is a vital psychological mechanism to deal with complexity and change. Often acquired through cultural transmission, habits serve as means of learning useful knowledge in human societies” (p. 595). It is accepted that routines relate to organisations as habits relate to individuals and that routines are organisational “meta-habits” and “are best treated as stored behavioural capacities or capabilities”. Furthermore these routines remain (after working hours) as long as individuals “have the potential and disposition to work together in the same context... the routines can be triggered by appropriate stimuli ...” (p. 595), such as, returning to work on the next day. In this light, the habits of individuals can form cues that trigger specific behaviours in others. These interlocking interactions cause the emergence of routines at the group level.

Nonaka, von Krogh & Voelpel (2006) state that organisational knowledge creation is “the process of making available and amplifying knowledge created by individuals as well as crystallizing and connecting it with an organization’s knowledge system” (p. 1179) This process is driven by phronesis or practical wisdom (Nonaka et al. 2014) and refers to the connection of both tacit and explicit knowledge from the individual to the group. The externalisation phase of “SECI” (Nonaka, Toyama & Hirata 2008, p. 18) is where an individual’s tacit knowledge is externalised and communicated to group members relies on the use of analogy, “metaphor” (Polanyi & Prosch 1975, pp. 75-90) and imagery. In particular, the use of metaphor enables “team members to articulate their own perspectives, and thereby reveal hidden tacit knowledge that is otherwise hard to communicate” (Nonaka 1994, p. 20). Julie Kendall and Kenneth Kendall explore case studies to illustrate the use of metaphors in explaining and articulating the concepts business information systems (1993).

As the “Ba” space (von Krogh & Geilinger 2014, p. 159) is developed and energised by managers, individual knowledge creators gradually synchronize their mental models through interactions and sharing context to form a common language that leads to the creation of a shared mental state. These interactions lead to an emergent state of group tacit knowledge (Nonaka 1994; Nonaka & Nishiguchi 2001; Nonaka, Toyama & Hirata 2008; Nonaka, Toyama & Konno 2000). Habits containing tacit

knowledge at the individual level are synonymous with routines containing group tacit knowledge at the group level.

The emergence of group tacit knowledge passes through four levels. Level 1 is the group as a collection of individuals having weak ties with no shared understanding. Level 2 is characterised by collective action to solve familiar tasks. Group members sharing memories, experiences and events create this capability. The group's routines are stored tacitly at the group level and are not capable of acting beyond the routines. This level signifies the emergence of a group culture and collective identity. Level 3 is "phronesis" where the group as a whole displays the aptitudes of "prudence", "practical wisdom" and "practical rationality" (Erden, von Krogh & Nonaka 2008, pp. 14-8; Nonaka et al. 2014, p. 139). Level 4 is termed "Collective improvisation" where the group "is able to make sense and improvise collectively even in complex, unfamiliar, uncertain, and urgent situations" (Erden, von Krogh & Nonaka 2008, pp. 14-8).

### 2.12.2 Trait Overlap

Researchers have interpreted cognitive distance as a measure of organisational and cultural compatibility rather than a spatial concept and consider this interpretation to be more important in assessing the success or failure in collaborations in an organisation (Minshall, Kouris & Mortara 2011). Balconi et al. (2012) use a business perspective to define cognitive distance as "the distance between the specialised knowledge bases of the actors involved in a collaboration" (p. 6). Their measure is based on an ecological measure used to compare different species on the basis of the number of traits they have in common.

I interpret traits as the fields of knowledge and human capabilities possessed by knowledge creators. A knowledge creator's traits can be compared with the traits required to fulfil the purpose of the collaboration: a high match count of traits gives a low cognitive distance. I posit that a cognitive distance measure based on traits should include an allowance for weighting each trait based on its usefulness and/or importance to the collaboration's purpose. Questions for further consideration include how are traits identified and ordered in their importance and how is the requisite variety of the role in a knowledge creation process measured?

### 2.12.3 The Extended Mind and the Group

Figure 10 below depicts the use of tools by individuals in a group context that creates extended cognitive processes (Clark 2005, 2007; Clark & Chalmers 1998). In the context of an organisation, a group meeting as depicted in the figure is composed of people with different perspectives (Hawryszkiewicz 2010b) of the topic, interacting in a discussion.

A review of group problem solving case studies by Theiner, Allen & Goldstone (2010) led to the view that "specific cognitive capacities that are commonly ascribed to individuals are also aptly ascribed at the level of groups" (p. 378). They consider that group cognition is "an emergent phenomenon" (p. 378). The researchers here are not advocating the group mind concept. Rather, they support the notion of an "extended mind" (see section 2.11 on page 73) which is a special case of the claim that "systems larger than an individual human, but containing that human, are capable of cognition" (p. 378). Furthermore, the researchers concentrate on using the extended mind hypothesis because the "location and causal efficacy of the 'group mind' proved to be an elusive target, because it remained unclear how the 'group mind' was supposed to interact with the individuals who comprise the group" (Theiner, Allen & Goldstone 2010, p. 392). The suggestion of utilising IT computing infrastructure as a closely couple cognitive system to act as a "group memory for knowledge, through which people can access past experiences, in particular overt clues, documented experiences, written reflections and so on, and thereby recollect an image of past events" (Erden, von Krogh & Nonaka 2008, p. 15) is compatible with Clark's hypothesis.

The extended mind at the LST group level in terms of OKC is an emergent arising from the complex cognitive interactions of the knowledge creators. IT physical memory only supports explicit knowledge, which together with clues and learnt practices enhances the socialisation of tacit knowledge within the group and enriches the emergence of group tacit knowledge. Pacanowsky (1995) explored the nature of the knowledge required to support brain storming sessions in relation to IT team tools to aid groups tackling wicked problems. He listed domain maps, mind maps and cause maps amongst knowledge that could be shown in a shared display. The concept of group memory has also been explored by Hasan (2003) through supporting activities in knowledge creation processes.

## Collaborative Wellness Through Dynamic Role Alignment

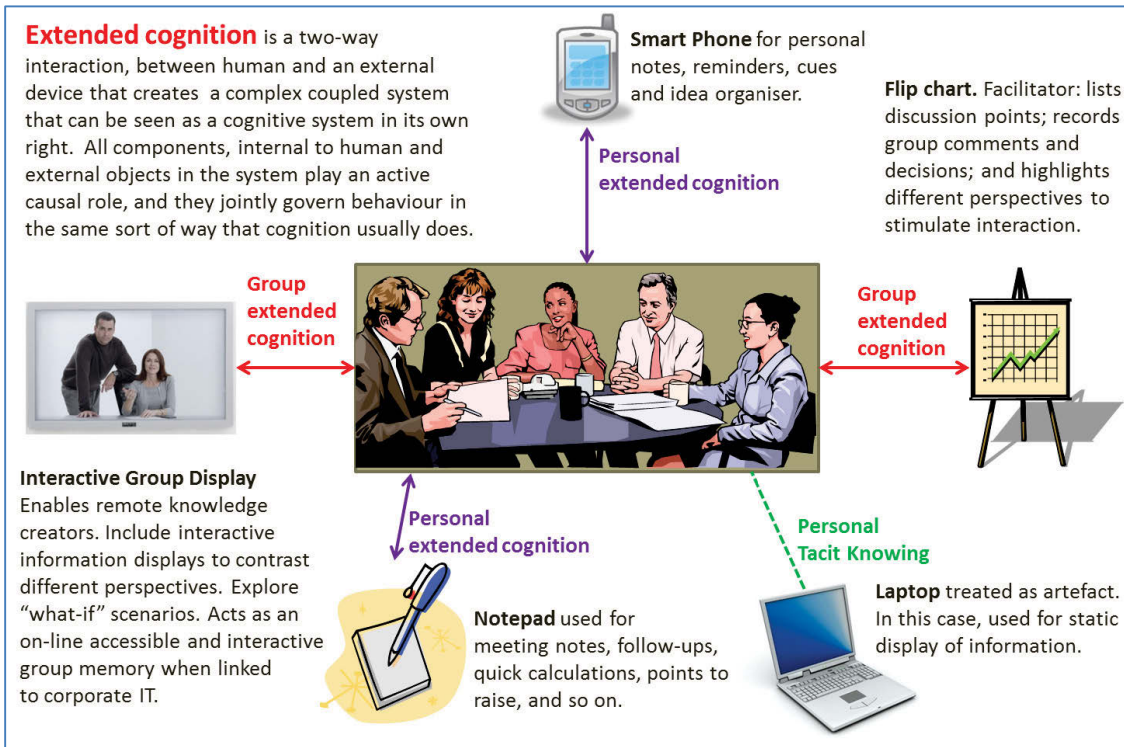


Figure 10 Extended Cognitive Processes in a Group

Support for complex emergence of group level emotions is provided by Barsade & Gibson (2012). They define “group affect” as “the affective state arising from a combination of the group’s top-down components (i.e., the affective context) and its bottom-up components (i.e., the affective composition of the group) as transferred and created through explicit and implicit affective transfer processes. When referring to the construct of group affect, we use the term *affect* as an umbrella term for phenomena that can encompass three general components: dispositional or trait affect, emotions, and moods” (2012, p. 119).

The opposite of emergence is “demergence”, in terms of LST levels above and including the group, it is “the situation where larger scale structures not only lack the properties that their components have, but are somehow constitutionally incapable of having those properties.” (Theiner, Allen & Goldstone 2010, p. 383). According to the authors, “the traditional view of consciousness, it is a demergent property – one that pops into existence at a certain level of organizational structure, but then disappears from higher levels of organization except insofar as it is found in the parts” (p. 383). They suggest, “once the resources exist to generate a new phenomenon at some scale, larger collections should be assumed to have the same potential. Thus, if cognition depends on the organizational structure within individual organisms, groups of organisms should be assumed to have the same kind of capacity for organizing themselves, and thus the same potential for instantiating cognitive properties” (p. 383).

2.12.4 Organisational Culture and Group Collaborations.

According to Choo (2004) in considering frameworks of knowledge management, both the model of Nonaka & Takeuchi (1995) and that of Davenport & Prusak (1998) “recognize that knowledge creation, sharing and use are inherently social activities that are embedded in a web of cultural norms and human relationships” (Choo 2004, p. 215). These cultural environments are “communities of practice” (Davenport & Manville 2012, p. 99; Davenport & Prusak 1998, p. 38) or shared contexts called “Ba” (Nonaka, Toyama & Hirata 2008, pp. 33-42; Nonaka, Toyama & Konno 2000, p. 13; von Krogh & Geilinger 2014, p. 159).

Jiacheng, Lu & Francesco (2010) explored the relationship between knowledge sharing and cultural influences. The authors selected the work of Hofstede (1989) for the basis of their study since “this cultural framework is underlain by norm- and value-based analysis” (Jiacheng, Lu & Francesco 2010, p. 223). Hofstede et al. (1990) defined organizational cultures as being “perceived common practices: symbols, heroes, and rituals that carry a specific meaning within the organizational unit” (p. 313) and they developed a framework for examining how cultural influences affected organisational structures.

Table 13 Dimensions of Business Cultural Diversity (Hofstede 1989, pp. 393-4)

Dimension of Business Cultural Diversity	Description (Hofstede 1989, pp. 393-4)
“Process-oriented versus results-oriented units” (p. 393).	“In results-oriented units, everybody perceived practices in about the same way. In process-oriented units, there were vast differences in perception among different levels and parts of the unit. Strong cultures are more results oriented than weak ones and vice versa” (p. 393).
“Job-oriented versus employee oriented” (p. 393).	“Job oriented cultures assume responsibility for the employees’ job performance only, and nothing more. Employee-oriented cultures assume a broader responsibility for their members’ well-being” (p. 393).
“Professionally versus parochially oriented units” (p. 394).	“In professional orientation, the (usually highly educated) members identify primarily with their profession. In parochially orientation, members identify primarily with the organization for which they work” (p. 394).

Dimension of Business Description (Hofstede 1989, pp. 393-4) Cultural Diversity	
"Open versus closed systems" (p. 394).	"Refers to the common style of internal and external communication and to the ease with which outsiders and newcomers are admitted" (p. 394).
"Tight versus loose internal control" (p. 394).	"Deals with the degree of formality and punctuality within the organization; it is partly a function of the unit's technology: banks and pharmaceutical companies can be expected to show tighter control, research laboratories and advertising agencies lose control; but even with the same technology, units still differ on this dimension" (p. 394).
"A pragmatic versus a normative way of dealing with the environment" (p. 394).	"Service units should be found towards the pragmatic (flexible) side, rule-bound units towards the normative (rigid) side" (p. 394).

### 2.12.5 Alignment at the Group Level.

What are the problems that arise from a lack of alignment of groups to organisational purposes? The literature dealt with issues from introducing agile IT development methodology into organisations. Agile collaborations are now common in IT business projects. "Agile" is a very broad and ill-defined term (Paulk 2002; Wang, Conboy & Cawley 2012). Here, the term agile is understood in terms of the Agile Manifesto (Beck et al. 2001) with explanations by Highsmith & Cockburn (2001).

Software development "is a knowledge creation activity" (Dingsøyr et al. 2012, p. 1217) and agile practices require a worldview that "organizations are complex adaptive systems" where "decentralized, independent individuals interact in self-organizing ways, guided by a set of simple, generative rules, to create innovative, emergent results" (Highsmith & Cockburn 2001, p. 121). Agile methods stress: rapid adaptation to changing circumstances and small iterative work cycles with dynamic planning and prioritization reviews. "Working software is the primary measure of progress" (Paulk 2009, p. 15). Agile teams are small group collaborations, typically co-located with less than 10 members. The most effective way of communicating in an agile team is in face-to-face conversation which emphasizes tacit knowledge over explicit knowledge (Paulk 2002, 2009).

## Collaborative Wellness Through Dynamic Role Alignment

A barrier to implementing an agile methodology in organisations lies in the difficulty of “maintaining close and effective customer collaboration and this barrier is likely to be erected on the customer’s side of the relationship” (Paulk 2002, p. 17). Scalability is problematic because practices “that rely on tacit knowledge and highly competent professionals may break down in larger teams with their rapidly expanding communication channels and coordination challenges. However, replacing those practices with ones appropriate for large teams may result in losing the emergent properties of the agile methodology” (Paulk 2002, p. 17).

Case studies have found communication issues to be a central theme in agile collaborations:

- project co-ordination difficulties and lack of negotiation skills (Adolph & Kruchten 2011; Strode et al. 2012);
- The need to use lean practices to improve team coordination (Wang, Conboy & Cawley 2012);
- Lack of organizational involvement inhibits successful implementation (Senapathi & Srinivasan 2011);
- Communication, trust and commitment issues as obstacles to effective team decision making (Drury, Conboy & Power 2012).

The review highlights the part played by poor communication in creating situations where the group’s role loses its alignment to its organisational purpose.

### 2.12.6 Leading and Managing Collaborations

Management is about “control” of people and processes and leadership is concerned with “showing the way” or “to guide” (Grint 2002, p. 248). Davenport has highlighted that knowledge workers “don’t like to be told what to do” (Davenport 2005, p. 15). He goes further and says that for high performing knowledge workers, managers should be supportive and take on the attributes of “player/coaches”, a reflection that managers are themselves knowledge workers and in the sense of coaching are guiding and showing the way (Davenport 2005, pp. 208-9). As Knowledge work moves from routine processing of codified knowledge to senior knowledge creators creating knowledge so the manager transforms to a leader along a continuum governed by the context of the knowledge work.

In Organisational Knowledge Creation theory, Von Krogh, Nonaka & Rechsteiner (2012) emphasize control over guidance. In their framework (p. 258 Fig. 1), the outer level is the “structural layer” (p. 258) that is the centralised leadership that structures and organises activities. The “conditional layer” (p. 258) has a mix of centralised and distributed control in “which managers enable lower-level group interaction” in the core activity layer “by intervening and providing access to critical

resources" (p. 258). In the "core activity layer" (p. 258), control is distributed and managers focus on "transforming the potential of Ba into functioning SECI processes by initiating and sustaining knowledge creation" (p. 258).

### 2.13 Characterising Improvement Strategies

In considering improvement strategies, Nonaka, Toyama & Byosiere (1998) interpret Ashby (1958)'s law of requisite variety and explain that in "order to deal with challenges posed by the environment, the internal diversity of an organization has to match the variety and complexity of the environment" (Nonaka, Toyama & Byosiere 1998, p. 510). In this light, to tackle an intractable problem, an organisation would seek to enhance its requisite variety through the strategy of "combining information differently, flexibly, and quickly" (p. 510). How can this strategy be realised?

One possibility is a solution strategy involving framing where knowledge can be applied in different combinations. Framing is discussed by Dorst (2011) when he considers wicked problems. He posits that a process of "design reasoning" (pp. 524-5) used by a designer can help the achievement of the desired value outcome. Design reasoning uses framing to construct a working principle that when applied to the problem may achieve the desired outcome. The essence of the approach is that "IF we look at the problem situation from this viewpoint, and adopt the working principle associated with that position, THEN we will create the value we are striving for" (p. 525). The working principle would embrace different sources of knowledge to bring a new perspective to the problem at hand.

Framing is a cognitive process may be explained by using the metaphor of a work of art. Polanyi & Prosch (1975) observe that as tacit knowing processes become more complex, they take "an increasing measure of imaginative effort" (p. 84) to achieve an appreciation of the work of art. In essence we need not know the artist's mind to appreciate their art, the art speaks to us not the artist. We read and appreciate Shakespeare's sonnets without understanding the poet. This is termed "framing" (p. 85). It is a conscious effort to erect a frame around the entity being perceived and sever the subject of focus (the work of art) from its subsidiary particulars (the artist). In a similar way we use framing to understand a decision and not the process that led to the decision. Similarly, Hallahan (1999) explains framing in terms of a metaphor based on a "window or portrait frame drawn around information that delimits the subject matter and, thus, focuses attention on key elements within. Framing involves processes of inclusion and exclusion as well as emphasis" (p. 207). The picture frame metaphor is also used in explaining how people focus on the essentials and ignore irrelevancies when assessing a social situation (Silverman 2010).



## 2.14 Social Networks

The heart of collaboration are humans occupying and performing roles to interact with others. The role was characterised as the building block of collaboration and the role-in-use was introduced as playing an important part of assessing the state of a collaboration. Interactions between roles-in-use form a social network in which the roles-in-use act as nodes. This section will focus on the structures of social networks and associated measures relevant to the research focus on collaborations.

The discussion embraces all knowledge creators, but to illustrate some concepts, scenarios will be presented using two interacting knowledge creators for the sake of simple explanations.

### 2.14.1 Social Network formed by Roles-in-use

Interactions between roles-in-use (section 2.9.5 on page 63) form a social network that is the lower level equivalent of the group level network-in-use (Merali 2006). ESN roles (Hawryszkiewicz 2010a) shown in Figure 11 below were devised by business designers to fulfil the collaboration's purpose mandated by the organisation. The snapshot, showing the roles-in-use, represent two of the group's knowledge creators' interpretation of their formal roles and how they occupy and perform their roles-in-use. Messaging is an amalgam of all communication processes covering information; knowledge; and data between all human and non-human entities. A change made to an ESN role acts as top down causation on a knowledge creator to adapt their interpretation of the formal ESN role.

In its most general form, there is no attempt to restrict membership or manage the conceptualisation of the network-in-use topology. This open membership includes not only knowledge creators engaged in active messaging but also sources of causality that affect the behaviour and output of the collaboration. As Freeman states, the "relationships that social network analysts study are usually those that link individual human beings. However, important social relationships may link social individuals that are not human, like ants or bees or deer or giraffes or apes. Or, they may link actors that are not individuals at all. The social network approach is grounded in the intuitive notion that the patterning of social ties in which actors are embedded has important consequences for those actors" (Freeman 2004, p. 2).

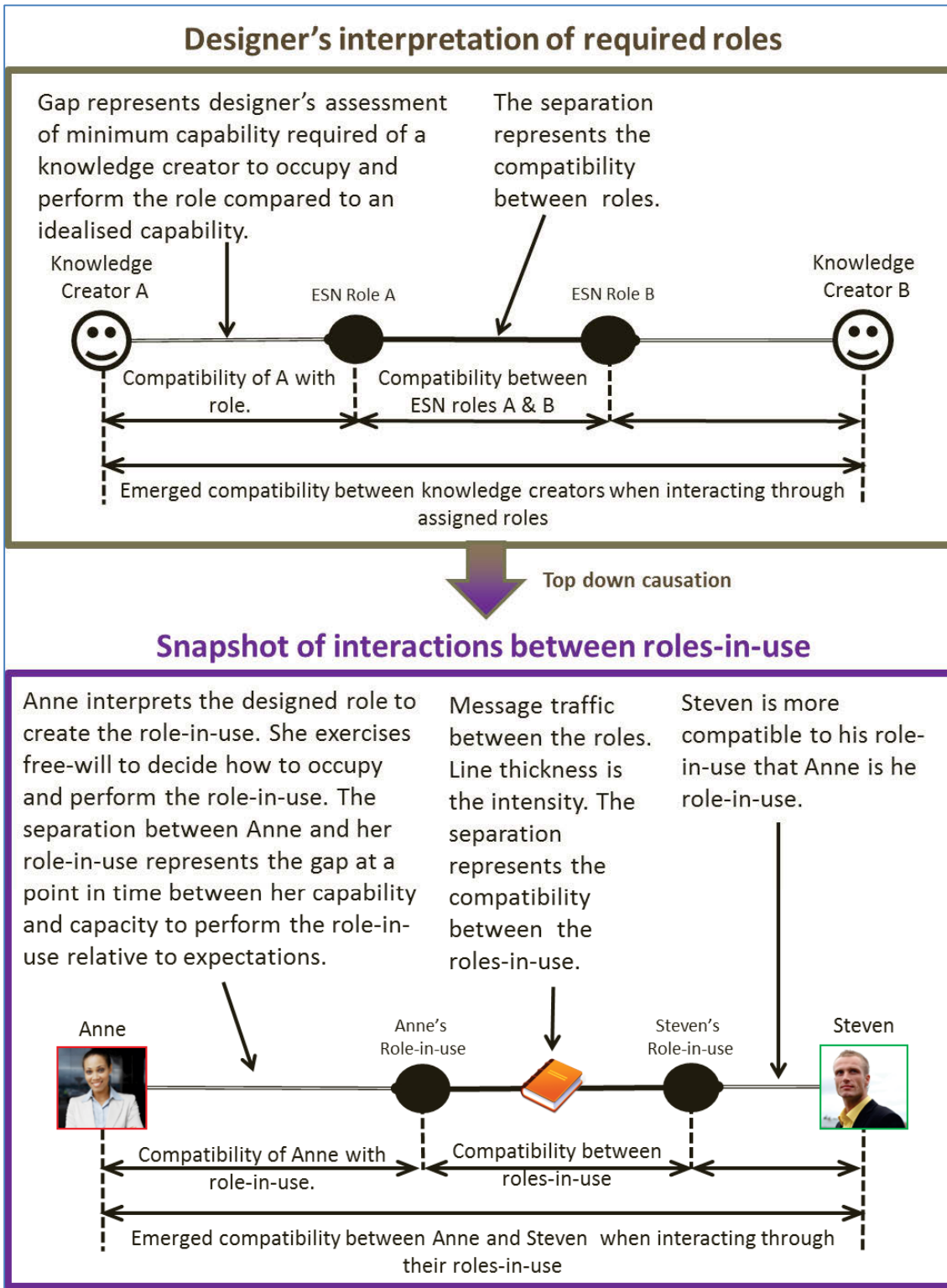


Figure 11 Social Network created by interactions between Roles-in-use

Knowledge Creators who have well established communication and social bonds are connected by strong links, that is, social ties that bind people together or bind social network nodes together. If two adjacent nodes in the social network have no social ties, there is an absence of a link between the knowledge creators and this is referred to as a "structural hole" (Borgatti et al. 2009, p. 894). Structural holes create "social capital" that Burt describes as "advantages that individuals or groups have because

of their location in social structure” (Burt 2001, p. 203. Figure 1). This underscores the discussion in section 2.9.8 on page 67 in which access to social capital is dependent upon other knowledge creator’s willingness to share.

A structural hole does not imply that people on either side of it are ignorant of each other’s existence, rather it means “people on either side of a structural hole circulate in different flows of information” (Burt 2001, p. 208). On the other hand, people whose social network spans a structural hole have an “opportunity to broker the flow of information between people and control projects that bring together people from opposite sides of the hole” (2001, p. 208).

Burt conjectures that people in a position to broker across structural holes will also have more opportunity to generate new ideas because “opinion and behaviour are more homogeneous within than between groups, so people connected across groups are more familiar with alternative ways of thinking and behaving, which gives them more options to select from and synthesize. New ideas emerge from selection and synthesis across the structural holes between groups.” (2004, p. 350). This alludes to Granovetter’s strength of weak ties that foster group interactions (1973). Interactions of human actors within the social network lead to the generation of new ideas. The existence of structural holes and the creation of boundaries between knowledge flows lead to a basis for understanding process improvement as a boundary spanning role of knowledge broking.

### 2.14.2 Messaging

The review shows that researchers determine the existence of a relationship in a social network by the messaging passed between a sender and a receiver. In considering messaging, there is the sending and receiving aspects of a message and then, most importantly for knowledge creation, the meaning of the message. The mechanism of sending and receiving a message in Living Systems Theory (LST), is conceptualised as information transmitted via a “marker” (Von Neumann 1958, p. 6). Here, a marker refers to “those observable bundles, units, or changes in matter-energy whose patterning bears or represents the information symbols from the ensemble or repertoire.” (Miller 1978, p. 12). The ensemble or repertoire is the collection of all possible combinations of symbols that may be transmitted (Shannon 2001). A piece of paper with a message written on it is an example of an information marker as is a USB memory stick containing an encoded word-processing document.

In LST, measuring information follows the ideas developed by Shannon where the “semantic aspects of communication are irrelevant” (Shannon 2001, p. 3). However, in studying and tracking knowledge creation, the semantic content of a message is of paramount importance and this leads to the question of how to measure and assess the semantic content of a message for its meaning. Two types of knowledge are

distinguished in messaging, namely explicit and tacit knowledge. Explicit “(or codified) knowledge can be expressed in words and numbers and easily shared”, and secondly, “tacit knowledge, such as subjective insights or emotions, is non-articulated, and embedded in contexts and actions. It is highly personal and hard to verbalize or communicate. Tacit knowledge, such as bodily skills or mental models, is deeply rooted in individual’s action and experience as well as in the ideals or values he or she embraces.” (Nonaka, Reinmoeller & Senoo 1998, p. 673). In this light, tracking the meaning of messages containing tacit and explicit knowledge exchanges between knowledge creators requires a researcher to directly observe and if necessary question the participants. See Table 8 on page 45 for a summary of the distinction between data, information and knowledge.

Messaging occurs in multiple channels including face-to-face conversations, between people using technology mediation, in disconnected scenarios using the written word or single person interactions through multi-media technology, and in reflective thinking (Dewey 1922) where messaging interactions are internal to the mind. Validation of messages requires the spanning of systems engineering for the physical means of message transmissions, cognition and the nature of knowledge to explain how humans receive, understand and transmit messages, and finally how humans collaborate to share, create and disseminate knowledge.

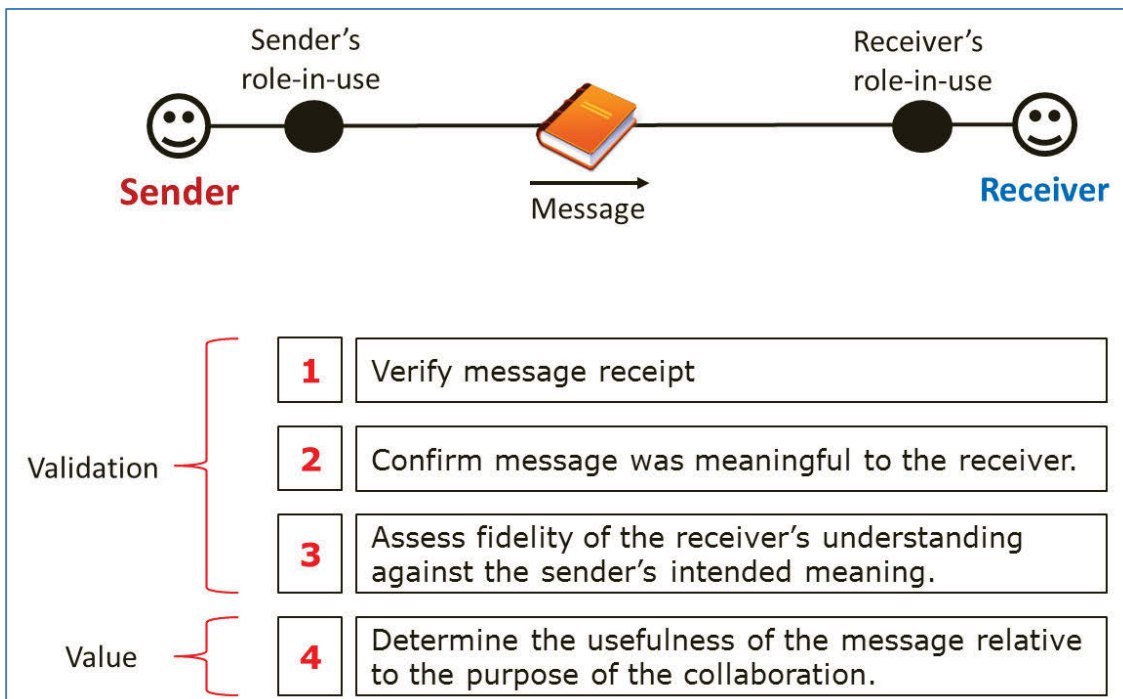


Figure 12 Message Validation

The review shows that message validation is a three step process (see Figure 12 above). First is the process of verifying message receipt. Secondly, confirming that the receiver derived meaning from the message, and lastly, assessing the fidelity of

the receiver's understanding against the sender's intended meaning. Once validated, the semantic content is assessed for its "informativeness and usefulness" (Davenport & Prusak 1998, p. 4) relative to the purpose of the collaboration by means of applying practical wisdom. The more useful and informative the message, the more certain is its content. If a collaboration is disbursed then messaging would be mediated by technology. In this latter case "Media Naturalness Theory" (Peng & Sutanto 2012, p. 145) would be applied to consider how the appropriateness of technology choices affects the content and ability to derive meaning from the message.

LST approaches the meaning of information from that of an observer measuring concrete systems. If both the receiver and transmitter use compatible messaging and "if the transmission alters the behaviour of the receiver in some way, the impact of the transmission is called its meaning" (Swanson & Miller 1989, p. 20). Furthermore, "meaning is the significance of information to the system which processes it" and "constitutes a change in that system's processes elicited by the information, often resulting from associations made to it on previous experience with it" (Miller 1978, p. 11). Therefore "it follows that the receiver, not the sender, decides whether the message he gets is really information" (Davenport & Prusak 1998, p. 3).

Tracking information requires that an observer parse the message in a process similar to techniques used in linkography to identify "design moves" (Goldschmidt 1990, p. 292). Goldschmidt (1995) extended linkography and its parsing process to the group level. The parsing methodology of linkography would need to be enhanced and applied to all collaborative message interactions irrespective of media format and times between communications. Once enhanced, the design moves in linkography become knowledge moves and links trace the development of ideas during the collaboration. These links would form an enhancement of Merali's concept of the "information content of the network-in-use" (2006, p. 218).

### 2.14.3 Measure of Utilisation and Capacity in Social Networks

"Resources are the core of manufacturing models" (Hedman et al. 2013, p. 443) and utilisation measures provide information about activities. However, "human resources are often defined to a very limited extent or even neglected" in these models (p. 443). Utilisation and indeed the measure of capacity are common concepts and may be applied to the human centric knowledge creation collaborations. In their paper, Hedman et al. (2013) give several definitions covering utilisation, performance and capacity as applied to production system processes. I re-interpret the utilisation and capacity definitions for situation of knowledge creators exercising free will and autonomy in knowledge creation activities as follows.

Table 14 Utilisation and Capacity Measures based on Hedman et al. (2013)

Measure	Description
Task Utilisation	The percentage time performing the knowledge task relative to the total allowed time specified in the collaboration’s purpose. Excludes administration, team meetings and planned stops. “Utilization is always in relation to the planned, intended, paid, or manned time” (Hedman et al. 2013, p. 444).
Capability Utilisation	The fields of knowledge employed in a knowledge contribution in relation to the knowledge creators total fields of knowledge. Expressed as a percentage that can never exceed 100%.
Activity Capacity	“Capacity is measured as products per time unit” (p. 444). The definition is re-interpreted as knowledge contributions per time unit. In the case of a collaboration based on the agile manifesto (Paulk 2002), a time unit may be interpreted as the collaboration’s agreed milestones.
Capability Capacity	The fields of knowledge that a knowledge creator could apply through their collaborative role in relation to their total number of fields of knowledge. Expressed as a percentage that can never exceed 100%.

**2.14.4 Strong Ties, Reciprocity and Cliques**

Strong ties occur in “relationships with high emotional commitment and high frequency of contact, usually among socially homogeneous individuals”. Whereas weak ties are “relationships with low emotional commitment and low frequency of contact” (Martinez & Aldrich 2011, p. 8). A clique must have at least 3 members (Hossain, Murshed & Uddin 2013), who exhibit strong ties such that they are linked to every other member and to none outside the clique (Granovetter 1973). Reciprocity in social network terms occurs when communication “ties between two participating actors are symmetric” (Hossain, Murshed & Uddin 2013, p. 25) All relationships within a clique are considered to be reciprocal in nature.

In collaboration, a clique can create fragmentation of knowledge by keeping knowledge from being diffused (Angelopoulos & Merali 2011). Cliques increase in numbers as organizations go through crisis since external threat draws members together to increase cohesiveness and provide mutual support (Hossain, Murshed & Uddin 2013).

Consider three knowledge creators in a group: A, B and C. If A chooses to communicate with B and B with C, then transitivity occurs when A chooses to communicate with C (or C with A). Granovetter (1973) suggests that transitivity requires the existence of strong ties between members rather than weak ties and

concludes that transitivity is a function of the strength of ties rather than a property of social structure.

### 2.14.5 Social Capital and Structural Holes

A "structural hole" (Borgatti et al. 2009, p. 894) is created in the social network when two adjacent knowledge creators in the social network have no social ties. Structural holes create "social capital" that Burt describes as "advantages that individuals or groups have because of their location in social structure" (Burt 2001, p. 203. Figure 1). The "structural hole between two groups does not mean that people in the groups are unaware of one another. It only means that the people are focussed on their own activities such that they do not attend to the activities of people in the other group. Holes are buffers, like an insulator in an electric circuit" (p. 208). The existence of structural holes identifies points to encourage knowledge sharing and creation.

Burt conjectures that people who are in a position to broker across structural holes have more opportunity to generate new ideas because "opinion and behaviour are more homogeneous within than between groups, so people connected across groups are more familiar with alternative ways of thinking and behaving, which gives them more options to select from and synthesize" (Burt 2004, p. 350).

The case study experiences highlighted the importance of identifying structural holes in the collaboration's social network. In the Woolworth's case study the structural holes were caused firstly, by difficulties in finding and engaging with knowledge domain experts and secondly by the difficulty in accessing closely held tacit knowledge within the confines of groups (Rose, Hawryskiewicz & Kang 2014, p. 222 Table II). These structural holes inhibited the sharing of process knowledge. The solution in the case study context was to follow Burt's conjectures by the researcher acting as a boundary spanner to facilitate the sharing of knowledge (Peng & Sutanto 2012; Williams 2011). See section 5.3.2.4 on page 173 and section 6.2 on page 194 for discussions on the importance of considering structural holes in the case study experiences.

### 2.14.6 Knowledge Gaps and Areas for Further Investigation

This section has characterised social networks resulting from the interactions of knowledge creators. The generalised social network is discovered from observation of in-situ collaborations that can be used as a source for abstracting knowledge-in-use networks. The knowledge gaps concern firstly, how to identify candidates for membership of the social network. The literature concentrates on evidence of activity, whereas for knowledge creation collaborations both activity and causality must be considered. Secondly, the discovered network cannot be regarded as complete, so considering how to make use of partial information is important. Thirdly, the research focus at the knowledge creator level results in a highly dynamic social network, which

changes according to socialisation activities. In this light, measures must be evaluated for their use in a dynamic environment involving complex behaviour such as emergence.

The part played by free will decisions of knowledge creators has not been evident in knowledge creation literature and according to Merali & Allen (2011) has not been modelled satisfactorily in systems research. The concept of roles-in-use enables studying dynamic interactions of the knowledge creators. Theoretical support for the role-in-use needs to be developed.

The knowledge revealed in this section of the review is fundamental to the conceptualisation of the collaborative wellness network (CWN) as discussed in section 3.9.8 on page 125. In turn, the concept of CWN informed the design of the participatory action research case studies, see sections 4.5.2 on page 155 and 4.5.3 on page 157.

### 2.15 Conclusion

The literature review has been a complicated process reflecting the breadth, depth and connectedness of the published research. The knowledge gaps are found to cover all three empirical dimensions of collaboration. The most important of these gaps is that a definition of collaboration has not emerged in the literature that satisfies the requirements of my research. However, sufficient information has been discovered to form a basis for defining a collaboration using complexity concepts. The need to cater for assessing complex behaviours in the collaboration requires devising a framework and measures based on the role-in-use that is capable of fine-grain tracking of dynamic knowledge interactions. Key questions to resolve are firstly, how can requisite variety be measured; and secondly how can the knowledge creator's compliance to the required requisite variety of a role be determined?

Fine grained observation and analysis requires precision in definitions and depth in detail of theoretical concepts. However, the literature review showed theories such as Organisational Knowledge Creation lacked the precision (Gourlay 2006) to support measures for tracking knowledge creator interactions and did not consider reflective thinking of individual knowledge creators. Other theories excluded concepts important in my research, for example, Living Systems Theory (Miller 1978) excluded the semantic content of messages from analysis (section 2.6.6 on page 41). The definition of collaboration by Wood & Gray (1991) excluded social complexity by assuming agreement between all stakeholders. Another example is that of Bedwell et al. (2012) who excluded non-human actors from consideration and thus made studying behaviours in modern technological mediated and virtual collaborations problematical.



## Collaborative Wellness Through Dynamic Role Alignment

Issues were found with candidate theories for a supporting framework. Miller's Living Systems Theory (Miller 1978) is in need of updating particularly in definitions of the community, group and sub-systems (Bailey 2005). The Viable System Model (Beer 1984) fails to deal explicitly with the behaviour and motivation of people (Merali & Allen 2011) and knowledge gaps were seen in the granularity of analysis for determining the influence of causality. Notwithstanding these issues, theories like Linkography (Goldschmidt 1990, 1995) can be enhanced and employed in a framework for parsing semantic content. Research into transition management (De Haan & Rotmans 2011; Rotmans & Loorbach 2009) and workflow change patterns (Weber, Reichert & Rinderle-Ma 2008) can be considered as a basis for categorising and exploring change patterns when synthesised with research on social complexity associated with human knowledge creators.

The literature review has characterised the nature of the next chapter of theory development for the collaborative wellness system (CWS). The objective is to address the knowledge gaps such as to provide a framework to enhance the granularity and precision of theory to support the study and improvement of group knowledge creation collaborations.

## **Chapter 3 Collaborative Wellness System (CWS).**

This chapter introduces the Collaborative Wellness System (CWS) (Rose, Hawryszkiewicz & Kang 2015) and measures. CWS is intended to support the evaluation and improvement of knowledge creation collaborations and their outcomes. CWS and its supporting theory lays the basis for devising a scale to compare collaborative experiences to aid in identifying good collaborative practices. The theory developed in this chapter to support CWS starts with filling the gaps identified in the literature review.

The introduction is followed by a guide to the theory developed based on a narrative of forming a knowledge creation collaboration. Subsequent sections develop the supporting theory and lead to the formal statement of the research question and research propositions. A discussion of these propositions using collaborative scenarios concludes the chapter. The definitions of CWS concepts is summarised in the glossary on page 223.

### **3.1 Introducing the Collaborative Wellness System (CWS).**

The collaborative wellness system (CWS) (Rose, Hawryszkiewicz & Kang 2015) is shown in Figure 13 below and is for use in studying, tracking and improving knowledge creation collaboration. The supporting theory for CWS has been developed iteratively by incorporating feedback experiences from four case studies. In particular, the two case studies hosted by Woolworths Limited showed that both knowledge creation and its use occurred simultaneously on multiple levels and indeed between levels of the business. I represented this by the "Collaborative Wellness Unit (CWU)" shown in Figure 13 below. Central to CWU is the joint value proposition created by stakeholders. Fulfilling the joint value proposition necessitates stakeholders and knowledge creators to interact in a process of value co-creation that forms the relationships of CWU. In this research, the case studies were conducted in an organisational context and so CWU existed in an organisational structure based on an interpretation of Living Systems Theory (Miller 1978) that I called the "Collaborative Wellness Framework (CWF)". CWF includes the technology and support necessary for the collaborative "spaces" (von Krogh & Geilinger 2014) of knowledge creation. Together, the CWU (relationships, activities and processes) and CWF (social, physical and technological structure) form the collaborative wellness system (CWS).

Organisations create collaborations for a purpose. The literature review showed that the purpose may be ill-defined and rely to a lesser or greater extent on implicit understanding of organisational culture and work habits of knowledge creators for its interpretation and implementation. Here, the purpose is to create knowledge for the organisation's process and product innovation activities and is expressed by

stakeholders when they collaborate and create a joint value proposition (Osterwalder & Pigneur 2003). The joint value proposition is the “basic relationship of service” (Maglio & Spohrer 2013, p. 667) that links stakeholders and knowledge creators in value co-creation. Users of the created knowledge both perceive and determine value on the basis of its use, this is “value-in-use” (Lusch & Vargo 2006, p. 284). CWS shown in Figure 13 below represents the network of a knowledge creation collaboration fulfilling a joint value proposition (the collaborative wellness unit) in the context of an organisation (the collaborative wellness framework). CWS maintains the context of knowledge creation by linking the concepts of Organisational Knowledge Creation (OKC) theory (Nonaka & Takeuchi 1995; Nonaka, Toyama & Hirata 2008) with tracking and improving outcomes.

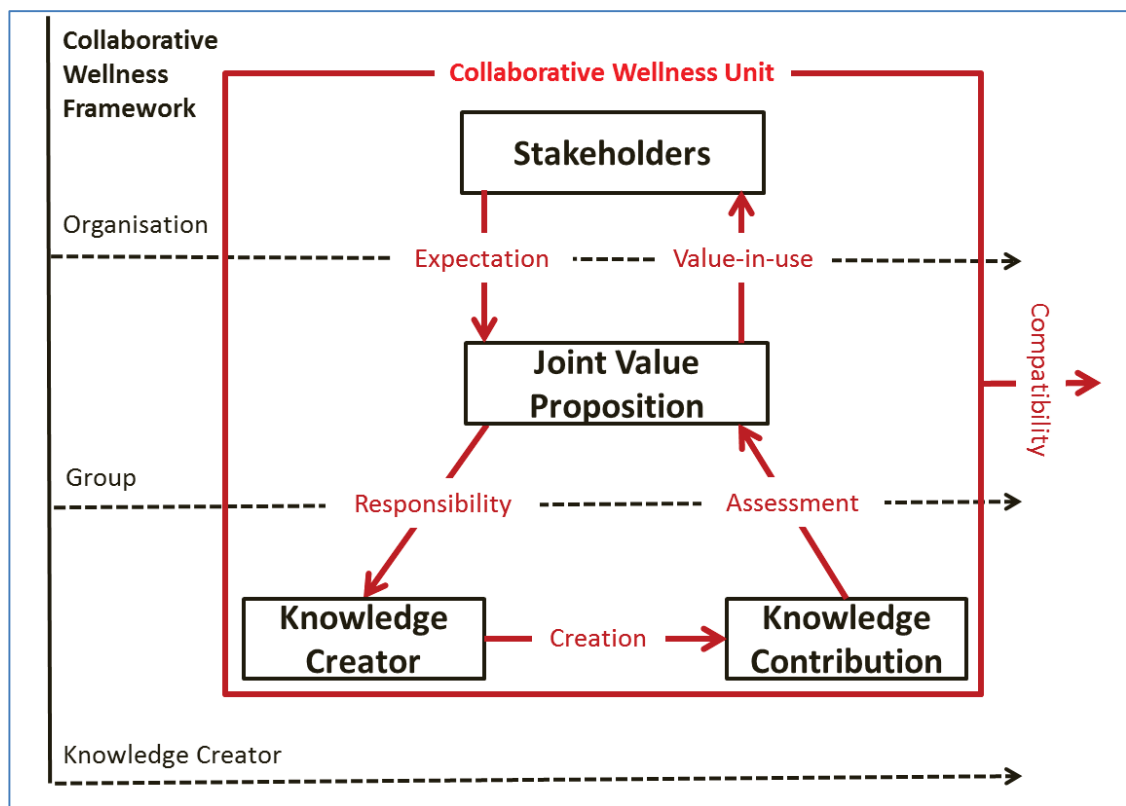


Figure 13 Collaborative Wellness System (Rose, Hawryskiewicz & Kang 2015)

The collaborative wellness unit arose from in-situ observations of case study collaborations synthesised with social network theory (see page 83), selected concepts that were enhanced from Miller’s Living Systems Theory (Miller 1978), and Organisational Knowledge Creation Theory’s “multi-layered networks of ‘ba’” (Nonaka et al. 2014, p. 139). CWS is an abstracted system (see Table 1 on page 23) created by using the dimensions of collaboration (SOCIAL, PROCESS and MEANS) (see Figure 1 on page 2) as perspective to detect or infer relationships and activity in a knowledge creation collaboration in its structural context. As an abstracted system, CWS

maintains contextual links with the parent system to provide the means for making comparisons between dimensional perspectives and with other collaborations.

CWS allows us to conceive human centric collaborations as interconnected collaborative wellness units (CWU) linked by the commonality of goals expressed in their joint value propositions. Knowledge creators can be involved in multiple CWU's and use common infrastructure. For example, a knowledge creator in one CWU, may be a knowledge creator or stakeholder in another CWU. CWU's may share collaborative Ba spaces (von Krogh & Geilinger 2014). This network of linked CWU's is called the "Collaborative Wellness Network (CWN)". The theory and components of CWS are now developed in the following sections.

### 3.2 Theory Development Guide

The literature review indicated that developing the theory and measures to support CWS would be broad in scope and require precision in definitions, concepts and measures. CWS was built on the base provided by existing theories that have been applied extensively in collaborations from the scale of the group to large distributed enterprises and government agencies so as to create a path for deploying and validating CWS as its scope is scaled-up to larger contexts. My research focussed on evaluating and subsequently improving the collaborative wellness of knowledge creation collaborations. However, this research may also be applied to design and implement new knowledge creation collaborations for collaborative wellness.

An informal discourse was used to introduce, develop concepts and then root them in the supporting theory. Once this context was established, the discussion became more formal and led to concept definitions and development of the research propositions. Table 15 below was conceived as a journey described by a series of linked storyboards (Antunes et al. 2013; Fraser 2003; Walker et al. 2013) that may contain activities, events, comments and observations relevant to an unfolding hypothetical collaboration (see Section 2.9.6 on page 65 on describing interactions).

Table 15. Guide to Theory Development.

Story board	Narrative	Concept Reference
1	An organisation creates a collaboration for the purpose of creating knowledge for product and/or process innovation. Stakeholders collaborate to express the purpose as a joint value proposition.	<ul style="list-style-type: none"> <li>• Collaborative Wellness System (CWS) concepts (p. 92), overview (p. 96)</li> <li>• Assumptions and Scope (p. 99)</li> <li>• Purpose &amp; value-proposition in collaborative dimensions (p. 101, 110).</li> </ul>

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Story board	Narrative	Concept Reference
		<ul style="list-style-type: none"> <li>• Product and process innovation (p. 63).</li> <li>• Joint Value Proposition (Frow &amp; Payne 2011; Osterwalder 2012; Osterwalder &amp; Pigneur 2003).</li> <li>• Value-in-use (p. 42).</li> </ul>
2	Once the collaboration has been created, business designers deconstruct the joint value proposition to joint value propositions that focus on detailing a role for a knowledge creator in the collaboration.	<ul style="list-style-type: none"> <li>• Collaborative Dimensions (p. 101)</li> <li>• Elementary Value Proposition (Osterwalder &amp; Pigneur 2003, p. 431)</li> <li>• Knowledge Creator (p 100)</li> <li>• Role-in-use (p. 116)</li> <li>• Collaboration (p 118).</li> </ul>
3	In accepting the role, a knowledge creator has confidence in their ability to fulfil the collaboration's expectations. They interpret the role and using free will to assess the traits they can apply to satisfy the requisite variety required by their responsibilities and then create and occupy one or more roles-in-use.	<ul style="list-style-type: none"> <li>• Freewill and Responsibility (p. 66).</li> <li>• Requisite variety and wellness of knowledge creators (p. 69).</li> <li>• Requisite variety measures (p. 120)</li> <li>• Trait Overlap (p. 76)</li> <li>• Role Alignment (p. 119)</li> <li>• Role-in-use (p. 83), definition (p. 116).</li> <li>• Trust and Sharing (p. 67).</li> <li>• Wellness (p. 69).</li> </ul>
4	Through their role-in-use the knowledge creator interacts with other knowledge creators to exchange messages and knowledge contributions through socialisation and synthesis. Knowledge creators interact with clients in a value co-creation process.	<ul style="list-style-type: none"> <li>• Message Validation and Usefulness (p. 107).</li> <li>• Effective Emergence as a measure for tracking knowledge contributions (p. 116).</li> <li>• Knowledge Contribution and Knowledge Creation (p. 110).</li> <li>• Knowledge contribution (p.113).</li> <li>• Knowledge contributions at the level of the group (p. 114).</li> </ul>
5	Responding to change, knowledge creators negotiate with other knowledge creators to maintain compatibility between	<ul style="list-style-type: none"> <li>• Action of causality (literature review p. 33).</li> </ul>

Story board	Narrative	Concept Reference
	roles-in-use to ensure a shared purpose is maintained in the collaboration.	
6	A participant-observer monitors progress by comparing the current state of the collaboration to the desired state necessary to achieve the collaboration’s purpose. This assessment of the gap between current and desired states relies on measures of requisite variety, role-in-use alignment, and the usefulness of knowledge contributions. The assessment is called the “Collaborative Wellness (CW)” of the collaboration.	<ul style="list-style-type: none"> <li>• Collaborative Wellness (p. 120).</li> <li>• Cognitive Distance measures (p.69).</li> <li>• Measures of Requisite Variety (p. 120).</li> <li>• The need for a scale of collaborative wellness (p. 124).</li> </ul>
7	Research propositions are developed for verification of collaborative wellness, its measures and validate outcomes of case studies.	<ul style="list-style-type: none"> <li>• Research propositions (p. 127)</li> <li>• Exploring the propositions in scenarios (p. 131).</li> </ul>

Theory development for CWS encompassed the empirical dimensions of collaboration, namely SOCIAL, PROCESS and MEANS shown in Figure 1 on page 2. CWS combines these dimensions through a synthesis of a social network from performing a process in a framework determined by the MEANS available to the organisation. Although the dimensions are interdependent, the starting point was to consider the MEANS dimension in the form of structure and how that forms the context of PROCESS in the collaboration. Finally, these two dimensions were developed to provide a context for the SOCIAL dimension represented by the social network of knowledge creation and use.

### 3.3 The Collaborative Wellness System (CWS) and Role-In-Use.

CWS implements Organisational Knowledge Creation Theory (OKC) discussed in section 2.8.6 on page 54. OKC conceives knowledge creation as occurring in “multi-layered networks of ‘ba’” (Nonaka et al. 2014, p. 139) in the context of an organisation. CWS was intended to support fine grained tracking and assessment of

## Collaborative Wellness Through Dynamic Role Alignment

knowledge creation according to OKC concepts for informing the development and application of improvement strategies in collaborations.

The organisational structural context is provided by the "Collaborative Wellness Framework (CWF)". CWF is an interpretation of Miller's Living Systems Theory (LST) (see section 2.6.1 on page 36). The relationships formed in knowledge creation and value co-creation are together called the "Collaborative Wellness Unit (CWU)" to underscore that the case studies showed that these relationships are all necessary for creating knowledge to fulfil a joint value proposition and realising the value-in-use of the created knowledge. CWS displayed in Figure 13 on page 93 is an abstracted system encompassing both CWF (structure) and CWU (relationships, activities and processes) of knowledge creation and use. Membership of CWS is anything that affects collaborative wellness.

Entities in CWS maintain their context in LST "concrete systems" (Miller & Miller 1982, p. 303) that occupy a physical space at a particular point in time and exchange matter, energy and information with their surroundings. In view of modern communications and supporting infrastructures, entities may use a variety of means to communicate including the establishment of small-world (Watts & Strogatz 1998) links between roles-in-use, not only within and across groups but also across organisational boundaries.

Perspectives are chosen to provide finer grained views of CWS. In Figure 14 below, a fine grain view is shown for an individual knowledge creator (section 2.8.2 on page 47) occupying a role-in-use to create knowledge according to their interpretation of responsibilities listed in a value proposition deconstructed from the collaboration's joint value proposition. The figure below shows this knowledge creator as part of a group collaboration. Modern communications enable the group to be co-located, disbursed or to take place in a virtual Ba. This will require extending LST's definition of the group from "face-to-face" (Miller 1971, p. 302) to support tracking of knowledge creation across disbursed and virtual spaces, and provide the ability to account for the influence of supporting technology choices on outcomes.

The concept of "design moves" in Linkography (Goldschmidt 1990, p. 291) is extended to support parsing of the semantic content of messages to identify knowledge contributions and assess their usefulness relative to the collaboration's purpose as expressed in the joint value proposition. The "Collaborative Wellness network (CWN)" is dynamic and based on (Merali 2006)'s "network-in-use" (p. 217). CWN is composed of CWU's linked through their joint value propositions.

LST's support for cross level and same level research (Miller & Miller 1995a) enables the application of perspectives both vertically across CWF levels and horizontally

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through CWF levels to examine knowledge creation activities and relationships in their structural context. CWS shown in Figure 13 on page 93 is a vertical perspective. Miller's Living Systems Theory (LST) (1978) unambiguously distinguishes between levels according to the structure of their decider systems. Organisations have multi-echelon deciders, group deciders have no formally designated echelons, and a human knowledge creator's decider is their mind (see Table 7 on page 38). In LST, a system at a particular level is a sub-system of the next higher level, knowledge creators are members of groups which in turn are members of an organization. The horizontal perspective applied at a particular level allows an in-situ observer to view interactions on this level, while lower level interactions are hidden. For example, if the observer moves from the knowledge creator up to the group, knowledge creation interactions within the group become opaque and interactions between groups become visible.

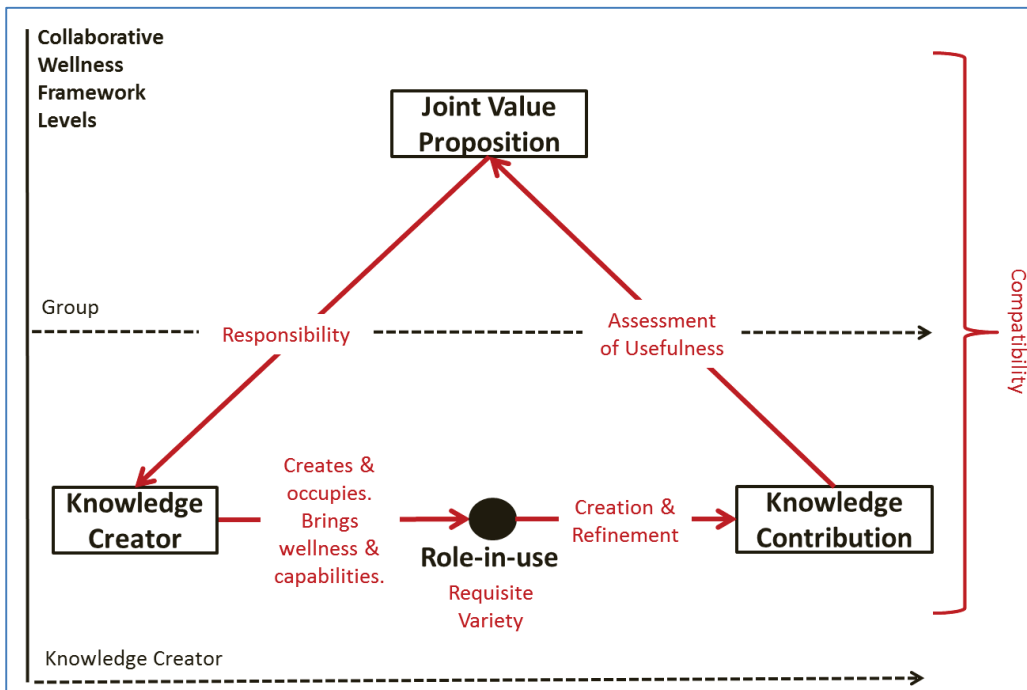


Figure 14 Role-in-use in the Collaborative Wellness Unit

Collaborative wellness (CW) is an assessment of the state in knowledge creation collaborations at a particular point in time. This assessment is relative and represents the gap between current and the desired states as expressed in its joint value proposition. The state is discussed in greater detail in following sections, but for now it is described by combining assessments of the traits applied by knowledge creators relative to the requisite variety needed to fulfil their responsibilities, how roles-in-use align to the collaboration's purpose, and the usefulness of the knowledge compared to that required by the collaboration's purpose.



### 3.4 Research Scope, Assumptions and Observations

This section lays the basis for developing the theory-informed CWS. The scope is outlined together with its underlying assumptions and observations.

#### 3.4.1 Practice Based Research

My practical experience covered improving knowledge creation collaborations involved in process and product innovation. I oversaw a small group of five knowledge creators that devised and applied strategies to improve collaborations ranging from small groups to large disbursed collaborations using an iterative learning-by-doing approach. Use of these strategies involved my group interacting with and monitoring the larger target groups. My group's long-term stable membership worked on a series of IT problems within the financial sector associated with process and product innovation (Rose 2009, 2010). This closely-knit group collaborated in a co-located environment that emphasised face-to-face communication.

The literature review found that collaborations of between four and 20 members are referred to as small group collaborations. Patel, Pettitt & Wilson (2012) nominated an optimum small group size of 6-8 members. Observations by Slater (1958) pointed to a small group size of 5 as being "most effective in dealing with an intellectual task involving the collection and exchange of information about a situation, the coordination, analysis, and evaluation of this information" (pp. 137-8). Case studies in this research encompassed not only the small research group but also the target collaboration that it interacted with and monitored. Therefore the research scope covered the knowledge creation processes of the small group, the interactions within the larger collaboration and the interactions between the two collaborations. The simplifying assumptions and averaging applicable to large groups could not be used in small groups without risk of missing significant behaviours or distorting analysis and conclusions (Lawrence, Boardman & Sauser 2008; Moss & Edmonds 2005; Shu et al. 2011; Van den Bergh & Gowdy 2009).

The review showed that because of the rapid implementation of communications infrastructures in our modern world, a richer language is required for defining groups other than Miller's "face-to-face" definition of the group (1978, p. 515). This requirement was met by group types being defined in section 3.6 on page 103 in terms of group boundaries and knowledge creator location. The relative importance of collaborative dimensions are ranked according to the type of group for investigating selected knowledge creation activities.

My group tackled class two wicked problems (Roberts 2000) (see section 2.3.1 on page 18) which had agreement on the problem definition (know what to solve) but the solution strategy (how to solve it and what to deliver) was unresolved due to disagreements between stakeholders. Wicked problems are to a degree unique and

tackling them requires an approach customised to suit each problem. Furthermore, approaches will often have unanticipated effects that result in the group having to adapt to the new circumstances of the problem. This adaption process proved costly in time and resources. One objective of using CWS was to apply and monitor improvement strategies to reduce the costs of adaption to changes in circumstance of the problem being addressed by the collaboration.

### 3.4.2 Knowledge Creators.

My research was about knowledge creation collaborations formed by an organisation for the purpose of creating knowledge for use in process and/or product innovation. I referred to participants in these collaborations as knowledge creators.

A knowledge creator is a type of “knowledge worker” (Drucker 2001, p. 78). They exercise free will in deciding whether to collaborate or not. The exercise of free-will relies upon the reality of the emergent human mind as discussed by Polanyi (1966). Using free will, knowledge creators interpret their responsibilities in the collaboration to create, occupy and perform one or more knowledge creation roles-in-use. Furthermore, as circumstances change, they negotiate with peers to ensure continuing compatibility between roles-in-use and maintenance of a shared sense of the collaboration’s purpose.

### 3.4.3 Messaging in Collaborations

The usefulness of the semantic content of messages between knowledge creators is crucial to a knowledge creation collaboration. The following scenario based on the literature review summarises how usefulness is assessed (see Figure 12 on page 86). Upon receipt of a message, a knowledge creator in the collaboration begins a tacit knowing process that results in extracting meaning from the message contents (Polanyi 1966; Polanyi & Prosch 1975). This meaning, embedded in the knowledge creator’s worldview is tacit knowledge that informs action (Boisot & MacMillan 2007; Nonaka & Zhu 2012). The same knowledge creator, exercising free-will judgement may decide to initiate a reply in which they provide interpretations, comments or additional material to the original sender and/or other knowledge creators. On the other hand, the recipient may decide to take no action on the meaning and indeed could decide to cease interaction all together.

An in-situ participant-observer observes these message interactions and assesses whether the messages contain a knowledge contribution that is useful relative to the purpose of the collaboration. These assessments are made by the participant-observer using tacit knowing to listen to tacit exchanges, examining explicit knowledge material, and when necessary, questioning the knowledge creators. This means that the assessment is dependent upon the expertise of the participant-observer to derive meaning from the material they process. The contribution may be

in the form of tacit knowledge in the socialisation stage or explicit knowledge in the externalisation stage of the “SECI” process (Nonaka, Toyama & Hirata 2008, p. 18; Nonaka & von Krogh 2009, p. 638). Participant-observers are not limited to assessing face-to-face interactions, they may read messages in the form of emails, scrutinise knowledge accessed or referenced during collaborative sessions, and peruse other written, recorded or multi-media material used or managed by the collaboration. Indeed the participant-observer may well consult other knowledge creators outside the collaboration to garner different perspectives to help assess usefulness.

Causality can be applied to the collaboration through messaging, for example: downward causality through information control, same level causality through peer-to-peer social exchanges, or bottom-up causality through changes in infrastructure (Auletta, Ellis & Jaeger 2008; Ellis 2008). Indeed, the frequency of messaging may apply causality to knowledge creators through delays, absence of messages, or too many messages, and so on.

### 3.5 Collaborative Dimensions and Aspects

The synthesis of the empirical dimensions of collaboration and aspects from the literature review are summarised in Figure 6 on page 17. This section underscores the dynamic interactions between aspects and between the dimensions. It is these dynamic interactions and their complex feedback loops that characterise these collaborative systems as complex, open, human-centric collaborations.

The importance of the dynamics in knowledge creation collaborations as shown in the literature review cannot be over emphasized. These complex interactions and relationship dependencies showed that simplifying assumptions may well have had the effect of nullifying the worth of conclusions. Although CWS was intended to have wide applicability, careful consideration is required before conclusions and findings are applied in wider research contexts.

Table 16 Interactions between collaborative dimensions and their aspects.

Collaborative Dimension	Aspect	Description
<b>SOCIAL</b>	Human Context, Responsibilities and Relationships, Social Complexity.	Humans exercise free will in deciding how to accept responsibilities in occupying and performing their roles-in-use with other knowledge creators. Humans detect, reason about, and adapt to emergence (level 5 emergence in Table 4 on page 28).

Collaborative Dimension	Aspect	Description
	Interactions, Sharing, Trust & Social Capital. Value proposition.	Trust and a willingness to share knowledge effects available social capital (knowledge resources). Negotiation and incentives rather than an authoritarian approach is the norm for managing knowledge creators. Knowledge creators re-assess commitments in the light of experience and changing incentives in the joint value proposition of the collaboration. Experience from the co-creation of value feeds back into the joint value proposition of the collaboration.
<b>PROCESS</b>	Process, Function, and Structure	All change in a system's function and structure over time is process. "Structure of a system is the arrangement of its sub-systems and components in three dimensional space at a given point in time" (Miller 1978, p. 22). Process, function and structure interact in causal feedback loops. They form constraints on all other aspects and dimensions of the collaboration. The environment of the collaboration space is important in determining how process occurs.
	Purpose, Knowledge Contributions, and Value	Collaborations are created by an organisation for a purpose. Purpose determines the kind and structure of collaboration. Knowledge contributions are created and assessed to fulfil of purpose. Value is created through use of the knowledge contributions.
	Process Complexity	In CWS, complex interactions, causalities and behaviours occur at all levels simultaneously. Ellis (2006, p. 15) distinguishes between level five emergences in social complexity that is unique to humans versus process

Collaborative Dimension	Aspect	Description
		complexity consisting of levels 1-4 of emergence (Table 4 on page 28).
<b>MEANS</b>	Channels, Messaging	Messages are exchanges of knowledge, information or data using a variety of channels and media formats. Channels and messages must suit the type of the collaboration.
	Communication, Technology	Knowledge creators communicate by messages through interactions between their roles-in-use. Communication may be remote and mediated by technology or local and face to face. The choice of technology and communication forms exert constraints on collaboration.

### 3.6 Types of Groups

This section addresses the need identified in the literature review for a richer language in describing groups. The definition of a group in Miller’s Living Systems Theory (LST) (1978) stressed that group members “relate to one another face-to-face” (p. 515). LST groups are distinguished from organisations because their “deciders have no formally designated echelons” (p. 595). See section 2.6.2 on page 38 for a detailed comparison between LST organisations and groups. Modern communication technologies support remote collaborative services such as teleconferencing, on-line social networks like Facebook (Berger-Wolf, Tantipathananandh & Kempe 2010) and virtual worlds (Lukosch et al. 2014). These technologies reduce and may even eliminate the necessity for physical face-to-face communication in group interactions. This made it necessary to devise a new way for classifying different types of knowledge creation groups and highlight the dimensions and aspects of collaboration (see Figure 6 on page17) that could be prominent in each type of group. Defining different types of groups created the basis for understanding possible interactions of virtual, distributed and co-located spaces on the knowledge creation (von Krogh & Geilinger 2014).

Modern communication technologies prompted the choice for the first attribute to classify groups, namely the location of knowledge creators. This attribute’s value is a continuum. At one extreme, disbursed knowledge creators interact solely within a virtual world setting, while at the other, knowledge creators are co-located and interaction is face-to-face. Between these extremes is a mix of communication

technologies involving face-to-face and remote interactions in a variety of channels and media formats.

Table 17 Classifying Groups by Knowledge Creator Location

Classification	Definition
Co-located	All knowledge creators share a physical space and face-to-face interactions are the norm.
Disbursed	Knowledge creators are geographically separated. Technology mediated communication is between the physical location of each knowledge creator using, for example, video conferencing, chat sessions, emails, instant messaging, digital communities, telephone and so on.
Virtual	Collaboration occurs in a virtual world using constructs such as avatars for “self-representation which gives a mechanism for communicating and interacting with other users, and for navigating the world” (Chesney et al. 2014, p. 2). A necessary condition for a group to be classified as virtual is that knowledge creators feel they are present in the virtual world. In “strong mediated presence, our experience is that the technology has become part of the self, and the mediated reality to which we are attending has become an integrated part of the other. When this happens, there is no additional conscious effort of access to information, nor effort of action to carry out overt responses in the mediated environment. We perceive and act directly, as if unmediated” (Riva & Waterworth 2014, p. 217). “Co-presence” (Schmeil et al. 2013, p. 166) occurs when numbers of people experience presence together. Presence results from acts of “tacit knowing” (Polanyi & Prosch 1975, p. 34).

As a practitioner, I helped and worked in groups creating knowledge to tackle type two wicked problems as described in section 2.3.1 on page 18. Head & Alford (2013) observed that each wicked problem is in some way unique and that to address them, strategies must be developed to suit the particular circumstances of the problem. In turn, the choice of strategy determined the design of the collaborative processes. In particular, implementation of the strategy often required boundary spanning (Peng & Sutanto 2012) to link resources in loosely coupled or diverse groups. Business processes were often divided amongst many collaborations, with each collaboration having upstream and downstream dependencies. This resulted in collaborative boundaries being an important consideration in improving outcomes. The process

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boundary variable forms a continuum from all collaborative processes being open (cross boundary) to all processes performed within the group (closed boundary).

Table 18 Group Boundaries

Group Boundary Modes	Description
Open	Collaborative processes cross the boundaries of the group. Processes may have dependencies on external groups completing a task and/or external groups may depend upon the completion of a task by the group. Differences in collaborative spaces may exert causality on outcomes. For example the interplay of time zone, culture and language differences. Membership of the group varies according to the needs of collaboration.
Closed	Collaborative processes are contained within the group's boundaries. These processes are usually tightly defined with clear goals and outcomes, they are well understood and performed by experienced knowledge creators within the group. These highly optimised processes are often referred to as algorithmic processes (Martin 2009). Membership of the group is fixed.

Figure 15 below shows the Group types according to the knowledge creator's location and whether the boundary is open or closed. The group type is matched to the dimensions of collaboration to form priorities for directing the study of a group.

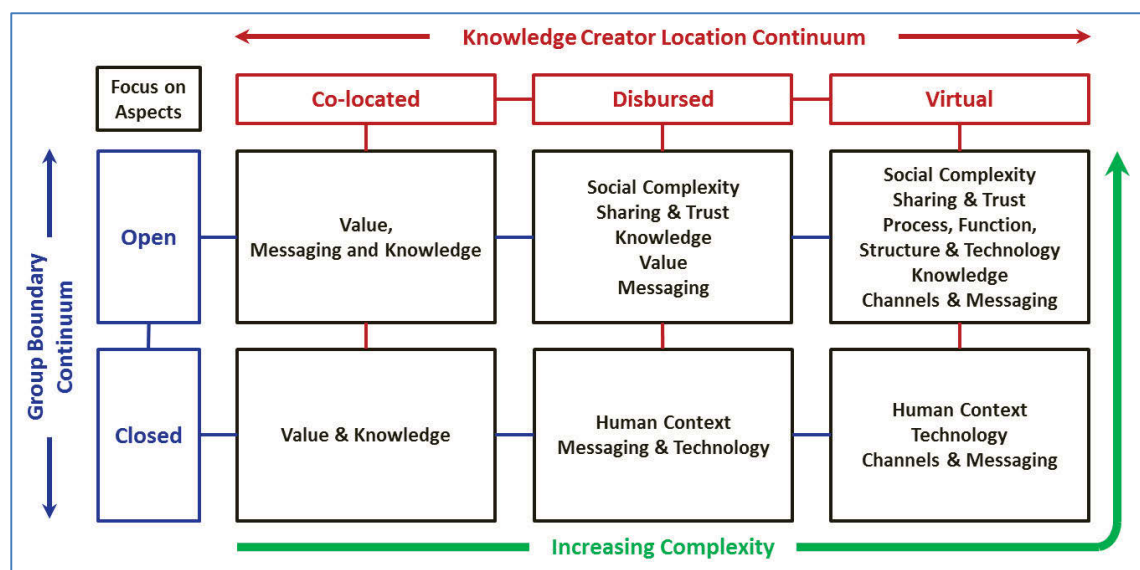


Figure 15 Group Types

It was conjectured that the virtual open group is not only the most socially complex collaboration, but also required the greatest effort in creating, deploying and maintaining compared to the co-located, closed group of Figure 15 above. From a different viewpoint, "requisite complexity" (Boisot & McKelvey 2011, p. 279) implied that as groups become more complex, so they are able to tackle problems of increasing complexity. Group types were viewed as representing a series of stable states in a social transition process (De Haan & Rotmans 2011) as they evolved or change from one type to another depending on purpose, knowledge creators and available resources. Virtual world environments introduced the concept of virtual agents or "non-player characters" (NPCs) (Rodrigues et al. 2014, p. 173), that are characters controlled solely by the computer game. NPC's here were conceived to be virtual artefacts that human knowledge creators interact with using tacit knowing and extended mind processes (see Figure 10 on page 78).

Organisational Knowledge Creation Theory (OKC)'s SECI process and indeed Ba (meaning place in Japanese) was completely compatible with the group types of Figure 15 above, as Ba is "a shared space for interaction" and "can take the physical form of business space and offices; the virtual form of mailing lists, intranet, meetings and social events; and a mental form, such as ideals or ideas" (Von Krogh, Nonaka & Rechsteiner 2012, p. 242). In a mixed Ba environment, differences in the characteristics of collaborative "space" have to be taken into account when assessing outcomes (von Krogh & Geilinger 2014, p. 156).

### 3.7 Definition of Knowledge Creation Collaborations

In a collaboration of knowledge creators, individuality, independence and the exercise of free are significant in determining outcomes. Account must be taken of the effects of supporting system vagaries, external causality and ad-hoc decisions in influencing the course of collaboration. The purpose here was to create knowledge for use in an organisation's process and product innovations. I had three principal goals in defining a knowledge creation collaboration, firstly to form the basis for articulating which attributes to change and what to take into account during application of improvement strategies. Secondly, to inform the design and deployment of the collaborative wellness system and its fine-grained measures for studying knowledge contributions. Finally, to support investigations employing the collaboration dimensions and aspects summarised in Table 16 on page 101.

Collaborations are characterised as complex human-centric open systems that dynamically co-adapt and co-evolve with their environment. These systems have a causal relationship with their environment (Ellis 2008). They are dissipative structures (Prigogine & Nicolis 1977), which maintain their state through exchanges



of energy, matter and/or information with their environment (Miller & Miller 1995a). This informs a definition of knowledge creation collaboration as follows:

*Knowledge creation collaborations are purposeful, complex adaptive social systems established by organisations to create knowledge for use in process and/or product innovation. In deciding to collaborate, knowledge creators exercise free will to interpret their responsibilities and believe they have and can apply their traits to satisfy the requisite variety required to fulfil their responsibilities. Their interpretation informs creating, occupying and performing roles-in-use in the collaboration. All knowledge creator interactions are through their roles-in-use that link to form social networks. Knowledge creators dynamically adapt their roles-in-use according to the changing circumstances and purpose of the collaboration.*

### 3.8 Knowledge Contributions

Previous sections have established a basis for considering the heart of a knowledge creation collaboration, that is, the messaging interactions between knowledge creators. This section characterises and defines knowledge contributions.

#### 3.8.1 Introduction

The literature review showed that a knowledge contribution is a difficult concept to define. Weihmann-Purcell & Reene (2012) characterise a “knowledge contribution” in collaborations as “ideas or examples” and knowledge creators “providing concrete bits of knowledge” (p. 29-4). The discussion now seeks to add precision to the definition of a knowledge contribution and provide a methodology for assessing the semantic content of a message to decide if it is a knowledge contribution and how useful it is to fulfilling the purpose of its collaboration.

#### 3.8.2 Knowledge Creation Processes

Polanyi (1966) put forward an explanation for knowledge creation in a scenario of a scientist pursuing a solution to a problem. The scientist sees a “range of potentialities” that are believed accessible and finally achieves innovation through the “actualization of certain potentialities” (1966, pp. 88-9). In this light, knowledge creation is a tacit knowing process involving the use of imagination to produce “ideas that are guided by a fine sense of their plausibility” (Polanyi & Prosch 1975, p. 97).

The literature review found that Organisational Knowledge Creation (OKC) theory relies upon tacit knowing and the distinction between tacit and explicit knowledge (Nonaka, von Krogh & Voelpel 2006). Furthermore, OKC emphasizes the need for “requisite variety” (Nonaka 1994, p. 23) in the group and the creation of a context amenable to creativity called Ba (Japanese for a field or place). Ba is necessary for OKC’s knowledge creation process called “SECI” by Nonaka, von Krogh & Voelpel

(2006, p. 1182). "SECI" starts with the socialisation of tacit knowledge amongst knowledge creators. The authors highlight that whereas justification of beliefs in an individual is a natural process, in an organisation "justification is a social process" (p. 1183).

Socialisation in Ba is a key focus of OKC since Ba was introduced by Nonaka & Konno (1998) and even now researchers highlight the need for theoretical and empirical investigation into the interactions between different types of Ba spaces and the effects of Ba spaces on collaboration (von Krogh & Geilinger 2014). The structure of the collaborative wellness system supports this empirical research into Ba spaces. There has been criticism of OKC for not including the reflective activity of individuals in the knowledge creation process (Gourlay 2006). Nonaka, von Krogh & Voelpel (2006) state that organisational knowledge creation is "the process of making available and amplifying knowledge created by individuals as well as crystallizing and connecting it with an organization's knowledge system" (p. 1179), that is OKC's SECI process starts at the point of socialisation.

In my research, I considered knowledge creation processes start with the decision by the organisation to form a knowledge creation collaboration and end with stakeholders in a co-creation process that realised the value of the created knowledge through use. I adopted the position that all knowledge creation is through tacit knowing processes. A knowledge creator uses tacit knowing as described previously to create knowledge and then socialises it with others using tacit knowing in the SECI process. In CWS (Figure 13 on page 93), knowledge creation processes occur at all levels. This approach is supported by the theories chosen to underpin CWS. Tacit knowledge of the individual (Polanyi 1966; Polanyi & Prosch 1975) has been applied to the group level (Erden, von Krogh & Nonaka 2008) and according to Miller's Living Systems Theory, similar processes occur at all levels of the hierarchy created by the individual, group and organisation (Miller 1978; Miller & Miller 1995a). The literature review supported the importance of the parts played by requisite variety and in a context that not only encouraged socialisation, but ensured utilisation rates that gave knowledge creators the time to fully participate in the SECI process.

### 3.8.3 Usefulness

Section 2.14.2 on page 85 of the literature review discussed the steps in validating the receipt of a message based on Miller's Living Systems Theory (Miller 1978) (LST). LST's approach does not rely upon the semantic content of the message (p. 11), however, the semantic content of the message is crucial to assessing its usefulness as a knowledge contribution. Figure 16 below summarises this assessment process.

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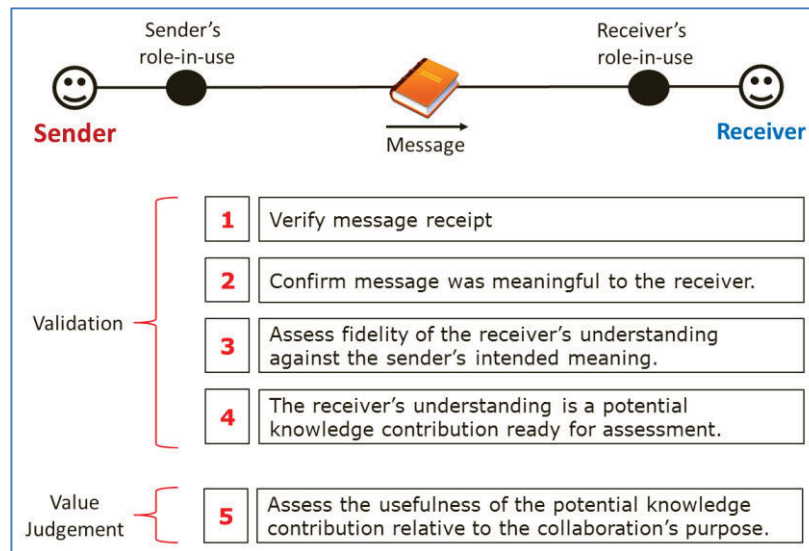


Figure 16 The Knowledge Contribution.

Referring to the above figure, determining a knowledge contribution begins with validation (steps 1 to 4). Upon receipt of the message, the knowledge creator extracts meaning from the message through tacit knowing (Polanyi 1966; Polanyi & Prosch 1975) and is asked by the participant-observer if the message is meaningful in the context of the collaboration. Next, the participant-observer must verify that the receiver's understanding of the message matches the intended meaning conveyed to them by the sender. If valid, the knowledge derived by the receiver is a potential knowledge contribution.

The final step is to assess the usefulness of the knowledge to fulfilling the purpose of the collaboration. A knowledge contribution's usefulness varies according to its uniqueness and novelty relative to other knowledge contributions, the capability of other knowledge creators to understand and use the knowledge contribution, and changes in purpose. Usefulness needs to be re-assessed according to changes in these relationships and dependencies.

The qualitative assessment of usefulness in determining a knowledge contribution is similar to parsing in linkography. This parsing is used to identify the "design move" (Goldschmidt 1990, p. 291; Goldschmidt 1995, p. 195). Goldschmidt explains a design move as "an act, an operation, which transforms the design situation relative to the state in which it was prior to that move" (1995, p. 195). Similarly, to be of value, a knowledge contribution has to transform the knowledge state of the collaboration's subject domain. State is an imprecise term especially when the question of how to measure it is considered. Defining the state of a collaboration in the collaborative wellness context is dealt with in following sections.

In linkography, design moves are determined based on "graphic and verbal output of think-aloud design sessions" (Goldschmidt 1990, p. 291) by an objective, expert

investigator. The investigator, employing their professional common sense, links each move to pertinent previous moves. These backward links may be assigned during a design session. Forward links however can only be established at the end of the process. In summary, “backlinks of a move record the path that led to its generation. Its fore-links bear evidence to its contribution to the production of further moves” (p. 293).

Linkography has been extended to a group level (Goldschmidt 1995) and to the consideration of multiple design sessions or sketches (Cai, Do & Zimring 2010). Cai, Do & Zimring (2010) introduced a distance measure being the number of design moves between the “inspirational move” and the current move to which it is linked (p. 160). This distance measure provided a foundation for defining the emergent path of knowledge contributions later in the chapter. In Linkography, the investigator determines links and the designer identifies design moves. However, in the collaborative wellness system, the participant-observer determines if a message is a knowledge contribution and infers the links based on previous assessments.

### 3.8.4 Purpose

In an organisation involved in process and/or product innovation, knowledge becomes a “competitive resource” (Nonaka & Takeuchi 1995, p. 6) that is crucial to the organisation’s survival and prosperity. In this situation, an organisation must have a “knowledge vision” (Von Krogh, Nonaka & Rechsteiner 2012, p. 266) that not only articulates exiting knowledge, but identifies areas where new knowledge is required.

The knowledge vision guides leadership in devising strategies to create the required knowledge identified in the knowledge vision. In turn, the knowledge strategies are given to business designers to develop in conjunction with stakeholders the purposes for knowledge creation collaborations. Figure 17 below, summarises the process and shows how the joint value proposition for the collaborative wellness unit is derived. A knowledge collaboration may have several joint value propositions within its purpose. These in turn may be deconstructed into “elementary” joint value propositions for a particular aspect of the collaboration (Osterwalder & Pigneur 2003, p. 431), such as for an individual knowledge contributor.

The literature review showed that a collaboration’s purpose was often ill-defined and relied to a lesser or greater extent on organisational culture and work habits for its interpretation and implementation as a joint value proposition. The first step in studying a collaboration is to characterise its purpose by asking the questions associated with the dimensions of collaboration (Figure 1 on page 2) as perspectives, namely SOCIAL (Who?), PROCESS (How?) and MEANS (With what?). This characterisation includes a description of objectives and identifying areas lacking

clarity, assumptions and constraints, unknowns, uncertainties and risks, and the role of corporate culture. I posited that an ill-defined purpose leads to uncertainty in knowledge contribution assessments and consequently is a risk for the value to be derived from using the created knowledge.

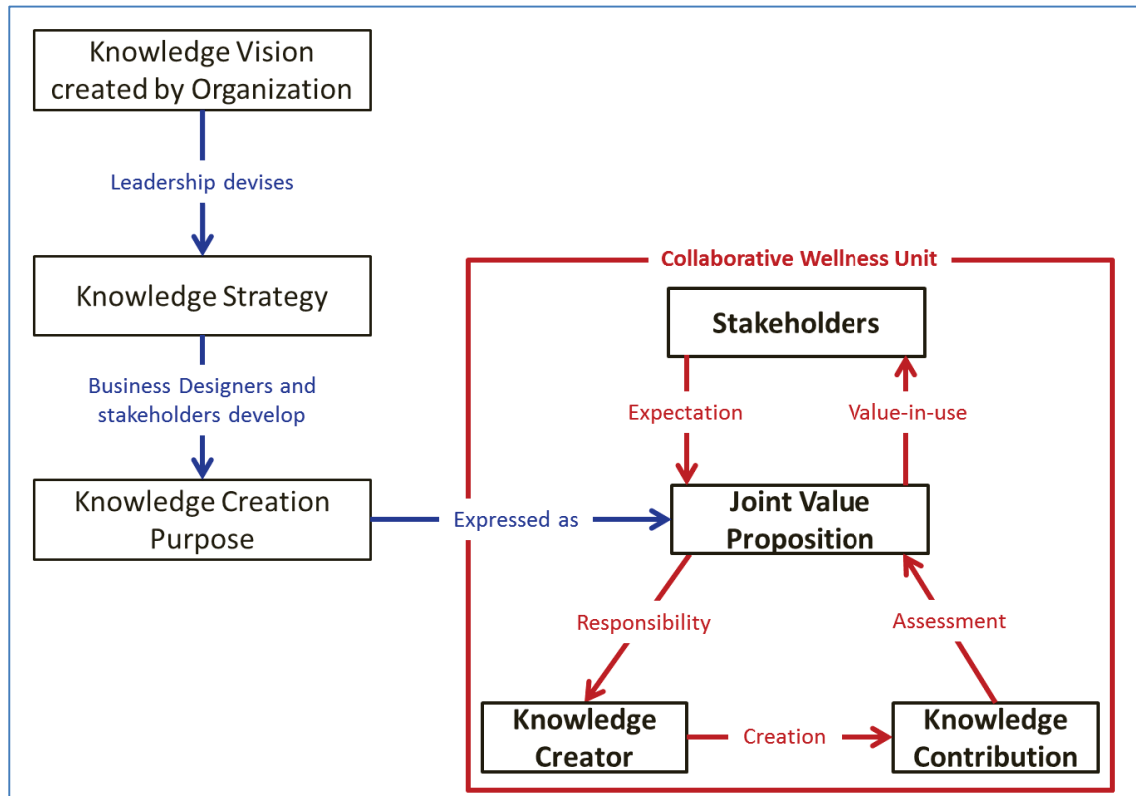


Figure 17 Knowledge Vision to Joint Value Proposition.

The participant-observer of the collaboration makes qualitative judgements of the knowledge contribution relative to the purpose using their understanding of the collaboration. This approach introduces uncertainty and it is acknowledged that assessments of collaborative wellness need to be revisited in the light of the participant-observer gaining deeper insights as the collaboration progresses. The qualitative assessment process comes into sharp focus on the question of how to identify emergence. A qualitative test of emergence proposed by Ronald, Sipper & Capcarrère (1999) is used (refer to Table 3 on page 25) in the case studies.

The structure of the purpose and the means of transcribing from the often ill-defined purposes encountered during my experience are detailed in Chapter 4 on page 136. A scenario approach (Konno, Nonaka & Ogilvy 2014) was proposed to describe the organisation's future situation when a collaboration's purpose is satisfied. The scenario is used as a reference by stakeholders who collaborate to express the purpose as a joint value proposition (Frow & Payne 2011; Osterwalder 2012; Osterwalder & Pigneur 2003). Joint value propositions can be successively deconstructed (Osterwalder & Pigneur 2003) to a form suitable for individual

knowledge creators. This structure gives a measure of clarity to the participant-observer's assessments by highlighting the known, unknown, uncertainties and risk. It allows for the understanding of the impacts of changes in the collaboration's purpose. Equally, the value propositions can be adjusted as the collaboration progresses and as value is created through using the knowledge contributions. The relationships are summarised the collaborative wellness system in Figure 13 on page 93 and Figure 14 on page 98.

The deconstruction of the joint value propositions can be used to create different perspectives of the collaboration. For example, the joint value proposition could be deconstructed or segmented on the basis of knowledge tasks to understand utilisation, or segmented according to areas of expertise required for knowledge contributions, or according to the physical locations of knowledge creators, or according to planning involving availability of resources and time prioritisation. The use of perspectives on purpose in this way enables fine grained tracking of collaborations.

### 3.8.5 Characterising Knowledge Contributions

Knowledge contributions may originate from a variety of sources including: books, emails, or accessing an "internet meme" as a "unit of information (idea, concept or belief)" (Díaz 2013, p. 97). Knowledge contributions may also emerge from ill-formed ideas honed by individual knowledge creators to the point of being capable of socialisation for refinement (Gabora 2013; Sowden, Pringle & Gabora 2014) in OKC's "SECI" process (Nonaka, Toyama & Hirata 2008, p. 18; Nonaka, Toyama & Konno 2000, p. 9). The knowledge contribution is distinguished by being tied to its context by a usefulness assessment. The usefulness assessment process is repeated as the knowledge contribution is refined by knowledge creators both individually and in on-going collaboration. Refinement includes complex feedback loops as knowledge creators' worldviews adapt and re-interpret the new knowledge. This process is shown diagrammatically in Figure 13 on page 93 and Figure 14 on page 98.

During socialisation, to accept and adapt to new knowledge, a knowledge creator balances the usefulness of the knowledge against the effort they are prepared to make, or are capable of making, in order to incorporate the knowledge into their worldview. Their mind makes a decision, consciously or unconsciously, on whether to allocate the necessary effort to accept or indeed reject the knowledge. This is a living systems' "adjustment process" (Miller 1978, p. 35) in which the mind seeks to either maintain equilibrium or expend effort to achieve a new state of equilibrium. Viewed in this light, the reason for OKC mandating the need for "energising Ba" (Nonaka, Toyama & Konno 2000, p. 25) is to synchronise worldviews so as to either

lessen the effort required to make knowledge creators more amenable to accepting the new knowledge contribution.

### 3.8.6 Working Definition of Knowledge Contributions

The informal discourse of previous sections sets the scene for a definition of a knowledge contribution as:

*Knowledge is the meaning that emerges from the act of tacit knowing and is embedded in the mind's worldview. It becomes a knowledge contribution when it is assessed for its usefulness in fulfilling the purpose of a collaboration. A knowledge contribution transforms the state of knowledge in the subject domain of collaboration and informs decisions to take actions.*

The above working definition needs clarification to determine the nature of the state of collaboration and the process by which the state of knowledge is transformed. The knowledge contribution and the role-in-use construct form the fundamental building blocks for tracking and understanding knowledge creation interactions using CWS.

The validation process (Figure 16 on page 109) applied by an in-situ participant-observer to the message is a "second order interpretation" (Neuman 2011, p. 177), the subsequent assessment of usefulness of the knowledge relative to the collaboration's purpose is a "third order interpretation" (p. 178). CWS requires that each knowledge contribution be linked to a narrative describing the validation and usefulness assessments. The narrative includes forward (how the knowledge contribution is used) and backward (the source of the knowledge contribution) links. The links are modelled on the previously discussed design move analysis used in linkography. The social network communications of a collaboration are a mix of messages and knowledge contributions.

### 3.8.7 How is Ba Created?

The importance of an energised Ba has been discussed in the sense that it reduces the effort required by knowledge creators to socialise knowledge. To devise and implement improvement strategies requires knowing what Ba is and how it is created. Ba is characterised as the "contexts and meanings that are shared and created through *interactions* that occur at a specific time and space" (Nonaka & Toyama 2005, p. 428) or more generally, a "shared context in motion" (Nonaka, Toyama & Hirata 2008, p. 34). In organisational knowledge creation (OKC) theory, the boundary of Ba dynamically changes as knowledge creators join or depart from it. Ba must be "energized" (Nonaka, Toyama & Byosiere 1998, p. 508) to establish and maintain the conditions for knowledge creation. Here, energising Ba was interpreted as promoting the alignment or synchronisation of knowledge creator worldviews to decrease the effort required to assimilate and socialise knowledge.

In OKC the knowledge creation process SECI “emerges in Ba” (Von Krogh, Nonaka & Rechsteiner 2012, p. 242). However, there is no mechanism posited to explain how Ba emerges “among individuals, in working groups, project teams, informal circles, temporary meetings, ...” and “... in virtual space” (Nonaka, Toyama & Hirata 2008, p. 34). I put forward a mechanism to explain Ba emergence based on a re-interpretation of Ba in terms of tacit knowing (Polanyi 1966) as described in section 2.8.5 on page 50 and the extended mind hypothesis (Clark & Chalmers 1998) (section 2.11 on page 73) as follows.

I conceived Ba as a cognitive space, dependent on place, context and time. Ba is anchored in the human mind and it occupies the physical space of the individual. The boundary of Ba is that of the mind’s cognitive map (Ackermann & Eden 2010, p. 138). The Ba boundary expands and contracts according to the tacit knowing process of “indwelling” (Polanyi & Prosch 1975, p. 44) as knowledge creators apprehend and socialise with other knowledge creators. Although the processes within Ba cannot be directly observed, they can be inferred from observations of human behaviour because the creation of knowledge informs decisions to take actions (Boisot & MacMillan 2007). Through careful observation, the impacts of knowledge can be identified as can the changes in the human subject’s behaviour resulting from meaning (Miller 1978; Swanson & Miller 1989). In my conception, Ba is an innate human attribute resulting from tacit knowing and that the knowledge created in Ba is either “tacit or rooted in tacit knowing” (Polanyi & Prosch 1975, p. 61).

How is Ba created in a virtual space? In a virtual world, (see Table 17 on page 104) the establishment of Ba was conceptualised as a two-step process of tacit knowing. In the first step, the knowledge creator establishes the indwelling of their avatar and incorporates the virtual environment into their cognitive map. The second step occurs when the knowledge creator believes they are present in the virtual world. Once “presence” (Riva & Waterworth 2014, p. 205) is established, the knowledge creator becomes aware of other people’s avatars and “co-presence” (Schmeil et al. 2013, p. 166) is established. At this point, the knowledge creator’s Ba is extended to the virtual world and the avatars of other knowledge creators become indwelling. With the establishment of co-presence the collaboration occurs solely within a virtual Ba.

### 3.8.8 The Group Knowledge Contribution

Tacit knowing of the individual is extended to a group process within the context of group tacit knowledge (GTK) (Erden, von Krogh & Nonaka 2008; Von Krogh, Nonaka & Rechsteiner 2012). GTK is the “capacity of a group to act as a collective body using their collective mind in situations that are familiar as well as unfamiliar and complex in the absence of explicit rules or directions. GTK allows the group to deal with uncertainty, to define new tasks and to solve predefined tasks” (Erden, von Krogh &



Nonaka 2008, p. 9). In creating GTK, the group establishes a "group identity" and "group boundaries" (p. 9) over time by sharing experiences, goals, stories and working together on projects.

The synthesis of group cognition with the extension of tacit knowing to Ba at the group level led to conceptualising the existence of a group knowledge contribution. Group knowledge contributions and their usefulness assessments are anchored in the shared group worldview that emerges from the complex interactions of the knowledge creators.

*A group knowledge contribution emerges in group Ba and is embedded in the group's shared worldview. The assessment of usefulness of the group knowledge contribution occurs at the group level relative to the group's purpose. The group knowledge contribution informs decisions of the group to take action.*

I posited that each knowledge creator's mind maintains a copy of the group-knowledge contribution, and the copy's fidelity to the original varies according to their degree of willing participation in socialisation. At cessation of the group session, the group knowledge contribution ceases to exist. The knowledge creator's mental copy is subject to change and re-assessment depending upon on-going tacit knowing processes of the knowledge creator and the related adaptation of their worldviews.

Once the group is reconvened, the group knowledge contribution could re-emerge from tacit knowing processes involved in the socialisation by knowledge creators of fragments and synchronisation through Ba of their respective worldviews. The complex interactions result in the emergence of a group role-in-use and its knowledge contribution that is similar too, but different from the original. A variety of factors interact to determine this difference including the perspective of each knowledge creator, their ability to adapt to the newness of the knowledge contribution, their adapted and evolved worldviews at the time of the current session compared to the original session, the wellness of each knowledge creator, and changes in framing.

"Framing" (Polanyi & Prosch 1975, p. 85) applies to how each knowledge creator recalls the previous group session. For example, one knowledge creator may remember a group decision, but discard the memories of the group processes that led to that decision. Re-establishing group knowledge contributions is facilitated through the use of shared IT infrastructure that is appropriate for serving "as a kind of group memory for knowledge, through which people can access past experiences, in particular overt clues, documented experiences, written reflections and so on, and thereby recollect an image of past events" (Erden, von Krogh & Nonaka 2008, p. 15).

### 3.8.9 Effective Emergence of Knowledge Contributions

A measure was needed to describe how knowledge contributions and their attendant assessments emerge during collaboration and used in subsequent SECI processes (see section 2.8.6 on page 54) to produce the knowledge outcomes of the collaboration. The results of applying the measure were intended to provide a basis for comparing knowledge creation experiences.

The measure called “effective complexity” was put forward to characterize a complex system by (Gell-Mann 2011). The “effective complexity of an entity is the length of a very concise description of its regularities, as distinct from features treated as random or incidental” (p. 53). The refinement of knowledge contributions during iterations of the SECI process leads to what De Haan & Rotmans (2011) characterise as chains of patterns or “transition paths” (p. 96).

In terms of collaborative wellness, these transitional paths were conceived as linked assessments of knowledge contributions based on the extension to linkography discussed in section 2.14.2. In fact, the distance measure of Cai, Do & Zimring (2010) that measures the number of moves between the “inspirational move” and the current move (p. 160) was used to inform the definition of effective emergence as follows:

*Effective emergence of a knowledge contribution is the measure of the number of assessments applied to the knowledge contribution between the ancestral assessment that identified the original knowledge contribution and the current assessment.*

Effective emergence is dependent upon the perspectives used by the participant-observer in their assessments. The effective emergence may need to be re-assessed in the light of the observer’s deepening insights into the collaboration and the on-going discovery process associated with the collaborative wellness network.

## 3.9 Roles-In-Use and Collaborative Wellness

This section uses a collaboration as a vehicle to define a role-in-use and the part it plays in the assessment of collaborative wellness. A perspective was employed to abstract the structure and interactions between two knowledge creators from the collaborative wellness system of Figure 13 on page 93 and is shown in the figure below.

### 3.9.1 Defining the Role-in-use

The concept of the role-in-use was introduced in section 2.9.4 on page 63 and is illustrated in Figure 18 below. Recapping our discussion, in implementing a collaboration, the organisation’s stakeholders collaborate to express the purpose as

## Collaborative Wellness Through Dynamic Role Alignment

a joint a value proposition (see section 3.8.4 page 110). The joint value proposition is deconstructed to a form suitable for offering to each potential knowledge creator. A knowledge creator considers the offered joint value proposition, and accepts in the confidence of possessing the skills necessary for meeting the purpose, that is meeting the requisite variety of the role (Rose, Hawryskiewicz & Kang 2015).

Knowledge Creators believe in and commit to fulfilling the collaboration's purpose. In accepting and committing to participate, the knowledge creator interprets their responsibilities contained in their joint value proposition and formulates a role-in-use which they then occupy and perform. At the start of collaboration, the organisation determines the requisite variety of the collaboration and the knowledge creator determines the requisite variety of the role-in-use.

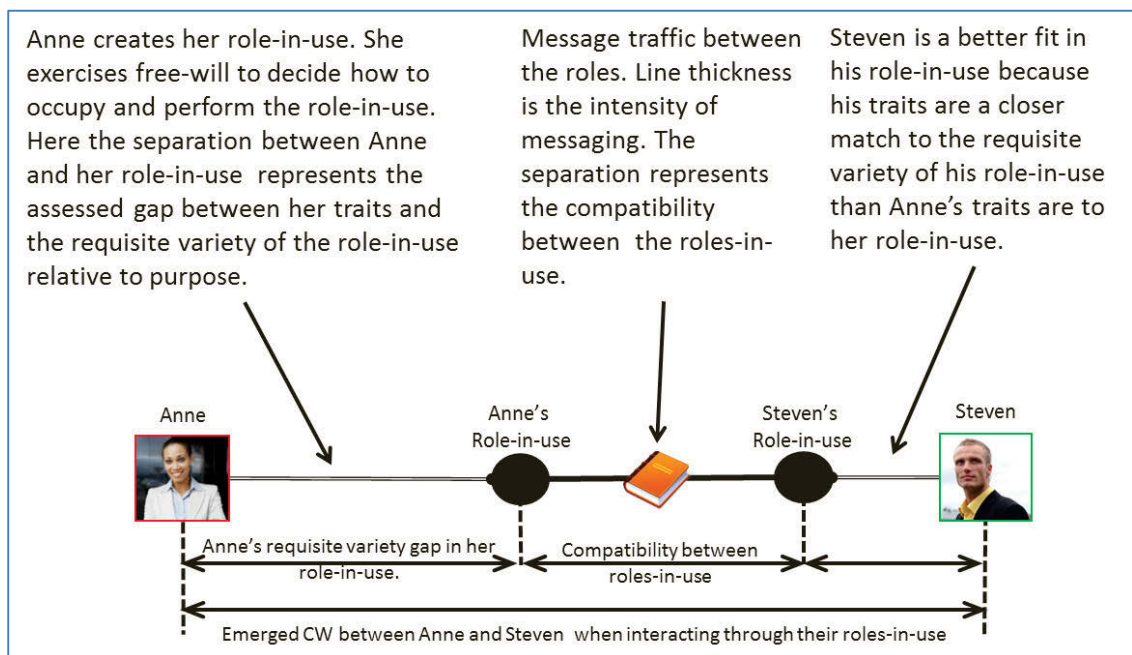


Figure 18 Role-in-use.

How well a knowledge creator performs their role-in-use relative to the purpose expressed in the joint value proposition is measured by the concept of role-in-use alignment. If a role-in-use is aligned, then the knowledge creator's degree of requisite variety and performance of their role-in-use matches that required to fulfil the purpose. The role-in-use was conceived as a dynamic construct that is changed by the knowledge creator as they adapt to changing circumstances. This discussion led to a definition of the role-in-use as

*The role-in-use is created by a knowledge creator from their free will interpretation of their assigned responsibilities expressed by a joint value proposition. The knowledge creator brings traits they believe satisfies the requisite variety required of the role-in-use when they occupy it. They perform*

*the role-in-use such that all interactions affecting the collaboration are through this role-in-use. The knowledge creator dynamically re-interprets and adapts the traits they apply to the role-in-use and/or adapts the role-in-use to meet changes in the collaboration.*

### 3.9.2 Role-in-use as a Building Block of Collaboration

Business designers interpret the purpose of a collaboration in order to design and specify collaborative roles. Figure 19 below illustrates how designed roles may be deconstructed by knowledge creators into component roles-in-use.

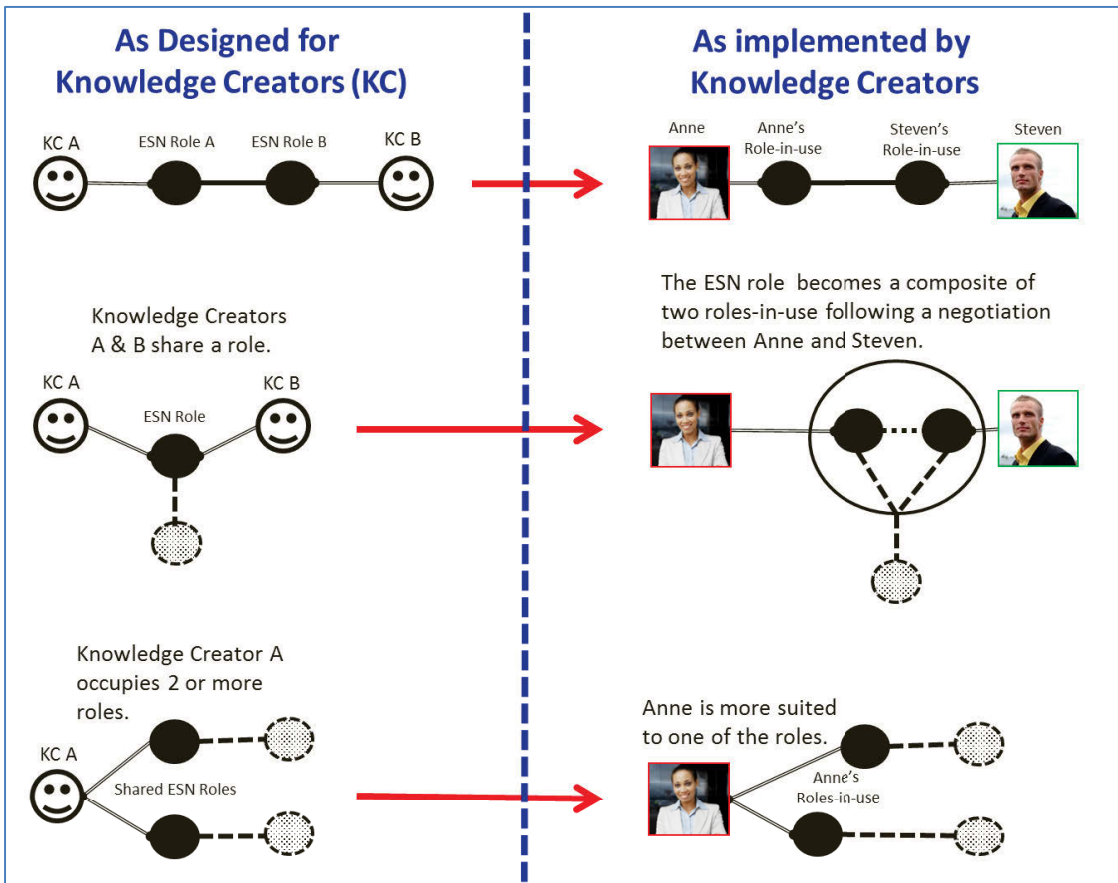


Figure 19: Roles-In-Use and Role Alignment.

Once this deconstruction is carried out, the parts played by individual knowledge creators can be assessed with greater precision by the participant-observer. On the left of the above diagram are the ESN roles designed by the business, while on the right are the roles-in-use devised and implemented by the knowledge creators when they interpret their responsibilities.

The roles-in-use implemented by the knowledge creators and how they perform them reflect not only the wellness of individuals, but their relationships with co-creators and interactions within Ba. Possible interactions between the aspects of collaboration are summarised in Table 16 on page 101. The roles-in-use are shown in the context of the CWU in Figure 14 on page 98.

### 3.9.3 Defining Role-in-use Alignment

Business designers interpret the purpose of a collaboration and specify roles for the collaboration. These designed roles must align to the purpose of the collaboration. From practical experience, this alignment of designed roles is relatively static and resistant to change. Once stakeholder agreement has been reached, the role is offered to the knowledge creator, who as shown in section 3.9.1 on page 116, creates, occupies and performs a role-in-use. This role-in-use must align to the purpose of the collaboration.

Role-in-use alignment has two inter-related components. Firstly, it is an assessment of a knowledge creator's capacity and capability to perform their responsibilities through their role-in-use. This assessment, at a particular point in time, concerns the knowledge creator's available traits relative to the requisite variety of the role-in-use and a wellness assessment as to how they can and do perform their role-in-use. Together, these assessments form the knowledge creator's degree of requisite variety. The assessments are subjective, qualitative and concerned with tacit knowledge. The implication is that neither the current required requisite variety of the role-in-use nor the knowledge creator's available traits can be precisely described. Requisite variety may change as the collaboration adapts to new situations, such as a change in purpose. Furthermore, there may be a mismatch between the requisite variety of the role-in-use and that required in the designed role owing to misinterpretation by the knowledge creator and/or a lack of clarity in setting out the responsibilities in the designed role.

The approach to assessing the knowledge creator's degree of requisite variety was devised through a re-interpretation of Balconi et al. (2012)'s cognitive distance as discussed in section 2.12.2 on page 76. Their measure was based on an ecological measure used to compare different species on the basis of the number of traits they have in common. I said, that the more traits a knowledge creator possesses relative to the requisite variety of the role-in-use then the higher degree of requisite variety the knowledge creator has for the role-in-use. Understanding the potential and applied traits of a knowledge creator may in part be inferred from knowledge contributions. This requires in-situ observation and discussion with the knowledge creator.

The second component of role-in-use alignment assessment concerned the performance of the knowledge creator in their role-in-use. This is an assessment of the effect of their wellness (see section 2.9.9 on page 69), eWellness and eImmunity (section 2.10.5 on page 73) upon their application of traits in performing their role-in-use and their relationships with other knowledge creators. I posited that a lack of wellness results in a decrease in the knowledge creator's ability to apply traits to

meet the requisite variety of the role-in-use. I considered that the usefulness of the knowledge contribution is an indicator for this second component.

*Role-in-use alignment is a qualitative assessment made relative to the purpose of the collaboration. It encapsulates an assessment at a particular point in time of the degree of requisite variety a knowledge creator brings to their role-in-use, their level of wellness versus expected wellness, and an assessment of the usefulness of their knowledge contributions relative to that required for fulfilling the purpose of the collaboration.*

Role-in-use alignment is sensitive to many of the dimensions of collaboration and as such is dynamic and exhibits path dependence. In a group collaboration, the primacy of measures and selected assessment processes for role-in-use alignment depends upon the situation and type of group as well as the circumstances of the group at a particular time. For example, "media naturalness" (Peng & Sutanto 2012, p. 145) features strongly in distributed and virtual collaborations. In the case of a knowledge creator, requisite variety refers to a set of traits that include experience in written and oral communication, subject domain knowledge, collaborative experiences, and technical skills. The refinement of improvement strategies applied to a collaboration is informed by measuring changes in role-in-use alignment.

### 3.9.4 Definition of Collaborative Wellness

The concept of wellness was basic to studying collaborations of knowledge creators. Smith, Tang & Nutbeam (2006) definition for wellness is "the optimal state of health of individuals and groups. There are two focal concerns: the realization of the fullest potential of an individual physically, psychologically, socially, spiritually and economically, and the fulfilment of one's role expectations in the family, community, place of worship, workplace and other settings" (p. 344).

This wellness definition underpinned two fundamental concepts of my research. Firstly, a knowledge creator occupies a role-in-use and interacts through that role-in-use. Secondly, measures of wellness represent the gap between the knowledge creator's current wellness and the wellness required of the knowledge creator to meet the expectations embodied in the role-in-use. In this light, a view of a collaboration's state was given by combining assessments of every individual's wellness together with measures of the empirical collaborative dimensions and their aspects. Wellness is a subjective and relative assessment (Chen, Liu & Chang 2013) and this mandates that the proposed view of a collaboration's state must also be relative in character.

A precise definition of collaborative wellness required a pragmatic answer to the question of how can a collaborative state be described with sufficient precision to be both useful and performed in a timely manner and how can a state be compared to

another state. The solution adopted was to conceive collaborative wellness as being the synthesis of three gap assessments namely the degree of requisite variety bought by knowledge creators to their roles-in-use, the alignment of the roles-in-use with the purpose of the collaboration, and the usefulness of knowledge contributions to fulfilling the purpose of the collaboration. These assessments overlap to a certain extent and are interdependent.

*"Collaborative wellness (CW)" is an assessment of the current state of a collaboration based on the knowledge creators' degree of requisite variety, alignment of roles-in-use, and the usefulness of knowledge contributions relative to the purpose of the collaboration. Collaborative wellness assessments may be deconstructed according to perspectives formed from the empirical collaborative dimensions and their aspects.*

In the past, "collaborative wellness" referred to collaborations of health practitioners that delivered wellness outcomes (Carney 2007, p. 163). However, my definition of collaborative wellness encompassed knowledge creators, outcomes and processes at all levels of a collaboration.

### 3.9.5 Assessing Requisite Variety

"Requisite Variety" (Ashby 1958, p. 3) has always been a key concept in Organisational Knowledge Creation (OKC) theory (Nonaka 1994, p. 27; Nonaka et al. 2014, p. 140). In OKC, "requisite variety" is stated as the requirement that "an organisation's internal diversity must match the variety and complexity posed by the environment" (Nonaka & Takeuchi 1995, p. 82).

The importance of requisite variety was underscored in a recent study by Begoña Lloria & Peris-Ortiz (2014). The authors call for further research that includes a qualitative study and inclusion of business context. This call has been echoed by von Krogh & Geilinger (2014). Business researchers consider the law of "Requisite Variety" to be a "fundamental law of business" (Lewis & Stewart 2003, p. 13), but the authors say "variety cannot be measured; the number of states of anything other than the simplest 'controller' is a vast, incomputable value. However, it is possible to carry out relative studies" (p. 13). Collaborative wellness supports this approach, as it is an assessment made relative to the purpose of the collaboration.

Ideally, the knowledge creators of a collaboration will possess an appropriate level of information "redundancy" relative to the needs of the collaboration's purpose (Nonaka & Takeuchi 1995, p. 80; Nonaka, von Krogh & Voelpel 2006, p. 1183). A collaboration's purpose should be devised with sufficient flexibility to enable knowledge creators to decide how best they can fulfil their responsibilities. As discussed, the knowledge creator determines the requisite variety of the role-in-use.

## Collaborative Wellness Through Dynamic Role Alignment

I proposed that at the start of collaboration, the requisite variety of the collaboration and knowledge creators satisfied that required to fulfil the assigned purpose. The emphasis therefore was on tracking changes in requisite variety relative to the purpose of the collaboration as adaption is made to changing circumstances.

The research case studies tested changes in the requisite variety of roles-in-use. These changes were assessed by measuring a knowledge creator's performance. Davenport (2005) opined that the measure that matters "is high-quality outputs per unit of time and cost" (p. 49). This assessment of quality was of necessity, qualitative and subjective. Davenport (2005) advocated the strategy of forming a peer group review for a particular knowledge creator. To overcome issues of objectivity, he further recommended several peer groups be involved to increase the number of responses. High-quality outputs mean useful knowledge contributions, where usefulness is a qualitative assessment made relative to the collaboration's purpose.

If the usefulness of knowledge contributions declines then the participant-observer has the task of investigating if the role-in-use no longer aligns with the purpose of the collaboration. This involves assessing if the knowledge creator is able to apply their traits to the role-in-use. Furthermore, it may well be that the requisite variety has changed to an extent that knowledge creators must bring new traits to bear. How the investigation is conducted is a matter for decision given the particular circumstances of the collaboration and the understanding of its participant-observer.

Knowledge creators bring their "persona" (Oxford Dictionary 2014), that is, an aspect of their character that is presented or perceived by others to their role-in-use. To understand the persona presented by a knowledge creator and their associated traits that could be applied to collaboration requires supplementing measures through questioning made during interactions by an in-situ participant-observer. If necessary, a background study of previous collaborations involving the knowledge creator and/or corporate knowledge systems should be undertaken. A directed interview of the knowledge creator in question could also be conducted.

The measurement process is necessarily iterative in character. As discoveries are made and the experience of the participant-observer develops, some or all of the assessments need to be re-visited. In these circumstances, the records of assessments are to be structured to enable re-assessment, comparisons and follow-up of all impacted assessments. The research design chapter outlines a method of recording assessments based on the familiar and proven business use-case (Cockburn 2000; Kulak & Eamonn 2012). The measures of requisite variety are summarised in the table below.



Table 19 Principal measures relating to assessment of Requisite Variety.

Measure or Assessment	Description	Notes
Knowledge contribution usefulness.	Assessed relative to purpose by the participant-observer.	A weak assessment may indicate lack of trait availability, wellness issues of knowledge creators (see sections 2.10.4 on page 72 and 2.10.5 on page 73) and changes in purpose leading to role-in-use adaptation and changes in requisite variety.
Knowledge usefulness assessments	Backward links indicate knowledge creator involvement. Forward links show how the knowledge contribution is used.	Indicate patterns of socialising, traits accessed from others or by others, existence of cliques, and issues of trust and sharing in applying traits. Refer section 3.8.3 on page 108
Effective Emergence	The number of knowledge usefulness assessments between start of idea socialisation and current knowledge contribution assessment.	Can be used to: <ul style="list-style-type: none"> <li>• Measure knowledge creator socialisation</li> <li>• Compare knowledge contributions</li> <li>• Point to issues of knowledge access and sharing.</li> </ul> Refer section 3.8.9 on page 116
Participant-observer in-situ questions and observations	To a degree, captures the tacit knowing processes through observation of behaviours, conversations and use of questions that are designed to elicit the context of exchanges.	To an extent, captures the context of the interaction and provides an understanding of how knowledge is created and refined in the collaborative spaces (von Krogh & Geilinger 2014).
Directed Interviews	Helps to establish the context of knowledge creators in the collaboration and organisation. Allows investigation of cultural constraints on the	Establishes if patterns of interaction are particular to current collaboration or common experiences. Highlights unusual or surprising behaviours that may affect roles-in-use. Directed

Measure or Assessment	Description	Notes
	collaboration and interactions between collaborative spaces.	interviews supplement direct in-situ observations.

### 3.9.6 The Need for a Scale of Collaborative Wellness (CW)

A common ontology was required for discussing and comparing the Collaborative Wellness (CW) of diverse entities, for example, how well were roles-in-use performed, how well did knowledge creators occupy roles-in-use and what was the collaborative wellness of a knowledge creation process? A common rating scale would have helped address this problem. The first task in devising this scale was to identify and characterise collaborative practices that can be accessed as necessary for outcomes to be acceptable to stakeholder. This category of acceptable became a reference point for establishing other categories. However, what other categories in the scale were necessary and how could they be unambiguously determined? How would the scale be used to inform the application of improvement strategies to collaborations for the purpose of improving CW? These questions and tasks were addressed in the case studies.

CW was measured by comparing the current state of a collaboration against a desired state. A scale representing these measures was therefore a “comparative scale” (Peterson 2000, p. 62). How many scale categories were appropriate? Although in the literature there is considerable debate over the choice of the number of scale categories, Peterson (2000) opines that “all things considered, rating scales with five to nine rating scale categories seem to work in most research situations” (p. 65). A task for the case studies was to devise a set of questions that would enable reliable categorisation of collaborative wellness measurements. Furthermore, the case studies pointed to what constituted the extrema of the collaborative wellness scale.

### 3.9.7 The Collaborative Wellness Unit (CWU).

To date, the discussion has been primarily about knowledge creators, roles, knowledge contributions and structure. This work resulted in the collaborative wellness framework (CWF) of CWS illustrated in Figure 13 on page 93. The discussion now turns to considering the network of relationships in the collaboration.

The joint value proposition is at the core of a knowledge creation collaboration. My practical experience was that once engaged to address an organisational problem involving collaborations, the first task was to use the dimensions of the collaboration to discover the “who?”, “what?” and “how?” (Figure 1, page 2) of the joint value

proposition of the collaboration. This required "looking in detail at conversations, emails, manuals and other types of text." (Underwood & McCabe 2012, p. 88). The answers described a multi-level network of relationships. This experience was confirmed by feedback from the case studies, especially those at Woolworths Limited (Rose, Hawryszkiewicz & Kang 2014, 2015) that showed knowledge creation and "value co-creation" (Vargo, Maglio & Akaka 2008, p. 149) utilising this knowledge occurred simultaneously on multiple levels and indeed between levels in the Woolworths' organisational structure.

These observations of the relationships created to perform the joint value proposition led to the conception of the collaborative wellness unit shown in Figure 3 on page 5. Furthermore, the experience of the case studies showed that for Collaborative Wellness it is necessary that all of these relationships to exist. This led to the definition of CWU as

*The "Collaborative Wellness Unit (CWU)" is composed of the relationships between stakeholders and knowledge creators that are necessary to perform a joint value contribution.*

A joint value proposition may be successively deconstructed into "elementary value propositions" that "describe different aspects of a value proposition" (Osterwalder & Pigneur 2003, p. 431). These elementary value propositions are referred to as joint value propositions as they required socialisation for refinement and validation with other stakeholders. Since a joint value proposition is the focus of a CWU, it follows that the deconstruction process was also applicable to the CWU.

The CWU exists in the context of the collaborative wellness framework as shown in Figure 3 on page 5. In this light, depending upon the type of group, a CWU is not only across organisation levels, but can also be across multiple collaborative spaces called "Ba" by Nonaka et al. (2014, p. 139). Reflecting modern communications, Ba ranges from the physical with co-located knowledge creators to collaborations conducted in virtual world simulations.

### 3.9.8 The Collaborative Wellness Network (CWN)

Deconstructing the joint value proposition results in the deconstruction of its associated collaborative wellness unit. This created the concept of CWU's linked by the commonality in their joint value propositions, such an arrangement is depicted in Figure 4 on page 6. These linked CWU's formed a network that I called the collaborative wellness network and defined as follows:

*The "Collaborative Wellness Network (CWN)" is the network formed by collaborative wellness units linked through commonality in their joint value propositions.*

CWN was derived from an iterative process of discovery taking into account the changing circumstances of the case study collaboration. The discovered CWN was therefore a "network-in-use" (Merali 2006, p. 217) and represented the collection of all CWU's affecting collaborative wellness at a particular point in time in the case study.

The environment was considered to be a "black box" (Miller 1971, p. 357) that exists, surrounds and permeates CWN such that all members of the CWN are also members of the environment. CWU's are linked to the environment through implicit roles-in-use. These roles-in-use were useful for tracking social communications that were outside the defined roles, but nonetheless influenced collaborations. Implicit roles-in-use cater for "small world" links (Watts & Strogatz 1998, p. 441) between CWU's and can be across collaboration and organisational boundaries.

### 3.9.9 The Collaborative Wellness Assessment (CWA) Process.

In our discussions, all of the measures associated with collaborative wellness are both qualitative and subjective. They are relative assessments and are an estimate of the gap between the current state and the desired state as determined by the purpose of the collaboration. I called these assessments "Collaborative Wellness Assessments (CWA)". CWA's are made at a point in time and in particular collaborative circumstances. A CWA is conceived as the answer to "how does a particular circumstance, at a particular place and point in time, affect the collaboration's ability to fulfil its purpose?" Any change, such as a change in purpose necessitates that all dependent CWA's be revisited.

CWA's exhibit path dependence. A CWA at the knowledge creator level has a narrow scope of the individual knowledge creator and their knowledge contribution. Lower level CWA's inform wider scoped CWA's at higher levels. Collaborative Wellness is the peak and final assessment with a scope over the whole collaboration. As discussed, the in-situ participant-observer requires knowledge of the collaboration so as to understand how an individual CWA affects the overall assessment of collaborative wellness. In practice, a plan of action was required to define a process that involves a CWA and checking all of its dependent CWA's. This was necessarily an iterative process and was referred to as the "Collaborative Wellness Assessment Process". The linked path dependencies of CWA's formed a structure akin to the concept of "key performance indicator trees" (KPI trees) (Kronz 2006, p. 36).

### 3.10 The Research Question and Research Propositions

A common theme in the reviewed literature was the observation that to survive, organisations must innovate and differentiate themselves in the marketplace from their competition. Yet despite this imperative, many organisations find it difficult to implement new ideas and processes (Rose, Hawryszkiewicz & Kang 2014). My research sought insights to help understand these difficulties and aid in the implementation of strategies to improve innovation outcomes. Theory development has been in the context of knowledge creators collaborating in groups. The intent was that once verified at this level, outcomes of my research may be applied to larger collaborations in various organisational and inter-organisational contexts.

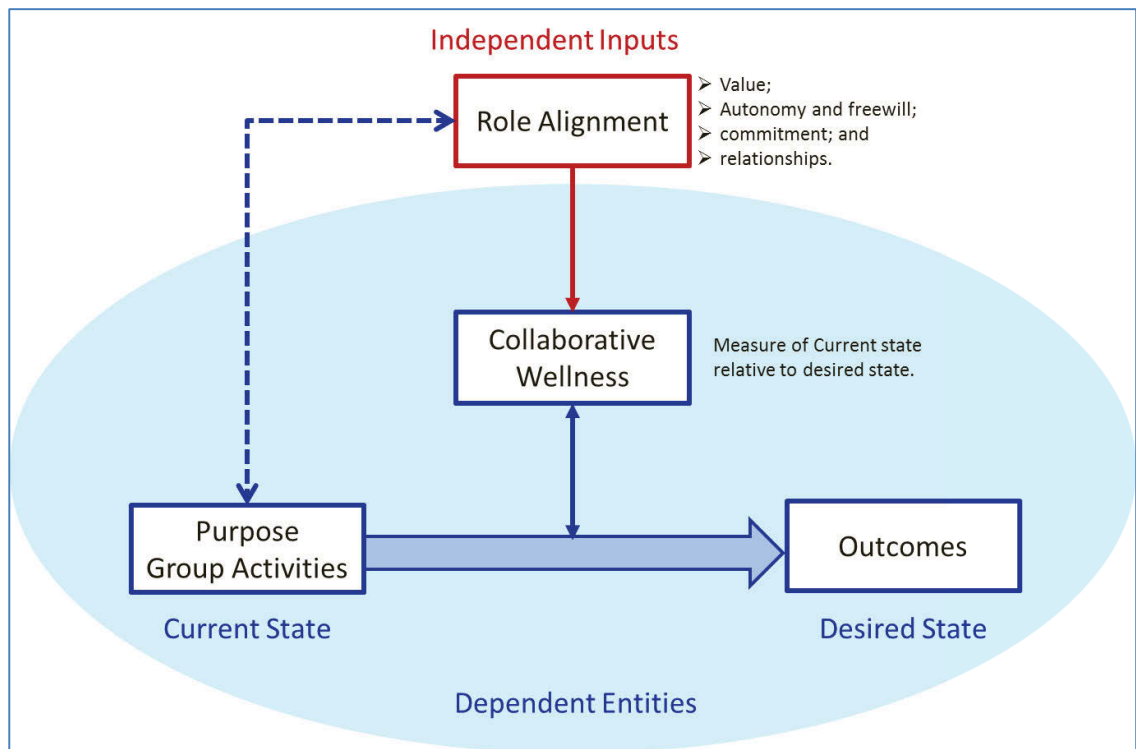


Figure 20 States of Collaboration.

Figure 20 shows the key inputs and outputs for considering the research question and research propositions that were verified by case studies. The collaborative wellness system (CWS) provided the basis for assessment of collaborative wellness (CW) that supported the study of knowledge creation collaborations and informed devising and application of improvement strategies.

The case studies were trials in which changes in a designed role alignment was an input to the collaboration and a change in Collaborative Wellness (CW) was the output. It was conceived that the alignment of the designed role would change if, for example, the purpose changed. In turn, this would affect the alignment of the roles-in-use, which would have flow-on effects to the knowledge creation activities and the assessment of collaborative wellness. CW was the assessment of the state

of collaboration relative to the desired state. The state was described by the knowledge creators' degree of requisite variety, the alignment of their roles-in-use, and the usefulness of knowledge contributions. Changes in CW resulted in changes in the value-in-use of the outcomes of collaboration.

CW process relationships of the case study trials are shown in the concept map below. Outcomes from changing role alignments were uncertain because a knowledge creation collaboration is a complex open system in which human knowledge creators perceive and use free-will judgement to adapt to change. Adaptations create complex feedback loops which lead to further adaptation. This situation is summed up by the observation that "small changes in inputs can have dramatic and unexpected effects on outputs" (Merali 2006, p. 219). It may also be the case that small changes have little or no effect due to adaptive strategies employed by knowledge creators to negate the effects of change. In this light, the research design adopted an iterative, "learning-by-doing" approach (Batie 2008, p. 1184) in which the effects of small incremental changes were assessed and informed strategy development for the next iteration. Furthermore, the collaborative attributes of "consensus-finding and knowledge creation, sharing and use" (Morner & Misgeld 2014, p. 17) were given prominence in developing the research proposals.

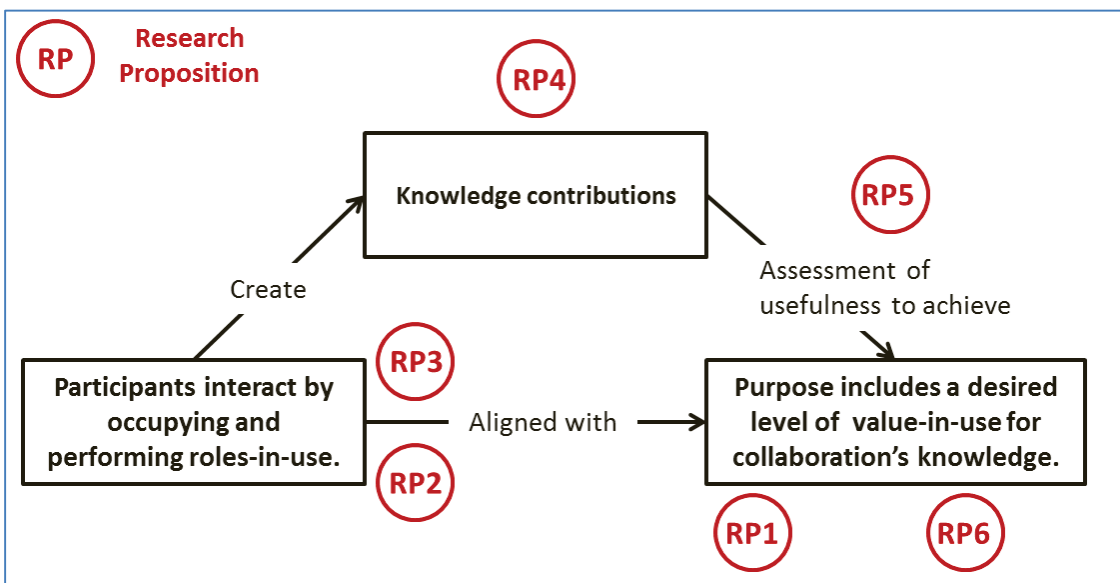


Figure 21: Collaborative Wellness Concept Map and Research Proposals.

Referring to the above two figures, my research asserted that strategies applied using an iterative, learning by doing approach that successfully improve role alignment will result in improved collaborative wellness and consequent improved outcomes. The research question, if answered in the affirmative will verify this assertion:

*Do acceptable outcomes result from aligning roles-in-use in collaborations purposed with creating knowledge for process and/or product innovation?*

Table 20 Concept Reference.

Concept	Description
<b>Collaborative Wellness</b>	An assessment of the current state of a collaboration relative to the state required of the collaboration for it to achieve its purpose. (Section 3.9.4 on page 120). The state of the collaboration is described by the degree to which knowledge creator satisfy requisite variety of their roles-in-use, role-in-use alignments and the usefulness of knowledge contributions.
<b>Collaborative Wellness Framework</b>	The collaborative wellness framework is the infrastructure that makes-up and supports the collaborative spaces used by knowledge creators to fulfil the joint value proposition of the collaboration. In my research, the infrastructure is that of an organisation which provides collaborative spaces and supporting technologies. Spaces include offices, work areas and meeting places. See section 3.1 on page 92.
<b>Collaborative Wellness Unit</b>	The collaborative wellness unit is the collection of relationships necessary to perform a joint value proposition. Knowledge creators create knowledge that is assessed for usefulness and used by stakeholders to realise value. See section 3.1 on page 92.
<b>Knowledge Contribution</b>	Knowledge is the meaning that emerges from the act of tacit knowing and is embedded in the mind’s worldview. It becomes a knowledge contribution when it is assessed for its usefulness in fulfilling the purpose of the collaboration. It transforms the state of knowledge in the collaboration and informs decisions to take actions. (Section 3.8.6 on page 113)
<b>Media Naturalness</b>	“Media Naturalness Theory” (Peng & Sutanto 2012, p. 145) is used to consider how the appropriateness of technology choices affects the knowledge contribution and collaborative wellness. The highest media naturalness occurs in face-to-face interactions of knowledge creators. As media naturalness decreases, the tacit knowing processes in socialisation become problematic.
<b>Requisite variety</b>	Nonaka, Toyama & Byosiere (1998, p. 510) interpret Ashby (1958)’s Law of Requisite Variety by explaining that in “order to deal with challenges posed by the environment, the internal diversity of an organization has to match the variety and complexity of the environment”. (Section 2.13 on page 82). Here, the knowledge creator brings traits that they believe will satisfy the requisite variety required to perform their role-in-use.

Concept	Description
	Requisite variety changes dynamically according to the collaboration circumstances, as does the degree to which knowledge creators can satisfy requisite variety.
<b>Role-in-use alignment</b>	Role-in-use alignment is a qualitative assessment made at a particular point in time relative to the purpose of the collaboration. It encapsulates an assessment of the degree to which a knowledge creator satisfies the requisite variety of their role-in-use, their level of wellness versus expected wellness, and their performance based on an assessment of the usefulness of their knowledge contributions relative to that required by the purpose of the collaboration. (Section 3.9.3 on page 119).
<b>Role-in-use</b>	A role-in-use is created by a knowledge creator's free will interpretation of their assigned responsibilities within a business model. The knowledge creator occupies and performs their role-in-use such that all of the collaborative interactions affecting the collaboration are via the role-in-use. The knowledge creator dynamically re-interprets and adapts their role-in-use to changing circumstances. (Section 3.9.1 on page 116).
<b>Utilisation and Socialisation</b>	Here, utilisation is interpreted as a collaborative wellness measure of the gap between current utilisation in terms of tasks, capabilities and capacity and that required for achieving the purpose of the collaboration. (Table 14 on page 88). A knowledge creator with high utilisation will have less capacity to socialise and adapt to changing circumstances of collaboration.

The following research propositions formed the basis for addressing the research question. All propositions needed to be verified for the research question to be answered in the affirmative. The propositions are listed below. Figure 21 above shows their context in the collaborative wellness process.

*RP1 Joint Value Proposition:*

*A clearly stated joint value proposition is a necessary condition for collaborative wellness in collaborations purposed with creating knowledge for process and/or product innovation.*

*RP2 Requisite Variety:*

*Achieving requisite variety is a necessary condition for role-in-use alignment.*

*RP3 Balancing utilisation:*

*Balancing utilisation with the capacity and means to socialise ideas is a necessary condition for improving the compatibility between roles-in-use.*



RP4 Improving role-in-use alignments and compatibilities:

*Improving role-in-use alignments and compatibilities is a necessary condition for improving the usefulness of knowledge contributions.*

RP5 Improving knowledge contributions:

*Improving the usefulness of knowledge contributions is a necessary condition for improving collaborative wellness.*

RP6 Improving collaborative wellness:

*Improving collaborative wellness is a necessary condition for improving the potential value-in-use of knowledge contributions.*

### 3.11 Exploring the Research Propositions using Scenarios

My research project took advantage of my experience in collaborations of knowledge creators. While there were benefits to be had from experience, there were also difficulties to be overcome. One of these difficulties arose from working in a “community of practice” (DiLorenzo 2008, p. 60; Hawryszkiewicz 2010a, pp. 27-30) in which knowledge was tacitly held and shared through social mediation. It was difficult to make this knowledge explicit in a thesis format. To ameliorate this problem an approach of developing scenarios to explain qualitative content was adopted (Konno, Nonaka & Ogilvy 2014; Ogilvy, Nonaka & Konno 2014).

#### 3.11.1 The Scenarios

Three simplified scenarios were chosen as being typical of my collaborative experiences as it was not possible to capture all possible experiences of knowledge creation collaborations in these scenarios. This emphasised the need for the research design in the next chapter and the theory developed in previous sections to be adaptable to manage diverse and often unforeseen collaborative structures and situations. In particular, the scenarios provided an anticipation of what to measure (see section 4.5.4 on page 158) for a situation encountered like the scenarios, how to measure it (see section 4.5.5 on page 160) and how to interpret the results of the measurement (see 4.5.6 on page 162).

In the scenarios, the researcher was a participant-observer and the collaboration occurred in a group context. Groups were assumed to be at Level 2 of the group tacit knowledge model where the “group tacitly knows how the routines work depending on the interrelated actions of the members” (Erden, von Krogh & Nonaka 2008, p. 11). Each group had an identity and was characterised by its use of collective action to solve familiar tasks (see section 2.11 on page 73). It was assumed that knowledge creators participated in a Ba environment of good will and trust.

The first scenario is a well-established business-as-usual group of knowledge creators with long term working relationships in collaboration with a well-understood purpose.

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Processes are routine and over time, roles-in-use have been refined to closely align with the group's purpose. From experience, these groups would have plans in place to manage anticipated eventualities such as holidays and short term sick leave. Monitoring the business as usual group establishes a collaborative wellness baseline that can be used to assess the effects of future changes.

Organisations must adapt to changes in the market, so the second scenario envisaged that the leadership reacts to the market place by enacting a change in organisational strategy. Management implements the strategy by modifying the collaboration's purpose. Collaboration stakeholders express the change in purpose by adjusting the joint value proposition of the designer and in turn managers adjust the responsibilities of knowledge creators and if necessary the structure of the group. The effect of this new situation is to accentuate the overheads of performing tasks. Firstly, personal change that applies to each knowledge creator, such as re-assessing their commitment, reframing the fields of knowledge required to satisfy changes in requisite variety, and how they should perform their changed roles-in-use. Secondly, the overhead of adapting to changed relationships within the group and perhaps with other groups in the organisation. This scenario comes about through such situations as changes in collaboration membership, changing locations or relocating individuals, process re-engineering, additional roles, splitting existing roles or removing roles, changing time and cost parameters, and/or asking the group to co-operate with other groups.

The third scenario acknowledges that over time, change is inevitable. In this final scenario the organisation decides improvement of collaboration is necessary to restore previous levels of collaborative wellness. Developing and applying improvement strategies to a knowledge creation collaboration is a learning-by-doing process. Experience and the literature review show that strategies have to be tailored to organisational context. Improvement usually employs a combination of two strategies. Firstly, rationalise and/or simplify processes and secondly improve access to and use of knowledge to support new and/or changed processes.

The scenarios were reflected to some degree in the four case studies. The application of improvement strategies was not fully played out within the time constraints imposed on the studies. The exception was the fuel reduction project of the second Woolworths' study. In the following section the scenarios will be mapped to the discussion of the case studies in Chapter 5 on page 165.

### 3.11.2 Comparing Scenario Expectations

The measures included in this table represent a "first pass" assessment of the collaborative scenarios. In reality, the measures would be selected and tailored to the in-situ collaboration and may require several iterations of study before issues can

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be clearly identified and addressed. References to the six propositions RP1 to RP6 are included in the comparison table.

The scenarios were evident in the case study experiences. The case study experiences are outlined in Chapter 5 and references have been included in the Measure column of Table 21 below to the discussions concerning each of the value propositions and how their context in the experiences of the case studies.

Table 21 Scenario Expectations

Measure (Applying a perspective)	Scenario 1. <b>Business as Usual Group</b>	Scenario 2. <b>Change in Purpose</b>	Scenario 3. <b>Improving of Knowledge Process</b>	
<p><b>Joint Value Proposition (RP1)</b></p> <p>Case study experience: Section 5.3.1 on page 170.</p>	<p><u>Satisfactory</u></p> <p>Mature Group understands and accepts the joint value proposition.</p>	<p><u>Changes</u></p> <p>Joint value proposition changes and understanding decreases in short term. It may improve as knowledge creators implement the new purpose.</p>	<p><u>Improves</u></p> <p>Knowledge creators acquire additional knowledge that they can apply to improve their understanding of the joint value proposition.</p>	<p><u>Improves</u></p> <p>As processes are improved and/or utilisation balances, the knowledge creators have the time to address any lack of their understanding or clarity in the joint value proposition.</p>
<p><b>Requisite Variety (RP2)</b></p> <p>Case study experience: Section 5.3.2 on page 171.</p>	<p><u>Satisfactory.</u></p> <p>Mature group. Requisite Variety of roles well understood. Refined algorithmic processes. Knowledge creators have sufficient capability and resources.</p>	<p><u>Changes.</u></p> <p>Increase or decrease in required responses of roles to meet purpose. Requires re-interpretation of responsibilities and adaptation by knowledge creators.</p>	<p><u>May Change.</u></p> <p>Knowledge Creators acquire knowledge and new perspectives to improve understanding of the requisite variety required in their roles.</p>	<p><u>Improves.</u></p> <p>Processes re-allocated to balance requisite variety in roles.</p>
<p><b>Knowledge Creators' Degree of Requisite Variety (RP2)</b></p>	<p><u>Satisfactory.</u></p> <p>Mature group. Refined algorithmic processes. Knowledge creators have</p>	<p><u>Decreases.</u></p> <p>Initial reduction, then knowledge creators re-access skill requirements and adapt but unlikely to</p>	<p><u>Improves.</u></p> <p>Degree to which knowledge creators satisfy requisite variety improves as knowledge</p>	<p><u>Improves</u></p> <p>Processes re-allocated to balance capabilities of knowledge creators.</p>

## Collaborative Wellness Through Dynamic Role Alignment

Measure (Applying a perspective)	Scenario 1.	Scenario 2.	Scenario 3.	
	<b>Business as Usual Group</b>	<b>Change in Purpose</b>	<b>Improving of Knowledge</b>	<b>Improving of Process</b>
Case study experience: Section 5.3.2 on page 171.	sufficient capability and resources.	completely recover without intervention.	creators gain additional skills and new perspectives.	Socialisation improves.
<b>Balancing Utilisation</b> (RP3)  Case study experience: Section 5.3.3 on page 175.	<u>Balanced.</u> Utilisation balanced across group knowledge creators enabling good socialisation of ideas.	<u>Skewed.</u> High utilisation of key knowledge creators inhibits socialisation. Utilisation of some knowledge creators may decrease owing to process delays.	<u>Re-balanced over time.</u> Depends upon successful knowledge, means and process improvements. Changes in utilisation will not be uniform as knowledge creators have to adapt to changes brought about by implementing improvement strategies.	
<b>Usefulness of Knowledge Contribution</b> (RP4, RP5)  Case study experience: Sections 5.3.4 on page 176 and 5.3.5 on page 178.	<u>Satisfactory.</u> Satisfactory assessment and socialisation balanced from all knowledge creators according to roles-in-use.	<u>Decreases.</u> Co-ordination tasks displace time available for knowledge tasks and socialisation.	<u>Increases.</u> Availability of new knowledge perspectives leads to improved productivity.	<u>May initially Reduce</u> Depends upon success of knowledge improvement.
<b>Cliques</b> (RP4)  Case study experience: Section 5.3.4 on page 176.	Mature group and processes. Strong ties present. No cliques expected.	Cliques may form as a reaction to stress imposed by change.	Overcoming cliques requires successful process and knowledge process improvement. May be a tendency for cliques to reform depending upon level of trust between knowledge creators.	
<b>Role-in-use Alignment</b> (RP4)	<u>Aligned.</u> Roles-in-use have been refined and aligned over time	<u>Misaligned</u> Expect some recovery as knowledge creators adapt. Clique formation	<u>Improved.</u> Improved access to knowledge allows knowledge creators to improve applied	<u>May improve</u> Dependent upon flow-on effects of successful knowledge

## Collaborative Wellness Through Dynamic Role Alignment

Measure (Applying a perspective)	Scenario 1. <b>Business as Usual Group</b>	Scenario 2. <b>Change in Purpose</b>	Scenario 3. <b>Improving of Knowledge Process</b>	
Case study experience: Section 5.3.4 on page 176.		may inhibit role-in-use re-alignment.	knowledge and reduce trait gap.	improvement strategies.
<b>Collaborative Wellness</b> (RP5, RP6)  Case study experience: Sections 5.3.5 on page 178 and 5.3.6 on page 180.	<u>Acceptable</u> Mature group. Refined, well understood processes and responsibilities.	<u>Decreases</u> May improve but not fully recover to previous levels.	<u>Expected to Recover.</u> Improvement aims to restore collaborative wellness. Depends upon acceptance of knowledge and process improvement strategies.	

### 3.12 Conclusion

The early sections of this chapter used the findings of the literature review to identify knowledge gaps that were addressed through theory development, formulation of the research question and devising research propositions for verification and answering the research question.

The Collaborative Wellness System (CWS), the concept of collaborative wellness, knowledge contributions, roles-in-use and role-n-use alignment have been defined with related measures. My re-interpretation of Ba addressed the issue of how Ba is created and provided a basis for understanding the process of assessing individual knowledge creators as concerns wellness and their degree in requisite variety and the impacts on Ba and subsequent socialisation of knowledge.

This chapter provides the theoretical support for using CWS in improving knowledge creations and their outcomes. Case studies were required to firstly verify the research propositions and secondly to identify collaborative practices for use in the creation of a comparative scale of collaborative wellness. The next chapter covers the research design for case studies for using the collaborative wellness system to study knowledge creation collaborations for verifying the propositions and answering the research question.

## Chapter 4 Research Design

This chapter discusses the development of the approach and methodologies to deploying and using CWS in participatory action research (Neuman 2011) case studies designed to answer the research question. The approach and design of the research case studies was grounded in my practical experience and recognized the diverse situations of collaboration by providing flexible guidelines to cater for a variety of possible CWS deployments.

The first part of this chapter lays the foundation of the research design by characterising studies of knowledge creation collaborations based on my experience. The flexible approach of the research design relied upon the collaborative wellness system (CWS). CWS enabled the deployment of architectures with measures customised to the particular situation of each case study.

Following the research approach, the remainder of this chapter elaborates the research design of the case studies with explanations of what and how to measure, analysis perspectives, and the detail of investigations required to support conclusions about collaborative wellness.

### 4.1 Introduction

The focus for the research design was on “participatory action research” (Neuman 2011, p. 31) studying and improving group knowledge creation collaborations involved in process and/or product innovation. As such, the case studies were subject to a value proposition that was intended to deliver a benefit to the hosting organisation. The research purpose was to verify the research propositions put forward in section 3.10 on page 127 through a trial involving changes in role alignments and observing the effects on collaborative wellness and outcomes. This same trial was performed in the different contexts of each case study and thereby provided a degree of data triangulation (Runeson & Höst 2009).

The business theme of the case studies was summarized by the question: why has implementing new processes into well-established organizations proven to be problematical (Rose, Hawryszkiewicz & Kang 2014)? March (1991) posited that the tension created between exploiting existing processes to return short term, low risk benefits versus exploring new ideas that return long term benefits, but with higher risks has to be balanced for an organization to survive. However, the choice of an optimal strategy to balance exploration versus exploitation was itself a complex problem (Debenham & Wilkinson 2006) and characterized as a wicked problem by Camillus (2008). These explanations, while characterizing the problem, did not provide pragmatic guidance for arranging collaborations and processes to mitigate the problem. The literature review showed much research has been published on

process improvement (Paulk 2009) and the introduction of new processes and methodologies, particularly in software development (Dingsøyr et al. 2012; Drury, Conboy & Power 2012; Strode et al. 2012). However, little was found on post-adoptive process experiences (Senapathi & Srinivasan 2011) or experiences in introducing new ideas into existing well established and optimized business structures.

The implication of the literature review was that applying the collaborative wellness system to a collaboration had to be done without the benefit of guidance from prior published research. Furthermore, a collaborative wellness scale was required for extending the scope of application of CWS by leveraging the experiences of the case studies through comparisons of collaborative experiences.

#### 4.2 Summary of Collaborative Wellness System Concepts.

Table 22 below provides a reference for the Collaborative Wellness System concepts developed and discussed in previous chapters.

Table 22 Collaborative Wellness System Concepts Reference

Concepts	Description	Reference
<b>Types of Innovation</b>	“Product innovation” is the introduction of new products and for which patents have been applied for; and “process innovation” is the introduction of new processes for which patents have been applied for (Tödtling & Grillitsch 2014, p. 346).	Section 2.9.4 on page 63
<b>Categories of Innovation</b>	Two categories of innovation are distinguished by Norman & Verganti (2014), namely “Incremental innovation”: doing better what we already do; and “Radical innovation”: doing what we did not do before (Norman & Verganti 2014, p. 82).	
<b>Purpose</b>	Documenting the purpose begins using a scenario approach (Konno, Nonaka & Ogilvy 2014) to describe the situation of the organisation should the purpose be satisfied. The scenario is then restated as a joint value proposition (Frow & Payne 2011; Osterwalder 2012; Osterwalder & Pigneur 2003) which is deconstructed into “elementary value propositions” (Osterwalder & Pigneur 2003, p.	Section 3.8.4 on page 110

Concepts	Description	Reference
	<p>431) for use by individual knowledge creators. The purpose includes implicit and explicit objectives, assumptions and constraints. It is influenced by both the organisation's culture and its environment. An ill-defined purpose leads to uncertainty in knowledge contribution assessments.</p>	
<p><b>Use-Case as a template for structuring assessments</b></p>	<p>A use-case describes part of a "system-in-use" (Cockburn 2000, p. 18). It is a "description of interactions between a system and actors in its environment" (Some' 2006, p. 44). It "represents an agreement between the stakeholders in a system about its behaviour" and "shows the different ways in which the actors act to either achieve the interests of each stakeholder, or fail in an agreeable fashion, under a specific triggering condition" (Cockburn 2000, p. 44).</p>	<p>Section 2.9.6 on page 65</p>
<p><b>Role-in-Use</b></p>	<p>The role-in-use is created by a knowledge creator from their interpretation of their assigned responsibilities within a business model. They bring traits to match the requisite variety required of the role-in-use when they occupy it. They perform the role-in-use such that all interactions affecting the collaboration are through the role-in-use. The knowledge creator dynamically re-interprets and decides the traits they apply to the role-in-use and when necessary, adapts the role-in-use to meet changes in the collaboration.</p>	<p>Section 3.9 starting on page 116.</p>
<p><b>Requisite Variety</b></p>	<p>In Organisational Knowledge Creation theory, "requisite variety" is the requirement that "an organisation's internal diversity must match the variety and complexity posed by the environment" (Nonaka &amp; Takeuchi 1995, p. 82).</p>	<p>Assessment of: section 3.9.5 on page 121. Measures for: Table 19 on page 123.</p>



Concepts	Description	Reference
<b>Knowledge Contribution</b>	Knowledge is the meaning emerging in tacit knowing and is embedded in the mind's worldview. It becomes a knowledge contribution when it is assessed as being useful in fulfilling the purpose of the collaboration. A knowledge contribution transforms the state of knowledge in the subject domain of the collaboration and informs decisions to take actions.	Individual: section 3.8.6 on page 113. Group: section 3.8.8 on page 114.
<b>Role-in-use Alignment</b>	Role-in-use alignment is a qualitative assessment made at a point in time relative to the purpose of the collaboration. It encapsulates an assessment of the degree of requisite variety a knowledge creator brings to their role-in-use, their level of wellness versus expected wellness; and an assessment of the usefulness of their knowledge contributions relative to that required for fulfilling the purpose of the collaboration.	Section 3.9.3 on page 119.
<b>Participant-Observer</b>	An assessment in the case study is a "qualitative study" (Neuman 2011, p. 193) made by an in-situ expert "participant-observer" (Yin 2009, p. 102 Fig. 4.1). A participant-observer will have some influence on the course of collaboration (Silverman 2010, pp. 29-30).	Section 3.8.4 on page 110.
<b>Collaborative Wellness</b>	"Collaborative wellness (CW)" is a qualitative assessment of the state of a collaboration at a point in time based on the knowledge creators' degree of requisite variety, alignment of their roles-in-use, and the usefulness of knowledge contributions relative to the state required of the collaboration for it to achieve its purpose.	Section 3.9.4 on page 120.
<b>Collaborative Wellness Network</b>	The collaborative wellness network is the network of linked collaborative wellness units at a particular point in time.	Section 3.9.7 on page 124.

### 4.3 Characterising Group Collaboration.

The research focussed on collaborations established by a business for the purpose of creating knowledge for use in product and/or process innovation. My experience indicated that these collaborations would be subject to a tight time frame, usually of three to five months duration and constrained by the injunction of minimal disruption to business-as-usual activities. My practical experience led to an expectation that the negotiation for a case study would take between two and four weeks from first contact to an agreed engagement.

The case study design assumed that knowledge creation collaborations would tackle type two wicked problems, where it was known what to solve but the solution strategy was unresolved (see section 2.3.2 on page 19). Furthermore, it was assumed that negotiating and successfully socialising the collaboration's progress with stakeholders was crucial to delivering a benefit to the host and a successful case study outcome.

Figure 22 below summarises the expected volumes of messaging and knowledge documents in the case study (Rose 2013, p. 426 Fig. 4). The negotiation was expected to produce three documents, namely, the vision describing motivations and intent, a statement of ownership that identified stakeholders and agreed responsibilities, and a project outline that included time lines and a value proposition. Once started, the study employed a weekly reporting cycle augmented with agreed, usually monthly milestone reviews. The anticipated levels of re-work and risk of running over time reflected the effects of having to adapt to changing circumstances.

As shown in Figure 22, there have been two principal knowledge sources available to my practice group: firstly a statement of the purpose and business case (joint value proposition), and secondly access to the organisation's knowledge portal. A portal provides a single, controlled access point to organisational data, information and knowledge (Renukappa, Egbu & Kumar 2006) appropriate to support the collaboration's purpose. In my experience, the knowledge portal was usually a searchable index with links to knowledge and for study purposes was treated as a single document.

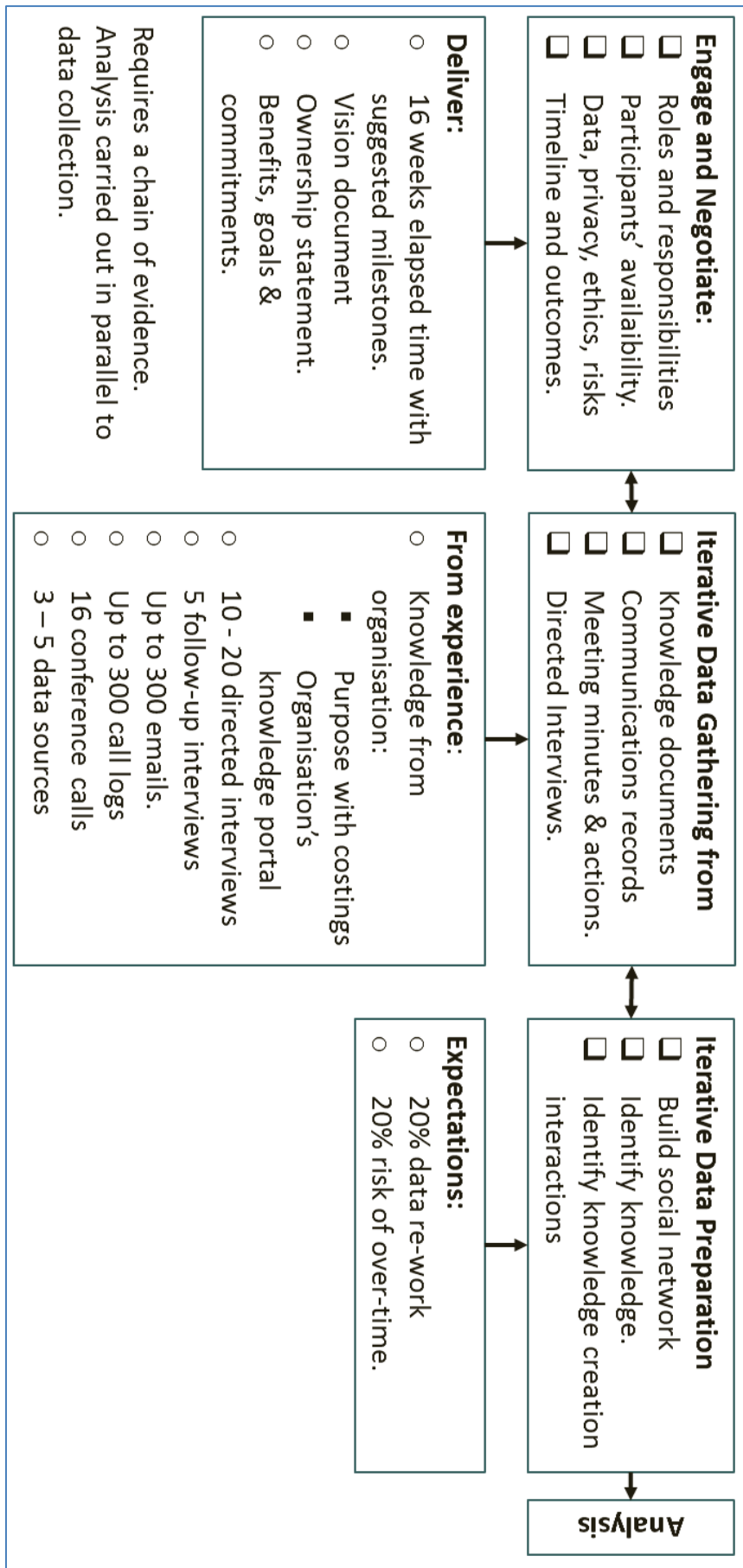


Figure 22 Case Study Expectations (Rose 2013, p. 426 Fig 4)

#### 4.4 The Research Approach

The common business theme of the case studies was to investigate the impact of introducing new ideas and processes in organisations (Rose, Hawryszkiewicz & Kang 2014). This theme raised three questions for the research design. Firstly, how are new idea implementations that need improvement identified, secondly, how can these implementations be improved, and finally, how can findings be socialized with stakeholders to aid in acceptance of study findings and implementation of recommendations? Under CWS and its measures, the answer to the first question involved identifying issues in role-in-use alignments and compatibilities. The second question was addressed by monitoring changes in role-in-use alignments so as to refine improvement strategies. Finally, using the collaborative wellness unit shown in Figure 13 on page 93, the third question was addressed by mapping collaborative wellness ratings to observations and assessments to form a consistent basis for tracking, comparing and socialising experiences.

The description above intimates that the researcher will be an active participant-observer in the research, responding to feedback provided by host leadership and participants. This was recognized by following the concepts of participatory action research in which “participants take an active role in formulating, designing and carrying out the research” (Neuman 2011, p. 31). In fact as will be discussed in the case study experience in Chapter 5 on page 165 and the analysis in Chapter 6 on page 193 all four case studies exhibited these characteristics. The case study approach was predicated on catering for this intervention and participation of participants.

My approach to the case study was composed of five stages after the initial contact and agreement of the host organisation to proceed. The first stage was to develop, socialise and include feedback from stakeholders to form a joint value proposition. The joint value proposition had to be persuasive to the extent that stakeholders were willing to commit support to the study through the provision of resources and be involved in the study. The agreed joint value proposition was an expression of the purpose and became the reference point for all collaborative wellness assessments.

In stage two, the collaborative wellness system was deployed, adapted and customised to suit the case study’s circumstances. The third stage was to outline the approach to the organisation hosting the case study. The intent of this stage was to obtain acceptance and ownership by stakeholders and knowledge creators from the organisation for fulfilling the case study’s joint value proposition. Stage four involved strategizing data collection and the qualitative interpretations of the data so as to derive and use the collaborative wellness assessments to guide the application of improvement strategies. The final stage was the socialisation of the results and

findings of the study with stakeholders so that the organisation realised value from use of the outcomes of the case study. The socialisation provided valuable feedback for refining and enhancing CWS for future research applications.

### 4.4.1 Action Plan.

The action plan for a participatory action case study is shown in Figure 23 on page 144 and was a refinement based on experiences by Rose, Hawryszkiewicz & Kang (2014, p. 219 Fig 6) and published in Rose, Hawryszkiewicz & Kang (2015). This plan is designed to aid participation by separating out iterative activities and providing for feedback and re-assessment activities. In fact this feedback and re-assessment was highlighted in the Woolworths' first case study concerned with developing cost extraction ideas where there was a lack of a clear statement on how estimates were to be derived and to the notional accuracy of the estimate. Without an agreed approach, the estimate process was left to the interpretation of individual knowledge creators in the collaboration. In my role as the participant-observer I adopted an engineering estimate approach based on my experience where an accuracy of plus or minus 20% was acceptable and the estimate would be used as a way of ranking choices. In contrast, the knowledge creators appointed by Woolworths wanted an estimate to the accuracy and scope of a Woolworths' business plan. This impasse is discussed in section 5.3.2.2 on page 172, but the result was a substantial disruption to the case study with 16 out of 20 idea estimates halted and a diminishing of collaborative wellness.

This action plan supported multiple scenarios of engagements such as a single group communicating with other groups, multiple groups co-operating to achieve a common purpose; or a situation of centralised control through a separate co-ordinating group such as that discussed by Von Krogh, Nonaka & Rechsteiner (2012, p. 258 Fig 1). This action plan acted as a template for all case studies that used the Collaborative Wellness System (CWS).

Although the action plan was for a single collaboration, the various phases can involve the use of different types of group structures (see Figure 15 on page 105). Experience has shown that during the contact period, collaboration is mainly through exchanges of emails, telephone calls or internet meetings that culminate in a face-to-face meeting with selected leaders of the organisation, for the purpose of reaching agreement to conduct the case study. The contact phase was conducted as an open disbursed type of group that transitioned to an open co-located type of group for the face-to-face meeting. The group was open in that knowledge creators could be added as the meeting progressed and knowledge created during this period became the basis of negotiation and formulation of the purpose and value proposition of stages 1 and 2.

There are many alternative scenarios to the contact and indeed to executing the other stages of the action plan. Figure 24 on page on 146 shows likely group types for a case study. The figure includes the collaborative dimensions that are important for the types of groups when applying the collaborative wellness system to the study.

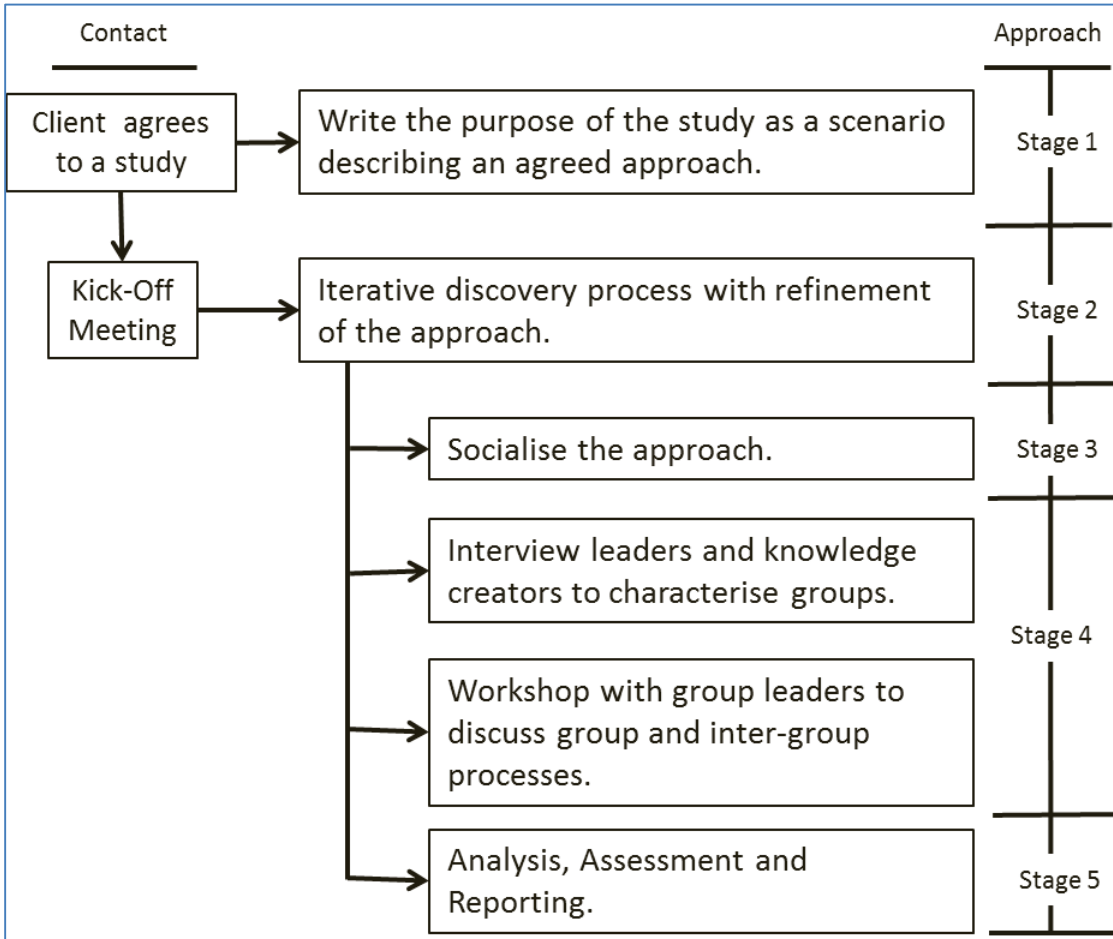


Figure 23 Case Study Action Plan (Rose, Hawryskiewicz & Kang 2015, p. Fig. 4)

Referring to the action plan in Figure 23, the activities within the stages are summarised as follows:

#### 4.4.1.1 Action Plan Stage 1

Write the purpose of the study as a scenario describing an agreed approach:

- a. Using available documents, supplemented with interviews, describe approaches, methodology, study design and possible outcomes.
- b. Socialise with client representatives. Identify benefits and initial starting points.
- c. Arrange formal kick-off meeting for all participants and stakeholders.

#### 4.4.1.2 Action Plan Stage 2

Iterative discovery process with refinement of the approach:

- a. Determine business units, groups, knowledge creator and contributors.

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- b. Discover existing management and team processes. (Minutes, emails, etc.)
- c. Develop a joint value proposition, socialise, and incorporate feedback.
- d. Deploy the Collaborative Wellness System to suit the collaboration.

### 4.4.1.3 Action Plan Stage 3

Socialise the approach:

- a. Validate discovery. Commitment of stakeholders/knowledge creators
- b. Confirm timelines and establish workshops and milestone reviews.
- c. Provide feedback to stakeholders and incorporate suggestions.

### 4.4.1.4 Action Plan Stage 4 Interviews

Interview leaders and knowledge creators to characterise groups:

- a. Identify processes for each group according to the scope of the study.
- b. Identify roles and expectations of role performance.
- c. As required, establish clarification interviews
- d. Update deployed collaborative wellness model.

### 4.4.1.5 Action Plan Stage 4 Workshops

Workshop with group leaders to discuss group and inter-group processes:

- a. Identify synchronisation processes.
- b. Identify group roles, role interactions and performance issues.
- c. Select and adapt improvement strategies and measures.
- d. Reach agreement with leaders & knowledge creators to apply strategy.
- e. Apply measures to obtain a "before" snapshot of process states
- f. Apply improvement strategy, perform measures for an "after" snapshot.

### 4.4.1.6 Action Plan Stage 5

Analysis, Assessment and Reporting:

- a. Analyse/compare "before" and "after" collaborative wellness network.
- b. Assess improvements, issues, areas of refinement.
- c. Document and report benefits to study stakeholders.
- d. Outline future work and next steps.

Stage 5 is an important part of the action plan. The qualitative nature of the assessments and findings are the researcher's subjective opinions. To mitigate the issue of lack of objectivity, the advice of Davenport (2005, p. 49) is followed to seek opinions from other peer groups such as the stakeholders about the assessments and findings.

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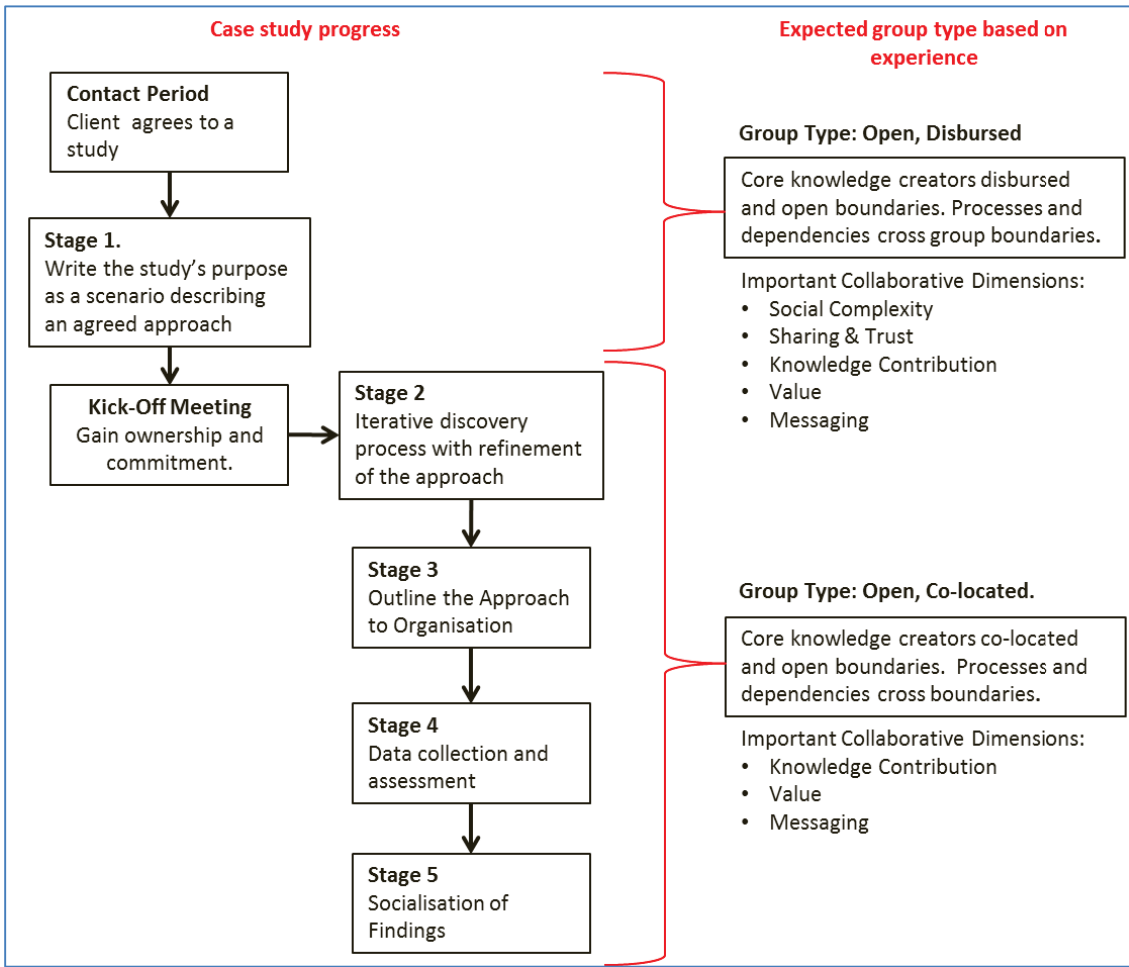


Figure 24 Changes in Group Type as Case Study Progress.

### 4.4.2 Context and Structure

Once an organisation agrees to host a case study, the researcher and client representatives negotiated a suitable management structure for reporting and socialising the case study progress. The structure adopted for the case study design was based on one put forward by Von Krogh, Nonaka & Rechsteiner (2012, p. 258 Fig 1) and is shown below in Figure 25. Here, the researcher was a participant-observer in the group of knowledge creators of the core activity layer and was a direct report to a boundary spanner (Fugate, Thomas & Golicic 2012; Peng & Sutanto 2012). The boundary spanner may be another group or an appointed representative between the conditional and core activity layers. In turn, another boundary spanning group or representative reports to the organisation's leadership. It was the intention that where feasible, existing management structures of the organisation be used so as to minimise disruption to business-as-usual activities.



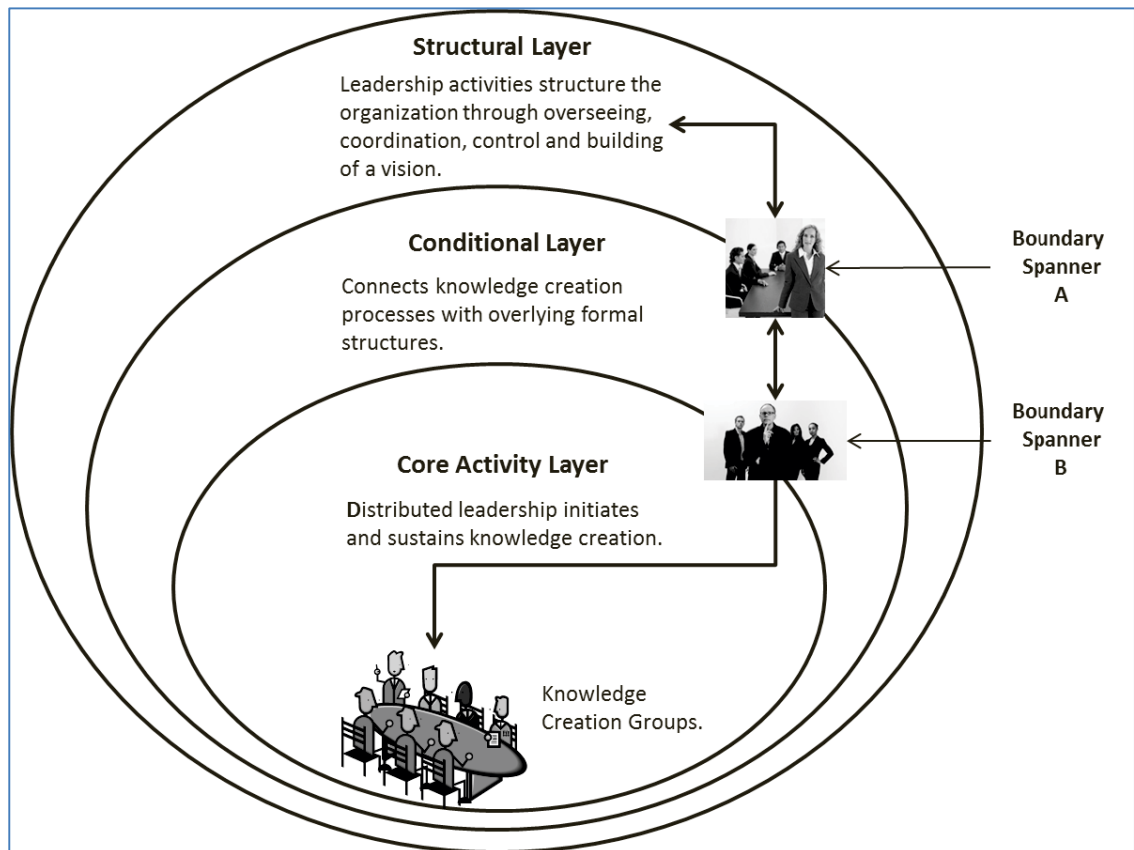


Figure 25 Case Study Context (Von Krogh, Nonaka & Rechsteiner 2012, p. 258)

The importance of establishing clarity in control structures lies in the nature of the type two wicked problem tackled by the group in the case study. Wicked problems are complex and often require intervention that may be outside of the remit of the case study. In this situation it is important to have clear reporting lines to minimise the time to adapt to new situations that require leadership intervention.

The case study was made up of two distinct collaborations. The first being the collaboration that performs the task of creating knowledge that the organisation can use in value co-creation activities. The second collaboration was the research effort of data gathering and analysis to verify the research proposals. The researcher acted as a “boundary spanner” (Peng & Sutanto 2012, p. 142; Williams 2011, p. 27) between the two collaborations and as a “participant-observer” (Silverman 2010, p. 29) by providing in-situ expert observation of knowledge creation activities.

#### 4.4.3 Case Study Purpose

The breadth and depth of both the literature review and nature of the collaborative wellness system meant that no one case study in my research could encompass all of the activities needed to verify the research proposals. The business theme discussed in a prior section may be summed up by the question “why has implementing new processes into well-established organizations proven to be problematical?” (Rose, Hawryszkiewicz & Kang 2014, p. 210). The case studies were

therefore concerned with the investigation of the impact of change through the introduction of new ideas and processes in the host organization. The case studies had to be carefully scoped and their purposes structured so that they complemented each other.

The purpose of the case study had a composite structure to cater for its dual collaborations. Firstly, the study had a purpose of providing a benefit to the host organisation and secondly, the study was to verify the research propositions by conducting trials involving changes to role alignments and observations of changes in collaborative wellness and outcomes. This created the necessity to clearly articulate the dual purpose and nature of the case study through socialising and gaining commitment to a joint value proposition. This joint value proposition was then deconstructed into joint value propositions designed to inform individual stakeholders and knowledge creators of their responsibilities, knowledge contribution assessments, and tracking value co-creation against expectations.

The interactions between the two collaborations had to be considered with a view to minimising the impact of an in-situ "participant-observer" (Yin 2009, p. 102 Fig. 4.1) based on the pragmatic acceptance that despite all efforts, a participant-observer did have some influence on the course of collaboration (Silverman 2010, pp. 29-30). The mitigation strategy of socialization of all findings and ensuring where possible the involvement of third party analysts was adopted to help minimize perceptions of bias. As discussed, the case studies were designed as participatory action research because each study was to deliver a benefit to the business host. In this way, the host was actively engaged in the case study's value proposition and its execution. This was highlighted in Woolworths' second case study involving the fuel reduction trials.

The action plan in Figure 23 on page 144 outlined the approach for writing the purpose as a scenario through the involvement and support of stakeholders. The scenario was a collection of narratives that described a set of possible "alternative futures" (Konno, Nonaka & Ogilvy 2014, p. 29) that may arise when undertaking the case study. This scenario detailed the agreed state of affairs at the start of collaboration and the desired completion state, and acted as the reference for developing a joint value proposition that was used in tracking the progress of the collaboration.

#### 4.4.4 Service Science and Value Proposition.

As shown in the action plan of Figure 23 on page 144, the first task in a case study was to negotiate a value proposition that was sufficiently persuasive to the potential host that they agreed to host the case study. Service Science concepts underpin the value proposition in that value is considered to be co-created in interactions between

the business and the case study collaboration. The value is derived through the use of the knowledge created by the case study. Progress assessments are based on the potential value of the created knowledge before being socialized with the client. The table below summarizes relevant service science concepts.

Table 23 Concepts in Service Science.

Concepts	Description
<b>Service Science</b>	Service science is the “study of service systems and of the co-creation of value within complex constellations of integrated resources” and “centres on the participants, processes, and resources that interact to create value in service systems” (Vargo, Maglio & Akaka 2008, pp. 145-6)
<b>Value Proposition</b>	A value proposition is seen as the glue of business social networks. A value proposition is an “aggregation or bundle of benefits” (Osterwalder & Pigneur 2010, p. 22) and may be successively deconstructed into “elementary value proposition(s)” that “describe different aspects of a value proposition” (Osterwalder & Pigneur 2003, p. 431).
<b>Value-in-use</b>	In the perspective of service science, the customer both perceives and determines value on the basis of use experience, this is, “value-in-use” (Lusch & Vargo 2006, p. 284). In this context, service becomes “the application of specialized competences (knowledge and skills) for the benefit of another entity, rather than the production of units of output” (Lusch, Vargo & Wessels 2008, p. 6). In this service science paradigm (Mahr, Kalogeras & Odekerken-Schröder 2013), the purpose of the collaboration is concerned with the potential to create value through use of the created knowledge.

#### 4.5 The Research Design

This section provides the design, tools and their use recommendations to support stages four and five of the action plan in Figure 23 on page 144. The discussion includes activities, measures and recording of findings to support an iterative assessment process. Previous sections emphasized that the deployed CWS has to be adapted and customised to suit the nature of a particular case study. So too, the measures and the associated activities need adaptation to each extant case study. Furthermore, as situations in the case study change, assessments may need to be revisited, different perspectives applied, and new measures or variations of measures used.

Supporting iterative processes requires careful consideration of the structure and instrument for recording measurements and assessments relative to the value proposition. Furthermore, the learning-by-doing approach involves not only modifying the deployed CWS, but incorporating feedback into the collaborative wellness system development. The research design must facilitate these adaptations. The next subsection describes how an instrument to meet these criteria.

### 4.5.1 The Collaborative Wellness Document (CWD).

The collaborative wellness document (CWD) formed a template for the recording instruments to be used in my research case studies. Instances of the CWD may be focused through the use of a collaborative aspects and concentrate on specific a perspective for measures, assessments, elements of value-propositions, and so on, to enable fine-grained tracking of the collaboration's progress. CWD's are linked to all entities involved in constructing the document. For example, a knowledge contribution assessment has both forward and back links to other assessments and links with the knowledge creator and their joint value proposition. The importance of linking lies in the need to understand the nature of cross dimension interactions and path dependencies of measures. The links form the collaborative wellness unit shown in Figure 13 on page 93.

The linking of CWD's to measures and assessments that, in turn, rely on lower level assessments used to assess the collaboration's state form a tree structure similar to the concept of "key performance indicator trees" (KPI trees) (Kronz 2006, p. 36). Lower level measures and assessments of narrow scope form inputs to higher-level measures of broader scope. Together, they form a comprehensive assessment of collaborative wellness. This abstracted system reflects the patterns of the human-centric collaboration that it is derived from.

I considered the question as to how should the collaborative wellness document (CWD) be structured. A pragmatic choice was made to base the CWD on the well-used and proven business use-case. The business use-case has been employed for writing functional requirements for object-orientated software systems and business process work (Cockburn 2000). It is a familiar tool to myself and was well regarded by the businesses I dealt with. A business use-case is defined as "a description of the possible sequences of interactions between the system under discussion and its external actors, related to a particular goal" (Cockburn 2000, p. 15) and acts "as a sort of 'hub' that links together different sorts of information" (p. 89). From the perspective of the stakeholder, the business use-case "represents an agreement between the stakeholders in a system about its behaviour" and "shows the different ways in which the actors act to either achieve the interests of each stakeholder, or fail in an agreeable fashion, under a specific triggering condition" (p. 44). A business

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use case documents a process and is about an actor achieving a goal. An actor may be a human, a computer system or in its most general form, anyone or anything capable of having a behaviour (Cockburn 2000). It is a description of a “system-in-use” (p. 18) dealing with the “interactions between a system and actors in its environment” (Some ´ 2006, p. 44).

The necessity of introducing the interests of stakeholders creates a degree of uncertainty in business use cases because of the possibility of competing agendas amongst stakeholders. One or more pragmatic decisions may be required to either include or exclude some stakeholders and their competing agendas from the CWD. In this light, the CWD should be treated as a partial description of the system-in-use. To cope with this uncertainty the different perspectives of stakeholders can be included as separate CWD’s. On the other hand, alternative action scenarios may be added in the CWD for investigation and decision on whether to include or exclude them according to case study experience. In any event, socialisation with identified stakeholders is essential for the successful development and acceptance of the CWD’s. Based on this discussion, the following definition was used for the collaborative wellness document.

*The collaborative wellness document (CWD) is a partial description of a collaborative wellness system, that is, it is a description of interactions between CWS and actors in its environment as agreed by relevant stakeholders. An actor is any entity likely to affect collaborative wellness.*

Table 24 below, shows the general structure of the CWD. It is customised to suit the particular situation of a case study and the nature of what is being recorded. Standard IT tools are used whether cloud sourced or stand-alone such as a spreadsheet, word processor or database utility to host and maintain links between CWD’s. Structural simplicity of CWD and links is required to ensure that complications in implementation do not obscure or hide behaviours and patterns crucial to the research and business outcomes.

Table 24 The Collaborative Wellness Document. Based on Cockburn (2000)

CWD Entry	Description.	Context and Examples
Title:	a label that uniquely identifies the CWD	The Name of the measure, purpose, value-proposition or assessment.
Type	Type of process	For example “Role-in-use alignment measure”, “knowledge contribution assessment”.

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CWD Entry	Description.	Context and Examples
	Type of communication	Email, telephone call, meeting, virtual meeting and so on.
Scope:	The domain of the collaboration.	Scope may be at the level of a "knowledge creator" or "group"; and so on. If appropriate, the scope includes the time, place and immediate circumstances.
Key Words:	Insert key words or phrases for use by search tools.	Keywords can be used to augment categorising and typing of the CWD.
Primary Actor:	The actor using the process.	For example, the researcher in the role of an assessor or sender of an email or convenor of a meeting.
Secondary Actor:	Provides a service necessary for the performance of this process. A secondary actor in one CWD may be a primary actor in another CWD.	For example, In the case of a role-in-use alignment assessment it would be the knowledge creator who had been assessed.
Goal:	What the process is going to do "NOW".	The process description should include a requirement to describe the relevant context and when the measurement should be conducted.
Goal Level:	Applies where there are sub CWD's. Use to identify the position of the CWD and subsidiary CWD's.	Use to indicate how this current CWD relates to lower level assessments and measures
Actors:	All actors (human and non-human, physical, virtual or incorporeal) required to participate in achieving the goal.	Collaborative Wellness entities that participate in the process or exert causality on the process. For example two actors in conversation and an observer who may influence the conversation. Or the people copied in on an email.

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CWD Entry	Description.	Context and Examples
Includes:	Higher-level CWD's contain the name of the lower-level CWD's.	Links to lower level CWD's such as measures and assessments.
Narrative:	Short, concise description of the process.	For example it may be the scenario developed for the collaboration's purpose.
Precondition:	Must be true before the CWD can be performed or used.	Dependencies that must be satisfied before this CWD can be performed. For example, it could be for a knowledge contribution assessment that is dependent upon a role-in-use alignment assessment.
Steps:	Steps may be an ordered combination of tasks for the current process or sub-processes (CWD's).	Assessment or measurement components.
Alternatives:	Either a set of alternatives that apply to all the steps in the CWD; or a possible alternative scenario that achieves the same goal.	For example using different perspectives for data triangulation, or outlining different steps for selected stakeholders.
Success End Condition	Primary: Goal satisfied. Secondary: stakeholder interests satisfied.	When successful, perform other CWD's. For example, current CWD maybe a milestone decision that approves the start of the next improvement cycle.
Failure End Condition	Process failed to reach goal, initiates failure management CWD's.	Alternative CWD to perform in the event of failure of the steps in this CWD. For example, a re-assessment of source information.
Post condition:	Must be true at the end of the CWD. It is important to indicate whether or not a CWD is performable. Subsidiary CWD's involving remedial actions can developed and verified.	The success and failure conditions assume that the CWD can be performed. If for example a measure cannot be performed (knowledge creator on leave, information not received, and so

CWD Entry	Description.	Context and Examples
		on) then an alternative CWD could be performed.
Failure Scenarios	The CWD has been performed, but the goal was not achieved. This entry refers to CWD's to be undertaken in the event of failure.	This is seen as providing for additional CWD's in the event of failure. It is dependent upon the nature of the study.

Each performance experience of a CWD is to be recorded as a date and time stamped performance document linked back to the CWD. The format of the history follows that of its parent CWD and is decided at the time of deployment of the collaborative wellness system. Table 25 below has a suggested format of the case study history that follows the CWD of Table 24 above. The CWD performance history provides context and additional insights into understanding current activities. This is an additional and necessary record for CWD's (assessments, measures and so on), particularly in tracking patterns of collaboration change. Furthermore, the CWD and associated performance histories provide a network of searchable links for supporting qualitative analyses. Careful consideration is required when establishing a case study to ensure the linked structures do not become unnecessarily complicated to the extent of making pattern analysis difficult and error prone.

Table 25 Performance History of a Collaborative Wellness Document.

CWD Case Entry	Performance Entries
Title:	The Name of the CWD being performed.
Scope:	Any issues concerning scope encountered during performance of the CWD. For example, an interview assessment had to be made out-of-office hours.
Key Words:	Can be used to categorise the performance of the CWD or unusual circumstances.
Primary Actor:	The actor performing the CWD, for example, the researcher as the assessor.
Secondary Actor:	For example, in the case of a role-in-use alignment assessment it would be the knowledge creator who had been interviewed.
Goal:	What was achieved in the current performance of the CWD? For example, a role-in-use alignment assessment



CWD Case Entry	Performance Entries
	was completed successfully and the outcome was an acceptable role-in-use alignment. The date and time of the assessment would be highlighted.
Goal Level:	This is a link to the parent CWD.
Actors:	Collaborative Wellness entities that participate in the CWD or exerted causality on the CWD.
Includes:	Links to lower level CWD's (if any)
Narrative:	A brief description of the performance and outcome.
Precondition:	Describe preconditions and note issues leading up to this performance.
Steps:	Outcomes of steps taken and note of any additional steps or exceptions
Alternatives:	Alternative approaches considered and decisions made with reasons.
Success End Condition	A list of CWD's performed if successful outcome.
Failure End Condition	A list of CWD's performed in event of failure.
Post condition	Actions taken in event CWD could not be performed.
Failure Scenarios	List of additional CWD's performed if appropriate for study

The CWD and its performance history are designed as general purpose document structures for a case study. Group types can range from co-located closed to virtual world collaborations (see Figure 15 on page 105), so the structures are tailored to each study and simplified to the minimum structure that supports the objectives of the study.

#### 4.5.2 Deploying the Collaborative Wellness System

Deciding how to deploy the collaborative wellness system and the strategy for discovering the collaborative wellness network will, in large part determine what can be measured, how it can be measured and the form of the qualitative assessments. In this light, the deployment and discovery process are detailed in these two sub-sections before considering the measures.

During deployment, the CWS is configured using the methodology of Design Science Research (DSR) (Gill & Hevner 2011). DSR is a tool that helped to ensure consistency; transparency; and reliable replication of CWS in the various

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collaborative studies. Using DSR, the deployment process became a series of layered iterative activities. Figure 26 below shows an interpretation of the activity layers for deploying the collaborative wellness system.

Consider the choice and deployment of CWS to suit a group situation. The top level of the three tier DSR hierarchy is called the “design space” (Gill & Hevner 2011, pp. 238,9 Fig. 1) and contains all possible configurations of CWS and measures for all types of group collaboration. The middle tier is the “Design Artefact Layer” (p. 238) and contains the selected CWS with measures adapted for the in-situ group collaboration. Once configured, CWS and its measures are deployed to the “Use Artefacts Layer” (p. 238). This last layer represents the application of CWS and measures to suit a particular collaboration.

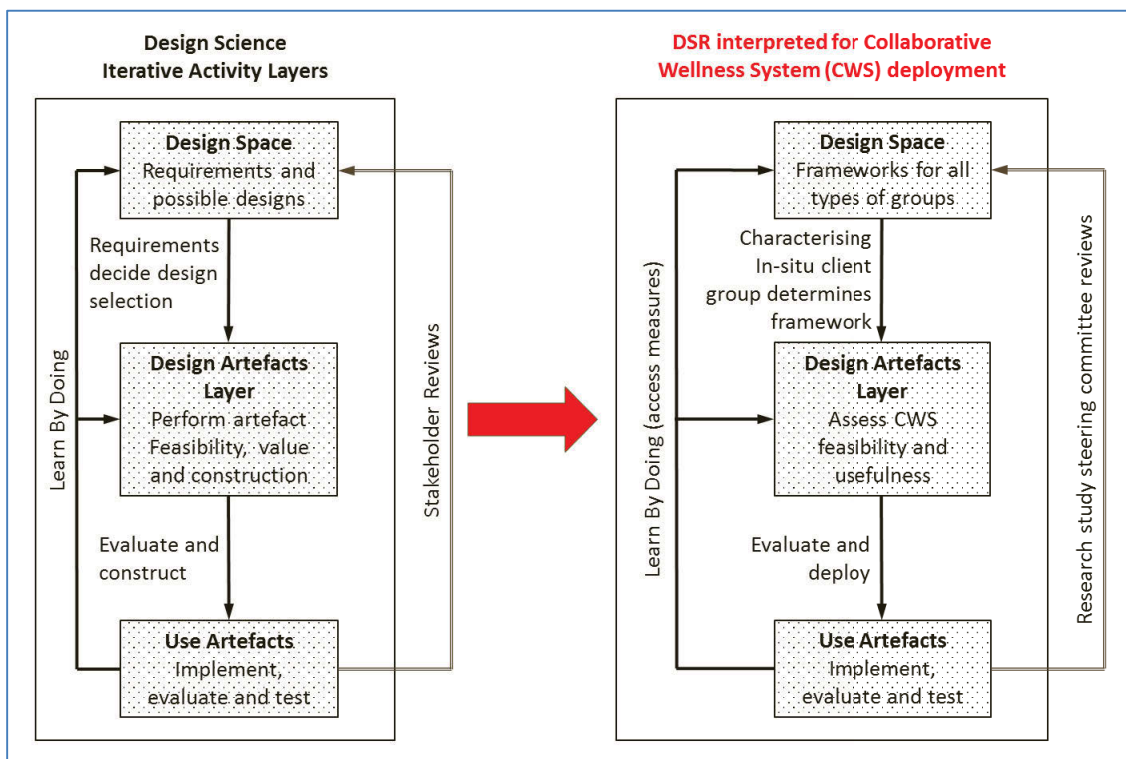


Figure 26 DSR Activity Layers (Gill & Hevner 2011, p. 239 Fig 1) for CWS.

There is a diverse range of group situations and possible configurations for deploying CWS. Deployment is a learning-by-doing iterative approach with assessments during each iteration as to the appropriateness of configurations and measures in supporting collaborative wellness assessments.

In considering the action plan in Section 4.4.1 on page 143, DSR’s design space is the outcome of stage 1 shown in Figure 23 on page 144. In stage 1, the purpose of the case study is negotiated with the host organisation. This negotiation ranges over all possible value propositions that populate the DSR design space shown in Figure 26 above. The value propositions in the design space include all of the possible types

of collaborations, the possible knowledge creators available to the organisation, resources and technology support available to the study. Additionally, the Design Space includes the range of possible knowledge artefacts that may be created and potential values to be derived from their use.

The refinement process of Stage 2 of the action plan has the goal of presenting a joint value proposition for socialisation and acceptance by the stakeholders and participants in stage 3 of the action plan. Stages 2 and 3 therefore represent a move to the Design Artefacts layer of DSR in the above figure. Stage 3 of the action plan is for evaluating and deploying in DSR as the value proposition moves from the design artefacts layer to the use artefacts layer. Finally, Stage 4 is the implementation of the collaboration in the Use Artefacts layer and Stage 5 is the analysis, verification, assessment and value creation of the Use Artefacts layer.

All of these processes are iterative within and between stages in the action plan and between layers of the DSR funnel of Figure 26 above.

### 4.5.3 Discovering the Collaborative Wellness Network.

The action plan outlines a process for discovering the collaborative wellness network (see section 3.9.7 on page 124 and Figure 23 on page 144). The discovery aspect of the action plan are the activities in the Design Artefacts layer of the DSR diagram in Figure 26 on page 156. The process is iterative and similar to the snowball sampling methodology (Atkinson & Flint 2001) used in the literature review. It begins with an investigation of organisational information that includes organisation charts, business plans and corporate communications, collaboration designs, supporting technical information, knowledge creator skill sets, role specifications, and so on. Examination of these documents leads to identifying collaborative wellness units that could be considered for membership in the collaborative wellness network (CWN) and the relationships between them. The discovery process is based on the methodology for narrative strategies (Konno, Nonaka & Ogilvy 2014; Ogilvy, Nonaka & Konno 2014). Once the approach has been socialised and agreed too, the group and if appropriate inter-group processes are identified and knowledge creators, contributors and managers interviewed. This starting point is treated as a baseline for comparisons with in-situ observations of collaborative processes and knowledge creators with a view to discovering the actual "what is" (see Figure 6 on page 17) and then the collaborative wellness network.

During discovery, knowledge creators, groups and/or systems in the collaborative wellness system may be conveniently treated as black boxes. The inner workings of "black boxes" are opaque to the discoverer and the focus is on the messaging inputs and outputs to these "black boxes" (Miller 1971, p. 357), this stratagem allows the discovery process to concentrate on the influence of the presence of the black box.

Black-boxing is ideal in situations where observations infer the presence of an unknown system in CWS or as a way of simplifying the structure by grouping entities that act as a single block.

### 4.5.4 What to Measure

The case studies had the task of verifying the research propositions. This required measuring the collaborative wellness of a collaboration as it progresses toward fulfilling its purpose. The collaborative wellness of a group in the case study collaboration was a high level measure that arose from lower level measures devised from the empirical dimensions of collaboration (section 2.2.1 on page 16).

In the previous chapter a composite measure of collaborative wellness was devised and this was used to satisfy the pragmatic time and resource constraints of my case studies. In this context, collaborative wellness was defined as an assessment of the current state of a collaboration based on knowledge creators' degree of requisite variety, alignment of roles-in-use, and the usefulness assessment of knowledge contributions (see sections 3.9.3 on 119 and 3.9.4 on page 120).

Group collaborations in the case studies were characterised by showing the expected volumes and types of messaging, meetings and documents (Figure 22 on page 141). These items are related to the dimensions of collaboration and their measures in Figure 27 below. The measures in the figure are based on cognitive distance measures discussed in the literature review (section 2.10 on page 69), capacity and utilisation measures (section 2.14.3 on page 87), and measures devised for requisite variety (section 3.9.5 on page 121). Measures for tracking knowledge emergence (section 3.8.9 on page 116) of knowledge contributions (section 3.8.6 on page 113) are an elaboration of "Linkography" (Goldschmidt 1990, p. 291; Goldschmidt 1995, p. 195). The CW measures were chosen according to the context of each case study.

The type of the group (Figure 15 on page 105) determines the principal measures for the initial focus of in-situ observation and assessment. The core of the case study was the assessment of knowledge creator role-in-use alignments and how changes in these alignments affected the outcome of the study. Therefore it was primarily a matter of deciding how to track the collaboration's activities and then applying the measures to inform assessments of collaborative wellness. Knowledge includes not only the knowledge created in accordance with the collaboration's purpose but also those knowledge documents in the organisation's possession that would or could aid knowledge creators in fulfilling the purpose of the group. All knowledge should be assessed for their usefulness relative to the purpose of the group.

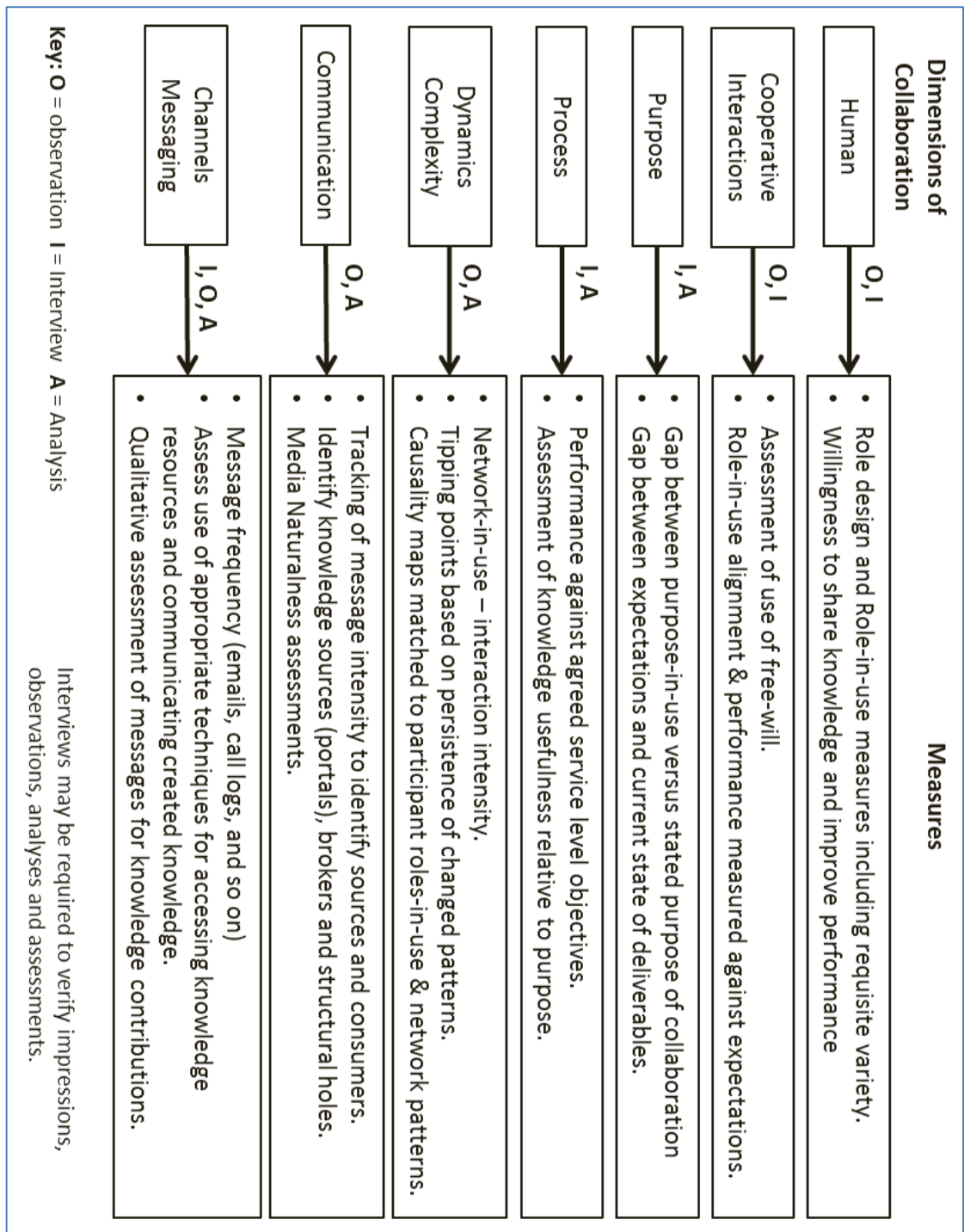


Figure 27 Collaborative wellness measures based on Rose (2013, p. 427 Fig 5)

The measures inform the iterative assessment, refinement and value co-creation processes. As such, they belong in the Use Artefacts layer of the DSR knowledge funnel in Figure 26 on page 156. The values and assessments derived from an iteration in this layer will inform the next refinement-deploy-use iteration.

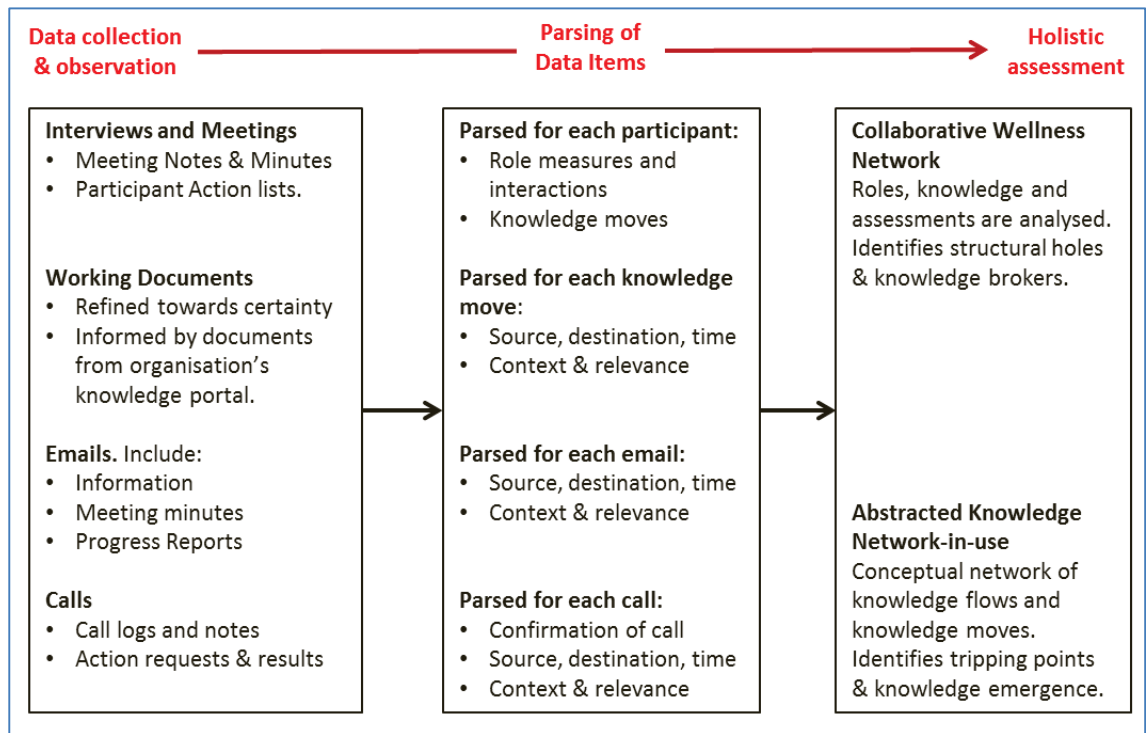
#### 4.5.5 How to Measure

The principle of the collaborative wellness assessment process was given in section 3.9.9 on page 126. The approach to implementing this process is qualitative following guidelines outlined in the collaborative wellness documents (CWD) and carefully recording all assessments and judgements so that all information used in an assessment is available for re-assessment as required. Highlighting the literature review and theory development, the case studies did not include simplifying assumptions and averaging that had been applied to large collaborations. Furthermore, the anticipated volumes of data, messages, documents based on experience were relatively low and judged to be insufficient for using automated text analysis tools.

As discussed in previous sections, the researcher acted as a participant-observer in a group collaboration which was characterised as a complex adaptive social system in which knowledge creators exercised free will in the way they adapted to changing circumstances. In these situations, activation of tipping points can result in emergent behaviours (Batie 2008). Emergence signifies a discontinuity as knowledge creators recognise and adapt to the new situation. To recognise these complex behaviours the research adopted a test put forward by Ronald, Sipper & Capcarrère (1999) as discussed in section 2.5.1 on page 25. The essence of this test was that an expert observer is surprised (a qualitative assessment) by the macro behaviour of the system. It was anticipated that the problems tackled by the case studies, in line with my previous experience, would be type two wicked problems (see sections 2.3.1 and 2.3.2 on page 19). This meant that to a lesser or greater extent each case study would have unique elements. This implied that lessons learnt from one study required careful evaluation before being applied to the context of other studies.

Measures in the communication and relationship dimensions require parsing of message's semantic content. Parsing of messages, particular verbal, to identify informative and useful content relies upon an in-situ observer with expertise in the subject matter of the message. Before parsing can take place, the message needs to be validated and once validated assessed for its "informativeness and usefulness" (Davenport & Prusak 1998, p. 4) to determine if it is a knowledge contribution (see section 3.8 on page 107). Face-to-face co-located groups rely on assessments of in-progress socialisation. If the collaboration was disbursed, then the means of socialisation would need to be considered. In particular, if socialisation is mediated by technology, then "Media Naturalness Theory" (Peng & Sutanto 2012, p. 145) would be useful to consider how the appropriateness of technology choices affects the knowledge contribution and collaborative wellness.

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**Figure 28 Implementing the Collaborative Wellness Assessment Process**

The above figure is a synthesis of three interlinked and interdependent phases of measurement activities. The data, information and knowledge documents of Figure 22 on page 141 are passed and assessed using the measures of Figure 27 on page 159 and populated to the collaborative wellness network for further analysis.

As discussed, the parsing process of the knowledge contribution assessment is similar to techniques used in linkography to identify the “design moves” (Goldschmidt 1990, p. 292). Goldschmidt (1995) extended linkography and its parsing process to the group level. The collaborative wellness system (CWS) extends Linkography’s parsing to all message interactions irrespective of media format and times between communications. The design moves in linkography become knowledge assessments and their links trace not only the development of ideas during the collaboration but also how the ideas were developed, that is through face-to-face socialisation, email exchanges and/or individual reflective thinking. The Collaborative Wellness Documents (CWD) were prepared for each of the measures and classes of measures when the collaborative wellness system was deployed for the case study.

The methodology in this section is pitched at a fine granularity of detail. It is both manual and qualitative and depends upon the expertise of the participant-observer. The methodology supports a learning-by-doing approach. The research design supports detailed tracking and impact analysis when re-assessments are necessary.

#### 4.5.6 How to Interpret

In this qualitative research, the case study produced a narrative made up of a series of stories that together constituted an unfolding account of sequences and events of the study. The study was therefore a focus on process that helped “to reveal how an issue evolves, a conflict emerges or a social relationship develops” (Neuman 2011, p. 177). The revelations of process events depend upon interpretation, “to interpret means to assign significance or coherent meaning” (p. 177). In the collaborative wellness case study context, it was not each measure of a collaborative wellness dimension that was important, rather it was the interactions between the dimensions that were important. The measures and values were required to show how the interactions and relationships between the dimensions of collaboration affect outcomes.

Table 26, below, describes the orders of interpretation and their context in the collaborative wellness assessment of a knowledge contribution’s usefulness. These orders of interpretation form a convenient way to organise the explanation of the design for data collection and analysis.

Table 26 Orders of Interpretation. Based on Neuman (2011, pp. 177-8)

Interpretation	Neuman’s Description	Collaborative Wellness
First Order	“People who create social activities and behaviours have personal reasons and motives for what they do” (p. 177).	Knowledge creators interpret their roles and exercise free-will in deciding how to occupy and perform their roles. They have the confidence in being able to contribute to the fulfilment of the collaboration’s purpose.
Second Order	“The human action being studied is placed into the stream of behaviour or events to which it is related: its context” (p. 178).	The assessment of a knowledge contribution’s usefulness relative to the purpose of the collaboration is performed and placed in context of the collaboration’s progress.
Third Order.	Researchers assign general theoretical significance to the second order interpretation.	The assessments are placed in the broader context of the collaborative wellness system to inform not only the improvement of the current study but be part of an experience-base for reference in future studies.



#### 4.5.7 Examples of Applying the Collaborative Wellness Document.

The research design chapter serves as a guide to implementing the CWS to the particular situation of a case study. This subsection provides some further guidance on using the collaborative wellness documents (CWD) and associated performance histories for sample situations involving knowledge contributions, requisite variety, and a value proposition.

##### 4.5.7.1 Knowledge Contribution

The forward and backward links of knowledge contributions are based on Linkography (Cai, Do & Zimring 2010; Goldschmidt 1990, 1995). In particular, the concept of effective emergence of a knowledge contribution (see section 3.8.9 on page 116) requires the backward knowledge contribution links to trace from the current to the original knowledge move. The “includes” section of the CWD performance history can refer to the last knowledge contribution assessment. In this way, the knowledge contribution linked list can be traversed relatively easily. For simplicity, forward and backward links are maintained to simplify searching.

##### 4.5.7.2 Requisite Variety Assessments

The requisite variety assessment is an example of a hierarchy of CWD performance histories. Section 3.9.5 on page 121 on assessing requisite variety included a table of measures that could be used to assess requisite variety of a role-in-use. It was noted that using multiple measures as perspectives enables data triangulation and helps improve the precision associated in assessing requisite variety. This creates a hierarchy in which lower level measures provide input into the higher-level assessment. In this situation, the lower level performance histories of the measures would have a link in the “includes” field back to the parent record, which creates a “parent-child” relationship that can be explored using tools such as a modern spreadsheet or database.

##### 4.5.7.3 Joint Value Propositions

The joint value proposition is a special instance of a CWD. Although there are several alternatives available for organising the CWD structures, it is best to start with a simple arrangement. The “narrative” entry of the CWD contains the scenario describing the value-proposition and the possible future states depending on the outcomes of the collaboration (see section 3.8.4 on page 110). Each entry in the “steps” section contains a link to a joint value proposition that relates the responsibilities of a knowledge creator to their knowledge contributions and the stakeholders.

The deconstructed joint value proposition CWD has a scenario describing an aspect of the value-proposition and the steps contain the requirements to be satisfied for the stakeholders to realise the value-in-use of this deconstructed value proposition.

The arrangement of directly linking deconstructed value propositions with their requirements for value realisation creates a structure for tracking value-in-use potential and then actual value-in-use by means of linked performance histories.

### 4.6 Conclusion

In this chapter, the design for deploying the collaborative wellness system has been developed. The design was necessarily a series of guidelines owing to the diverse nature of group collaborations and the variety of possible deployment scenarios.

A feature of the research design is that the Collaborative wellness Document (CWD) and its performance history also applies to the research design. It is intended that the CWD template and attendant performance histories be used to inform improvements in the research design. The next chapter covers the deployment of the research design and its application in the case studies in order to verify the research proposals.

## **Chapter 5 Case Study Experiences.**

Four case studies were undertaken to verify the research propositions and the use of the Collaborative Wellness System (CWS). A prime objective in the case studies was to identify good collaborative practices that would form the basis of a scale for comparing knowledge creation collaborations and processes.

This chapter begins with an overview of the case studies that includes a summary of experiences and a comparison with the action plan and expectations detailed in the research design chapter. The experiences of the four case studies are discussed and synthesized to verify the six research propositions and answer the research question. Findings are used to identify good collaborative practices to form a basis for a collaborative wellness rating scale. A compendium of questions is provided to guide the application of the comparative scale. The final section outlines how CWS can be used as a socialization and investigative tool in studying collaborations.

### **5.1 Introduction**

The four case studies were conducted over the period from January 2012 to December 2013. The Collaborative Wellness System (CWS) incorporated feedback from the experiences of three case studies, one at a State Government Agency (SGA) involving the implementation of an inter-group on-line reporting system (Rose 2013), and two case studies hosted by Woolworths Limited that focussed on the implementation of new ideas (Rose, Hawryszkiewicz & Kang 2014). The fourth case study, hosted by a Commonwealth Government Agency (CGA) (Rose, Hawryszkiewicz & Kang 2015) made use of CWS for investigating issues identified by CGA in their IT services department (see Appendix for an excerpt of the Issue Summary report on page 210).

The research purpose of the case studies was to conduct a trial on a collaboration engaged in knowledge creation for product or process innovation. The independent input of role alignment would either be varied or observed as it changed during the progress of the collaboration. Any changes in the dependent collaborative wellness would be observed and investigated (see Figure 20 on page 127). The same trial was performed in each case study with the different organizational contexts providing opportunities for data triangulation (Runeson & Höst 2009). Where possible, assessments were sought from other knowledge creators and stakeholders in the hosting organizations to help overcome the potential bias introduced by my presence as a participant-observer. The negotiated business purposes are shown in the table below and the conduct of the case studies are summarized in the next section.

All four case studies were performed under the same approved UTS ethics guidelines (Rose 2012) and negotiated according to the action plan guidelines on page 144. All

case studies were designed to deliver an agreed benefit to the host organization. The CGA case study was funded by a grant from the Industry and Innovation Project Scheme of the University of Technology, Sydney.

Table 27 Case Study Business Purpose Overview

Case Study	Negotiated Purpose
<p><b>NSW State Government Agency (SGA) Process Facilitation Study.</b> (Rose 2013)</p> <p>First Contact: 22/Aug/2012.                      Agreement: 20/Dec/2012.                      Report presented: 7/Jun/2013.</p>	<p>Devise strategies to facilitate collaboration and performance of processes supporting SGA systems. (Appendix p. 209).</p>
<p><b>Woolworths Limited Logistics Cost Extraction Study.</b> (Rose 2013; Rose, Hawryszkiewicz &amp; Kang 2014)</p> <p>First Contact: 4/Jan/2012                      Agreement: 15/Mar/2012.                      Report presented: 6/Jul/2012.</p>	<p>Devise cost extraction ideas for the Woolworths logistics business in the context of a retail distribution center. (Appendix p.209)</p>
<p><b>Woolworths Idea Process Study.</b> (Rose, Hawryszkiewicz &amp; Kang 2014, 2015)</p> <p>First Contact: 8/July/2012.                      Started: 8/Feb/2013.                      Report presented: 29/Oct/2013.</p>	<p>Devise and recommend methods to improve the management of ideas, information and utilization of knowledge in the logistics business unit. (Appendix p.210)</p>
<p><b>Commonwealth Government Agency</b> (Rose, Hawryszkiewicz &amp; Kang 2015)</p> <p>First Contact: 26/Mar/2013.                      Started: 23/Jul/2013.                      Report presented: 12/Dec/2013.</p>	<p>Categorize and recommend solution approaches for the top three issues nominated by each of the eight teams in the IT Delivery Services department engaged with the external facing departments of CGA. (Appendix p. 210)</p>

## 5.2 Case Study Activity.

The case studies were intended to be of three to five months duration. However, the necessity to minimize impacts to business-as-usual activities reduced case study priorities and meant that elapsed times were greater than estimates. Case study collaborations were expected to be face-to-face with knowledge creators sharing data, information and knowledge. It was assumed that I, as the participant-observer, would collate, synthesize and present findings with clear approbations to contributing knowledge creators. In fact, the low priority of the studies created difficulties in arranging meetings with key personnel with the result of greater than expected reliance on email communication and my role of “boundary spanner” (Williams 2011, p. 27) for distributing, socializing and coordinating information. In the second

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Woolworths' study the boundary spanner role was extended to cover managing a project for verifying fuel savings (Rose, Hawryszkiewicz & Kang 2014).

Structures of the research collaboration alternated between group types of open/co-located for meetings and interviews and an open/distributed type for emails and telephone conversations (see Figure 15 on page 105). These changes in group type resulted in activity counts and elapsed times differing from the expectations shown in Figure 22 on page 141. The counts were also affected by the necessity of confirming receipt and understanding of emails. The times taken to negotiate each study in the contact period were also longer than anticipated as the onus was on myself to devise and negotiate the value proposition, rather than just presenting a persuasive argument to the business to show that I could satisfy their value proposition.

Table 28 Case Study Activity 4/Jan/2012 to 12/Dec/2013.

Stage	Activity	NSW State Govt. Agency (SGA)	Woolworths Limited Cost Extraction Ideas (Woolworths No. 1)	Woolworths Limited Idea Management (Woolworths No. 2)	Commonwealth Govt. Agency (CGA)
<b>Contact</b>	Period	22/Aug/12 to 9/Nov/12	4/Jan/12 to 7/Feb/12	Follow-on study. Agreed on 6/Jul/12	26/Mar/13 to 18/Jun/13
	Email	6	15		23
	Meeting				1
<b>Stage 1</b> Value Proposition	Period	9/Nov/12 to 16/Jan/13	15/Mar/12 to 16/Apr/12	8/Feb/13	23/Jul/13 to 9/Aug/13
	Email	38	18		18
	Kick-off meeting	1	1	1	1
	Meeting	1	1		1
<b>Stage 2</b> Deploy framework	Period	16/Jan/13 to 19/Mar/13	17/Apr/12 to 17/May/12	8/Feb/13	16/Aug/13 to 24/Sep/13
	Email	15	16	1	27
	Meeting		2		2
	Phone		3		
	Mail		2 Signed agreement exchanges		
<b>Stage 3</b> Socialize approach	Period	20/Mar/13 to 21/Mar/13	17/May/12	12/Feb/13	25/Sep/13 to 26/Sep/13
	Email	5			1
	Meeting	1	1	1	1
<b>Stage 4</b>	Period	25/Mar/13 to 13/May/13	18/May/12 to 5/Jul/12	12/Feb/13 to 4/Jul/13	26/Sep/13 to 6/Nov/13
	Email	112	57	146	39

## Collaborative Wellness Through Dynamic Role Alignment

Stage	Activity	NSW State Govt. Agency (SGA)	Woolworths Limited Cost Extraction Ideas (Woolworths No. 1)	Woolworths Limited Idea Management (Woolworths No. 2)	Commonwealth Govt. Agency (CGA)
Collect & Assess Data	Meeting	11	5 workshops	2	1
	Phone			3	
<b>Stage 5</b> Socialize findings	Period	14/May/13 to 7/Jun/13	5/Jul/12 to 12/Jul/12	5/Jul/13 to 29/Oct/13	6/Nov/13 To 12/Dec/13
	Email	20	10	62	15
	Meeting	1	1	1	1
<b>Totals</b>		<b>211</b>	<b>132</b>	<b>217</b>	<b>133</b>
<b>Elapsed Time</b>		<b>9.5 months</b>	<b>6.25 months</b>	<b>16 months</b>	<b>8.5 months</b>

Based on my practical experience, I assumed that during the case studies I would have full access to the knowledge portal of the organization and be able to access all information pertinent to the case study. However, in all four case studies, security clearance for accessing the organization’s knowledge portal was not granted. Access to knowledge was negotiated through intermediaries and then either emailed or handed to me during meetings. The effect of this arrangement was to impose a filter that prevented background and follow-up exploration of organizational information. At the time of the studies, the impact of this arrangement on the course of the studies could not be assessed.

### 5.3 Verifying the Research Propositions

The case studies were intended to answer the research question developed in section 3.10 on page 127 by verifying the research propositions shown in Figure 29 below. Answering the research question in the affirmative requires that all six propositions be verified. The propositions act as perspectives to view and discuss events. The research design intended that the four case studies were to provide different contexts in which to perform a trial of varying or observing the variation of the alignment in roles-in-use and then studying changes in outcomes. The case study experience supported this approach as the collaborative wellness network “displayed similarities in their patterns. This similarity helped in identifying common issues” between the studies (Rose, Hawryszkiewicz & Kang 2014, p. 429).

Collaborative Wellness and the use of its framework and measures was described in a paper presented at the ECMLG conference in 2013 (Rose 2013). The Woolworths’ studies gave valuable feedback for further development of CWS and were described at the ACIS 2013 conference (Rose, Hawryszkiewicz & Kang 2013) and later published with Woolworths’ support (Rose, Hawryszkiewicz & Kang 2014). The study

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at the Commonwealth Government Agency (CGA) was used to verify the use of CWS for investigating IT issues identified by CGA (Rose, Hawryszkiewicz & Kang 2015).

In all case studies, once the joint value position had been agreed, the hosting organization arranged the logistics of the case study, selected and appointed staff to either participate in the study as knowledge creators or act as on-call contributors. The host organization exercised an overview and facilitation role through an appointed senior manager. In all studies, the role interactions by knowledge creators “reflected long term, familiar working relationships and identification with corporate culture and values” (Rose 2013, p. 429). It was assumed that collaborative dimensions such as cultural traits, trust and willingness to share did not play significant parts in determining outcomes.

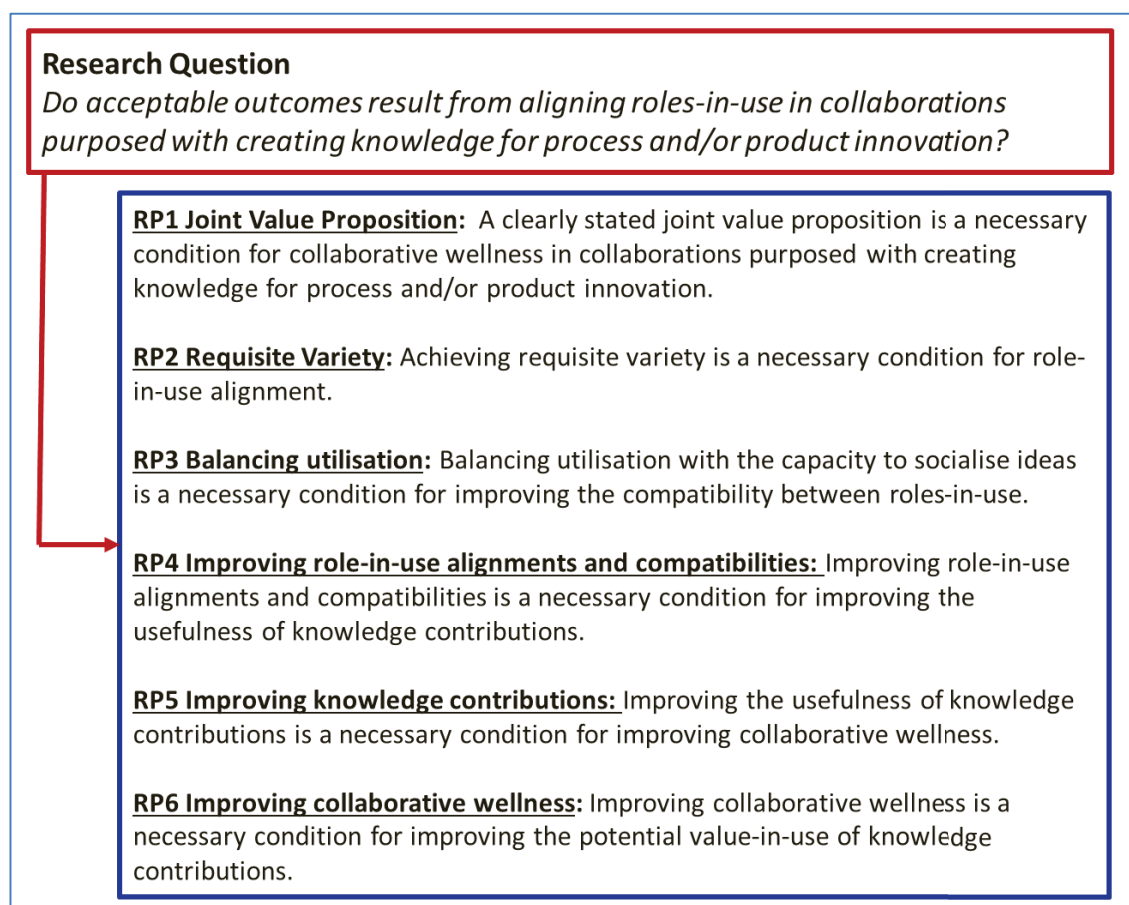


Figure 29 Research Question and Research Propositions

After completing the SGA study and Woolworths Limited’s first study it was evident that my role as a participant-observer was more active than originally intended. My active role stemmed from the belief, bolstered by experience, of the importance of commitment and delivering on agreed value propositions. However, the qualitative assessments and my role-in-use raised a concern from the research perspective about the introduction of bias and consequently, the need for greater objectivity and process transparency. The “Transport fuel reduction idea” (Rose, Hawryszkiewicz &

Kang 2014, p. 2 Table I) collaboration addressed this concern by ensuring independent assessments and endorsement of findings by Woolworths. This collaboration established a basis for determining acceptable collaborative wellness.

### 5.3.1 RP1: Joint Value Proposition

*RP1: A clearly stated joint value proposition is a necessary condition for collaborative wellness in collaborations purposed with creating knowledge for process and/or product innovation.*

A knowledge creation collaboration may have one or more joint value propositions. For the sake of pragmatism, the term joint value proposition encompasses the set of one or more joint value propositions derived by stakeholders to express the purpose of the collaboration (see Figure 17 on page 111); it also includes any deconstructed joint value propositions. Collaborative Wellness is an assessment of the gap between a collaboration's current state and the state that would come about if the joint value proposition were fulfilled.

The joint value proposition must give clarity to the answers of the questions associated with the dimensions of collaboration (see Figure 6 on page 17), namely "Who" (social dimension), "How" (the process dimension) and "With what" (the means dimension). From the perspective of the collaborative wellness system, the joint value proposition must be a clear statement of how the collaborative wellness unit (see section 3.9.7 on page 124) is to be performed and progress assessed. The case studies showed what happens when clarity was lacking and conversely what happens when the purpose is clear.

In the second Woolworths case study, the "Mixed vendor Storage" idea was cancelled six months into the project (Rose, Hawryszkiewicz & Kang 2014, p. 221 Table 1). Implementing the idea would "require a change in basic warehouse operations across Woolworths and a re-alignment of external vendor commercial arrangements" (p. 221 Table 1). Although the project had been given permission to proceed, there was no evidence of active involvement of stakeholders from the leadership of external vendors. The result of not including crucial stakeholders is that the joint value proposition lacked clarity on how external relationships would be re-aligned and this led to the project cancellation.

The joint value proposition for the first Woolworths case study showed an issue with clarity in the process dimension (the "How?" question). The issue stemmed from the lack of a clear statement on how estimates were to be derived and to the notional accuracy of the estimate. Without an agreed approach, the estimate process was left to the interpretation of individual knowledge creators in the collaboration. In my role as the participant-observer I adopted an engineering estimate approach based on my



experience where an accuracy of plus or minus 20% was acceptable and the estimate would be used as a way of ranking choices. In contrast, the knowledge creators appointed by Woolworths wanted an estimate to the accuracy and scope of a Woolworths' business plan. This impasse is discussed in section 5.3.2.2 below, but the result was a substantial disruption to the case study with 16 out of 20 idea estimates halted and a diminishing of collaborative wellness.

In the second Woolworths' case study, the Fuel Reduction Idea (see section 5.3.5 below) was planned in the light of the experiences from the first study. Here, use was made of the collaborative wellness unit (see section 3.9.7 on page 124) in conjunction with the questions of the collaborative wellness dimensions to structure the joint value proposition. Where possible, business as usual processes were employed for testing tyres by involving the tyre vendor and Woolworths' maintenance staff. The tyre vendor monitored tyre wear and received fuel use documentation from Woolworths' fuel suppliers. Results were verified jointly between Woolworths and the tyre vendor. In addition, the trucks were chosen to simplify project logistics and ensure all savings were realised in the Woolworths' business unit. The clearly stated joint value proposition was necessary to collaborative wellness and Woolworths endorsed the successful outcome.

Proposition RP1 is verified based on the case study experiences. That is, a clearly stated joint value proposition is a necessary condition for collaborative wellness.

### 5.3.2 RP2: Requisite Variety

*RP2: Achieving requisite variety is a necessary condition for role-in-use alignment.*

The collaborative wellness system (CWS) relies on the interpretation of requisite variety from Organisational Knowledge Creation (OKC) theory as the requirement that "an organisation's internal diversity must match the variety and complexity posed by the environment" (Nonaka & Takeuchi 1995, p. 82). CWS measures changes in requisite variety (see section 3.9.5 on page 121). The assessment of requisite variety changes in CWS is first discussed and then case study experience provides the basis for verifying the RP2 research proposition.

#### 5.3.2.1 Requisite Variety and the Collaborative Wellness System

There are two components for consideration in this proposition, firstly the degree to which a knowledge creator can satisfy the requisite variety of their role-in-use and secondly the match of the role-in-use's requisite variety with that required by the collaboration's purpose (see section 3.9.5 on page 121). At the start of the collaboration, the requisite variety is assumed satisfied as the knowledge creator interprets their responsibilities and then creates, occupies and performs a role-in-use in the belief that they have the traits necessary for their part in the collaboration.

Role-in-use alignment was defined in section 3.9.3 on page 119 as a qualitative assessment made at a particular point in time relative to the purpose of the collaboration. It encapsulates the degree of requisite variety a knowledge creator brings to their role-in-use, their level of wellness versus expected wellness, and an assessment of the usefulness of their knowledge contributions relative to that required for fulfilling the purpose of the collaboration.

### 5.3.2.2 Conflict of Purpose

The first Woolworths case study had the purpose of devising cost extraction ideas for application in the logistics business. The findings reported a conflict of purpose over the method of quantifying savings from implementing the cost extraction ideas. The knowledge creators, who were operational managers in the logistics business, "were concerned that the estimates would impact their forward operational budgets. Greater certainty was required in the estimates, but was not feasible within the agreed structure and timing of the study" (Rose 2013, p. 429). Despite the depth of experience and expertise available to support the study, "only 4 of 20 cost extraction ideas could be quantified in terms of costs and benefits to Woolworths' business case requirements within the timeframe of the study" (Rose, Hawryszkiewicz & Kang 2014, p. 211).

As the participant-observer in the study, I possessed the experience and skills to devise engineering estimates, but did not possess the knowledge required to produce an estimate in the form and to the accuracy of a Woolworths' business case. Adopting the requirement for greater accuracy in estimates, created the situation where I could not satisfy the changed requisite variety of my participant-observer role-in-use. The documented ideas, that is, the knowledge contributions at this point of collaboration had diminished usefulness relative to the purpose of the collaboration and my role-in-use was not aligned to the collaboration's purpose.

Following negotiations with the study facilitator, it was agreed that unquantified ideas would be accepted in the final presentation with explanations of issues encountered. This change mitigated the impact of the conflict in purpose. The requisite variety of my role-in-use was reduced by not having to produce estimates in accordance with Woolworths' business case standards and I was able to apply my existing traits to satisfy the reduced requirement in requisite variety. In turn, the knowledge contributions were useful relative to the changed purpose and my role-in-use was re-aligned. These changes in purpose were discussed at the final presentation of the case study and led to agreement to undertake the second Woolworths' case study to investigate how to facilitate the introduction of new ideas into the Woolworths' logistics business unit (Rose, Hawryszkiewicz & Kang 2014).

Resolving the conflict of purpose improved the ability of knowledge creators to meet the requisite variety of their roles-in-use. This satisfied one of the necessary conditions to create an “energized Ba” (Nonaka & Toyama 2005, p. 432). Achieving requisite variety is a necessary condition for role-in-use alignment. From the perspective of OKC, the creation and amplification of knowledge in the SECI process is enhanced by improving the alignment of the “sense of shared purpose” with the direction of the “firm’s knowledge vision” (Nonaka, Toyama & Hirata 2008, p. 37).

### 5.3.2.3 High Utilisation

In the Woolworth’s case studies it was found that extending “or adding processes places tensions on staff with high utilisations and may impact the performance of existing processes and negate benefits associated with the new process” (Rose, Hawryszkiewicz & Kang 2014, p. 222). In this situation, high utilisation had affected the degree to which knowledge creators could adapt to change in order to satisfy increases in the requisite variety of their roles-in-use.

In the SGA case study it was found that “some groups and knowledge workers had high levels of utilisation because of a focus on fulfilling assigned business purposes. This resulted in experts having little time to participate in planning and implementing change” (Rose 2013, p. 429). In this situation, knowledge creators had not expended the effort to adapt to changes in the requisite variety of their roles-in-use and consequently their roles-in-use were out of alignment with the changed purpose of the collaboration.

High utilisation inhibits the ability of knowledge creators and groups to adapt to changes in requisite variety and therefore their ability to maintain role-in-use alignment.

### 5.3.2.4 Effects of Structure

The SGA study was concerned with devising strategies to facilitate the introduction of inter-group processes. At the time of the case study, it was found that there “were no formal arrangements in place to share knowledge ... and there was effort expended in duplicating knowledge and repeat processing of data” (Rose 2013, p. 429). The mismatch between structure and process caused repeat processing that increased the utilisation of knowledge creators.

The two groups involved in the study were structured as closed co-located group collaborations performing “heuristic processes” (Martin 2009, pp. 9-12) within separate reporting structures. The study had recommended the groups, for the purposes of the inter-group processes, be structured as loosely coupled, open co-located groups (Rose 2013, p. 425 Fig 2) where an appointed boundary spanner had “two responsibilities: firstly, to socialise the changes through workshops and thereby

secure co-operation; and secondly to oversee change implementation and remediate difficulties before they impacted the program" (p. 429). These recommendations were in line with OKC's acknowledgement that "while Ba needs boundaries, these must be open" as "meaningful context-sharing requires boundaries ... but these must be permeable to allow for connections with other Ba."(Nonaka, Toyama & Hirata 2008, pp. 37-8).

In the second Woolworths' case study, which examined the introduction of new ideas, it was found that there were structural holes in the social networks. These were caused firstly, by difficulties in finding and engaging with knowledge domain experts and secondly by the difficulty in accessing closely held tacit knowledge within the confines of groups (Rose, Hawryszkiewicz & Kang 2014, p. 222 Table II). The study recommended the adoption of a "negotiated implementation to ensure acceptance by the team of the changes" (p. 222 Table II). This recommendation accords with OKC's view that it is the task of the leader to use an organisation's legitimate power to both protect Ba boundaries and ensure they are permeable and connected to various Ba within the organisation (Nonaka, Toyama & Hirata 2008).

In these case studies, existing structures inhibited access to knowledge required by knowledge creators to achieve the requisite variety their changed roles-in-use. This affected their performance and placed their roles-in-use out of alignment relative to the collaboration's purpose.

### 5.3.2.5 The Constraint of Time.

The constraint of time was most evident in the first Woolworth's case study. In dealing with the conflict of purpose discussed in section 5.3.2.2, I could have undertaken to acquire the knowledge for producing estimates and conducting the investigations necessary to satisfy manager knowledge creators., but this was "not feasible within the agreed structure and timing of the study" (Rose 2013, p. 429). The result, as discussed, was that I was unable to achieve the requisite variety required in my role-in-use and this led to a situation of misalignment of my role-in-use.

When introducing new ideas and processes into organisations, adequate time must be allowed for groups and their knowledge creators to acquire the knowledge and skills necessary to adapt to changes in requisite variety to ensure roles-in-use align with the purpose of the collaboration.

### 5.3.2.6 RP2 Summary

The published observations and experiences of the case studies discussed in this section lead to the assessment that research proposition RP2 is verified in this

research context, that is, *achieving requisite variety is a necessary condition for role-in-use alignment.*

### 5.3.3 RP3 Balancing utilisation

*RP3: Balancing utilisation with the capacity to socialise ideas is a necessary condition for improving the compatibility between roles-in-use.*

The observations of the case studies show that not only must knowledge creators adapt their roles-in-use to change, but they must then ensure they can perform their roles-in-use in such a way as to be aligned with the collaboration's purpose. The resolution of the conflict in purpose, discussed above, in the first Woolworths case study required negotiation with both knowledge creators and stakeholders, to resolve the conflict in purpose. Negotiation requires that all involved have the time to socialise ideas to devise and implement changes to their roles-in-use. High utilisation of knowledge creators reduces the time available to undertake the negotiation process and impacts the ability of knowledge workers to improve compatibility between roles-in-use. Put another way, high utilisation prevents the establishment of a shared purpose in Ba that is necessary for knowledge creation in the SECI process (Nonaka, Toyama & Hirata 2008).

Utilisation was seen as a constraint in the case studies. In considering requisite variety, high utilisation inhibited the maintenance of role-in-use alignment (see section 5.3.2.3 on page 173). In introducing ideas into existing collaborations, it was found that high utilisation of key staff may impact their performance and negate the benefits to be derived from the new idea (Rose, Hawryszkiewicz & Kang 2014, p. 222 Table II). In these circumstances, it was recommended that a "that the new idea implementation can only be carried out if existing processes can be improved; or the new process be merged into existing processes; or existing processes be rationalised across teams" (p. 223). This recommendation applied to the SGA and Woolworths' case studies would reduce high utilisation through balancing the utilisation of knowledge creators. As discussed in section 5.3.2.4 on page 173 structural holes in the social network created a situation in the SGA study where staff in effect had to duplicate knowledge and this had the flow-on effect of increasing their utilisation. In this way, achieving a balance of utilisation not only would require rationalising process but also addressing structural in the boundaries of the teams.

The observations and experiences of the case study at SGA and the first Woolworths first case study led to the assessment that RP3 is verified in this research context, that is balancing utilisation with the capacity to socialise ideas is a necessary condition for improving the compatibility between roles-in-use.

### 5.3.4 RP4 Improving role-in-use alignments and compatibilities

*RP4: Improving role-in-use alignments and compatibilities is a necessary condition for improving the usefulness of knowledge contributions.*

The second Woolworths’ case study had the purpose of “to recommend how and when to facilitate the introduction of new ideas” (Rose, Hawryskiewicz & Kang 2014, p. 215). I performed the role of a “boundary-spanner” (p. 215) to answer the questions of how to identify new idea implementations that need facilitation and then how these facilitations can be implemented. The investigation covered four ideas shown in the Table 29 below, the first idea established a business-as-usual baseline.

Table 29 Woolworths Ideas (Rose, Hawryskiewicz & Kang 2014, p. 221 Table 1)

Idea	Problem Summary	Research Perspective
Reclaimed stock distribution	Current manual process for managing reclaimed stock from damaged cartons does not provide traceability.	An example of a business-as-usual approach to implementing a new process in the logistics system by TS.
Vendor pack resizing	If inbound product process is not followed correctly, it is possible to change the number of units per package even though there was inventory of the old stock.	An example of a business-as-usual approach to implementing a new process in the logistics system by TS.
Mixed vendor storage	Spare capacity in warehouse to be shared with vendors to reduce costs and inventory value.	Implementation was cancelled after six months. Could facilitation change the outcome?
Transport fuel reduction idea	Follow-up to the 2012 case study to validate a cost extraction idea on using low rolling resistance tyres.	Provided a perspective to study the interactions between Woolworths and its vendors.

#### 5.3.4.1 Vendor Pack Resizing

The Vendor Pack Resizing project originated from a problem in one retail business unit. When the problem occurred, it impacted Technical Services (TS) in a cascade manner as the changed pack size was propagated by update processes throughout all stock holdings. Once the issue had propagated, remediation by TS was both time consuming and expensive. A collaboration was established between TS and representatives of the retail business unit to devise a solution that had minimal impact to both business and IT processes within an environment of budget constraint.

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At first, the approach of TS was based on remediating the corporate system. This was subject to disagreement because although it would solve the technical issue for TS, it was considered to be too costly by business representatives. In this situation of disagreement, all roles-in-use were out of alignment with the collaboration's purpose. Further, TS representatives' roles-in-use concentrated on functionality and were incompatible with business roles-in-use that focused on cost.

TS reframed their approach to seek a solution within the cost constraints set by the business unit. The collaboration scope was widened to include staff familiar with the manual remediation process and this brought new perspectives to the collaboration. These new perspectives enabled a new knowledge contribution to be devised in which a work-around in the user-side application would give sufficient warning of the problem occurrence to enable correction before the problem impacted the corporate system.

The requisite variety required of the collaboration to resolve the issue was met by introducing new perspectives and thereby energising Ba (Nonaka & Toyama 2005) and improving the sense of shared purpose. The roles-in-use were now aligned to the purpose and roles-in-use were compatible since the approach considered both technical and cost issues. The knowledge contribution produced was assessed as being useful and enabled the group to collaborate on implementing the solution. Here, improving role-in-use alignments and compatibilities was necessary in order to produce and implement the solution.

### 5.3.4.2 Mixed Vendor Storage

A Woolworths' distribution centre manager put forward a proposal to share un-used centre storage capacity with vendors to reduce costs and improve stock handling processes. The business case showed that substantial savings could be achieved if the initiative was applied at the national level. The project received leadership approval but was not facilitated at the leadership level. The distribution centre group had the capacity to meet all process requirements at the distribution centre level, but not at the national level as it "would require a change in basic warehouse operations across Woolworths and a re-alignment of external vendor commercial arrangements" (Rose, Hawryskiewicz & Kang 2014, p. 222).

Within the distribution centre, implementing process change to adapt to changing logistics circumstances was well understood and carried out in accordance with accepted work practices. Although the mixed vendor storage proposal introduced some new requirements, they were successfully managed under existing procedures. That is, collaborating knowledge creators adapted to change and maintained existing role-in-use alignments and compatibilities to devise and implement the required changes. However, managing changes to relationships with other groups within the

logistics business unit and external vendors to successfully implement the new system was unsuccessful and resulted in the project being cancelled by stakeholders.

The project failure stemmed from an incomplete discovery process of the collaborative wellness network because not all entities outside of the distribution centre that could affect the project either directly or indirectly were discovered. This meant that the external responsibilities of the distribution centre group could not be defined and therefore roles-in-use could never align to actual project needs. The result was the execution of created strategies in the project were neither useful nor acceptable to all stakeholders. The project was cancelled through the withdrawal of support by an external vendor.

### 5.3.4.3 RP4 Summary

The discussions of the studies showed that for these case studies RP4 was verified, namely improving role-in-use alignments and compatibilities is a necessary condition for improving the usefulness of knowledge contributions.

### 5.3.5 RP5 Improving knowledge contributions

*RP5: Improving the usefulness of knowledge contributions is a necessary condition for improving collaborative wellness.*

The Transport Fuel Reduction Idea (Rose, Hawryszkiewicz & Kang 2014) was devised as part of Woolworths' first case study. The purpose of the collaboration was to verify that using low rolling resistance tyre technology in the truck fleet would deliver a reduction in fuel usage. This was extended into the second case study in which running trials were performed on Woolworths' rigid trucks. The trials showed that using the technology on three trucks delivered an 11% reduction in fuel usage. These outcomes were in line with Woolworths' sustainability goals. Findings were checked by Woolworths Limited and published with their permission by Rose, Hawryszkiewicz & Kang (2014, pp. 223-4). This collaboration is used to characterise the acceptable rating on the collaborative wellness scale (see section 3.9.6 on page 124).

The first Woolworths case study did not quantify the fuel reduction idea because an estimate could not be derived within the study's time constraints (see section 5.3.2.2 on page 172). However, because of the supporting documentation provided in the presentation to stakeholders, the idea was found to be compelling and set for inclusion in the second case study. Woolworths have a diverse range of vehicles in their transport fleet managed under a variety of schemes ranging from outright ownership to contracted services and the first task was to identify the best way of realising value from any identified savings. The trucks selected were fully owned by Woolworths. They were of rigid configuration with six wheels on three axles capable of transporting up to 14 pallets. The trucks with contract drivers were based at the



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retail distribution centres and used for urban retail store replenishment within scheduled routes. The tyres (new tyres, casings and rethreads) were manufactured in on-site facilities at the distribution centre and managed by the tyre vendor. These choices meant all savings would accrue to Woolworths and reduced the uncertainty in the business case. Knowledge usefulness is increased by reducing uncertainty (Boisot, MacMillan & Han 2007).

The trial process involved fitting “three rigid trucks with a set of low rolling friction tyres using a combination of re-treads and new tyres. Once fitted, fuel consumption and tyre wear were monitored over a three-month period with savings estimated through comparisons with the same period in prior years” (Rose, Hawryszkiewicz & Kang 2014, p. 223). GPS logs were provided by Woolworths TS information systems, fuel consumption dockets came from the fuel vendor and tyre condition reports were supplied by the tyre vendor. In my participant-observer role I acted as project manager/co-ordinator that included examining GPS logs to identify any extended idling periods that could affect fuel consumption measures and confirming that the consistency between the trial and historical routes. Although the contract drivers in the trials could not be confirmed as being the same as those who drove the historical routes, stakeholders decided that the impact to the study should be minimal. In acting as a boundary spanner, I shared all information and analyses with stakeholders. The tyre vendor used GPS and fuel consumption information to conduct calculations of fuel savings, which were then checked by Woolworths. The result showed that an 11% fuel savings had been achieved during the trials with little difference in wear rates compared to conventional tyres (Rose, Hawryszkiewicz & Kang 2014). Furthermore, the new tyre technology could be fitted to the rigid truck fleet during routine servicing under existing commercial arrangements with no additional costs.

Collaborative wellness is defined as an assessment of the current state of a collaboration based on the knowledge creators’ degree of requisite variety, alignment of their roles-in-use, and the usefulness of knowledge contributions relative to the state required of the collaboration for it to achieve its purpose (section 3.9.4 on page 120). The savings idea was conducted in a collaboration I co-ordinated with all information, data and knowledge circulated with briefing notes as required. Trucks were trialed, maintained and checked in business-as-usual activities so overall requisite variety was achieved at the start of the collaboration by Woolworths’ staff and maintained throughout the project. The roles-in-use were in alignment with the carefully scoped purpose of the collaboration. The knowledge contribution went from an unquantified suggestion in the first case study to a quantified idea of savings with a clear path to realising value-in-use that was endorsed by Woolworths Limited.

In the context of the Woolworths' case study RP5 is verified, that is, improving the usefulness of knowledge contributions is a necessary condition for improving collaborative wellness.

### 5.3.6 RP6 Improving collaborative wellness

*RP6: Improving collaborative wellness is a necessary condition for improving the potential value-in-use of knowledge contributions.*

Returning to the Transport Fuel Reduction Idea, initially, this idea could not be quantified within the constraints of the first case study owing to a clash of purpose with consequent roles-in-use being out of alignment. The diverse nature and use of the Woolworths' fleet made trialing a representative sample (rigid trucks, tractor-trailers, small form factor trucks, cars and special purpose vehicles) problematical. Additionally, the business models of managing the fleet ran from Woolworths' sole ownership and servicing to owning trailers and out-sourcing tractors through to complete out-sourcing. In these circumstances, quantifying operational savings that could be realised through adopting the tyre technology would be a difficult and time-consuming task.

In negotiating the collaboration to quantify the fuel reduction idea, the first task was to devise a joint value proposition that would enable the idea to be quantified such that savings could be easily tracked and fully realised in Woolworths' logistics. The decision was to trial three rigid trucks based in Sydney running well-established routes. The trucks were fully owned, operated and maintained by Woolworths. To satisfy objectivity concerns, the tyre vendor agreed to work with Woolworths to quantify the results. This effectively ensured that the quantification would be open, transparent and conducted within an accepted framework of work practices.

The stakeholders of the fuel reduction idea in Woolworths Logistics, Transport Management and Technical Services were regularly briefed and updated with progress. Issues raised during the trials such as long idle times of trucks awaiting docking space were dealt with promptly and results circulated for comment. The joint value proposition had showed a clear path for realising operational value from any identified savings in the trial.

In OKC terms, in my role for the Tyre trial, I acted in a way to energise the collaboration's Ba that helped to align knowledge creator worldviews, maintain a sense of shared purpose, and decrease the effort required to assimilate and socialise project information (see section 3.8.7 on page 113). From a collaborative wellness perspective, energising Ba was equivalent to maintaining role-in-use alignment.

In the collaboration to verify the fuel reductions idea, all factors considered necessary for collaborative wellness were established from inception of the project collaboration. The purpose was devised to ensure a clear path to realising operational value and the method of quantifying results was objective and transparent to all stakeholders. This collaboration showed that research proposition RP6 was verified. That is, improving collaborative wellness is a necessary condition for improving the potential value-in-use of knowledge contributions.

### 5.3.7 Results

The case study experiences have shown that the six research propositions are verified for the collaborations performed within the case studies at the Stage Government Agency, and Woolworths Limited. The research question, *“Do acceptable outcomes result from aligning roles-in-use in collaborations purposed with creating knowledge for process and/or product innovation?”* is answered in the affirmative.

The case study experiences may now be used to develop a scale of collaborative wellness so that collaborations may be compared and improvement strategies evaluated, prioritized, implemented and value-in-use created assessed.

## 5.4 Using the Collaborative Wellness System

In the Commonwealth Government Agency (CGA) case study I used the Collaborative Wellness System (CWS) for characterising and recommending solution approaches for the 22 issues identified by CGA in their inter-department information systems. A summary of CGA issues is provided in an excerpt of the CGA report in the appendix on page 210. The State Government Agency (SGA) case study looked at loosely coupled systems for on-line reporting (Rose 2013). The case study design was based on my practical experience, as such they were all hosted by host organisations based on the same hierarchical structure which I have called the Collaborative Wellness System (CWS) (see section 3.3 on page 96). In this light, I decided to map all of the discovered issues of the four case studies to CWS, which is summarised by issue counts in Figure 30 below.

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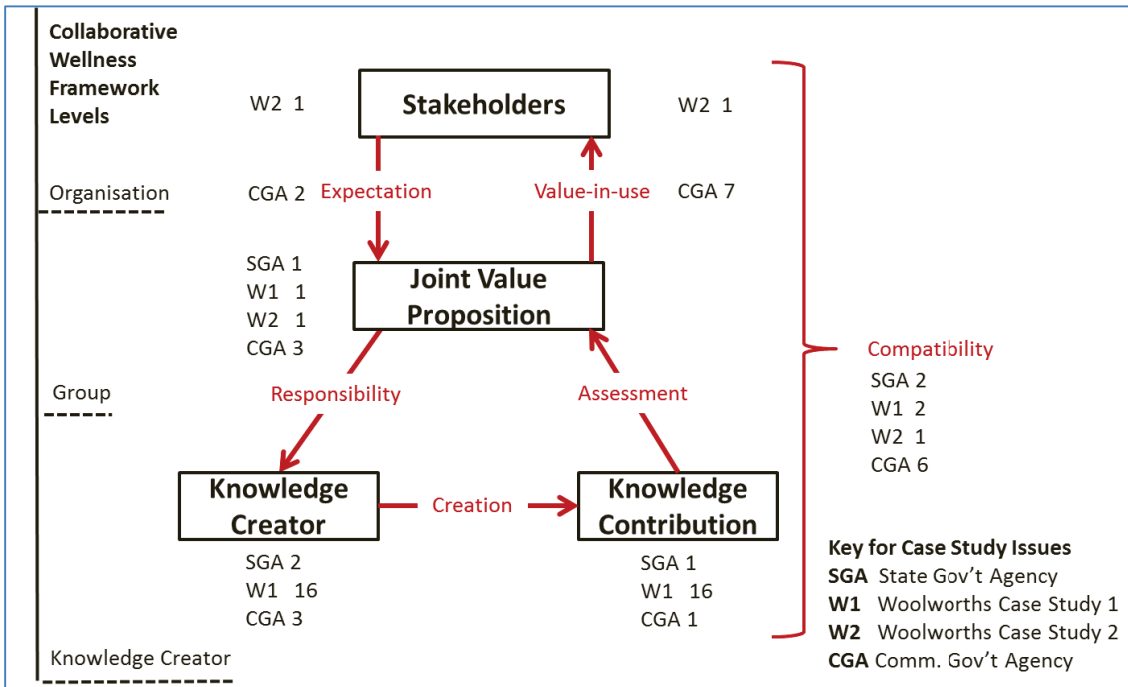


Figure 30 Case Study Issues shown mapped to the Collaborative Wellness System

The stakeholder entries for Woolworths' second study reflect my assessment from studying the mixed vendor storage project where not all crucial stakeholders were engaged in the project. Here, expectations of all stakeholders could not be identified and that made realisation of value from the project problematical. In the SGA study, I found that the lack of arrangements for implementing inter-group processes inhibited developing joint value propositions. While high rates of utilisation affected the knowledge creators and their knowledge contributions. In the case of the first Woolworths' study, the conflict in purpose resulted in 16 ideas not being quantified. The CGA issues (see Appendix on page 210) were found mainly to be associated with issues in stakeholders collaborating to devise value propositions and the lack of collaboration in the co-creation of value-in-use. The advantage of using CWS is in identifying the location of the problem in the collaborative wellness relationship unit (see Figure 13 on page 93). Here, the relationships correspond to actual process steps in the human centric information systems being studied. Therefore, issues once positioned, indicate the process requiring investigation and remediation. Tracking anti-clockwise from the location of the problem identifies the impacts of the problem, while moving clockwise from the problem identifies sources of the problem.

The annotated CWS shown of Figure 30 above illustrates that all of the components of the collaborative wellness unit must be present for continuing collaboration, for example, the missing stakeholders in the shared vendor idea of Woolworths' second case study led to the project being cancelled. The fuel reduction testing showed that maintaining an acceptable level of collaborative wellness requires a balancing of all the dimensions of collaboration rather than concentrating on any one dimension or

aspect. This annotated CWS demonstrates the value of comparing collaborative experiences. The comparisons here were valuable because the studies were designed to complement each other and be performed using the same action plan. Comparing a diverse range of collaborations using CWS will require a rating scale with a guide for rating collaborations and their processes. This is discussed in the next section.

### 5.5 The Collaborative Wellness Comparative Rating Scale

This section deals with the development of the collaborative wellness scale by drawing upon the literature review, theory developed in Chapter 3, the research design and case study experiences. Good collaborative practices identified in the case studies have been useful in characterising a rating of acceptable collaborative wellness. The proposed scale is considered to characterise categories below acceptable and how should they be measured. Similarly, categories above acceptable are detailed together with how they should be measured. A list of questions was devised to guide in categorising collaborations based on collaborative wellness assessments of the case studies and thus lay the basis for using the same scale to rate collaborative processes. Key concepts are summarised in Table 30 below.

Table 30 Concepts for the Collaborative Wellness Scale

Concepts	Description	Reference
<b>Value Proposition</b>	A value proposition is an “aggregation or bundle of benefits” (Osterwalder & Pigneur 2010, p. 22) that a business offers customers to help them “get either a functional, social, or emotional job done, or help him/her satisfy basic needs” (Osterwalder 2012, p. 1). Value propositions may be successively deconstructed into “elementary value proposition(s)” that “describe different aspects of a value proposition” (Osterwalder & Pigneur 2003, p. 431). A value proposition is “a basic relationship of service” (Maglio & Spohrer 2013, p. 667).	Section 2.7.2 on page 43
<b>Purpose</b>	Documenting the purpose begins using a scenario approach (Konno, Nonaka & Ogilvy 2014) to describe the situation of the organisation should the purpose be satisfied. The scenario is then restated as a value proposition which is deconstructed into elements for use by individual knowledge	<u>Characterising Purpose:</u> Section 3.8.4 on page 110.

Concepts	Description	Reference
	<p>creators. The purpose includes implicit and explicit objectives, assumptions and constraints. It is influenced by both the organisation’s culture and its environment. An ill-defined purpose leads to uncertainty in knowledge contribution assessments.</p>	<p><u>Documenting:</u> Section 4.5.1 on page 150</p>
<p><b>Knowledge Contribution</b></p>	<p>Knowledge is the meaning emerging in tacit knowing and is embedded in the mind’s worldview. It becomes a knowledge contribution when it is assessed as being useful in fulfilling the purpose of the collaboration. A knowledge contribution transforms the state of knowledge in the subject domain of the collaboration and informs decisions to take actions.</p>	<p><u>Individual:</u> section 3.8.6 on page 113. <u>Group:</u> section 3.8.8 on page 114. <u>Refinement:</u> section 2.8.4 on page 49.</p>
<p><b>Collaborative Wellness</b></p>	<p>“Collaborative wellness (CW)” is a qualitative assessment of the state of a collaboration at a point in time based on the knowledge creators’ degree of requisite variety; alignment of their roles-in-use; and the usefulness of knowledge contributions relative to the state required of the collaboration for it to achieve its purpose.</p>	<p><u>Concept</u> Section 3.9.4 on page 120. <u>Assessment:</u> Sections 4.5.4, 4.5.5, 4.5.6. Pages 158 - 163.</p>
<p><b>Collaborative Wellness Network</b></p>	<p>The collaborative wellness network is the network at a particular point in time of all the collaborative wellness units that share a commonality in their joint value propositions.</p>	<p>Section 3.9.7 on page 124.</p>
<p><b>Distinguishing between risk and uncertainty</b></p>	<p>“Risk is the combination of the probability of a consequence and its magnitude. Therefore, risk considers the frequency or likelihood of occurrence of certain states or events (often termed ‘hazards’) and the magnitude of the likely consequences associated with those exposed to these hazardous states or events. ... Uncertainty exists where there is a lack of knowledge concerning outcomes. Uncertainty may result from an imprecise knowledge of the risk.” (Willows et al. 2003, p. 43 Box 1)</p>	

### 5.5.1 Structure of the Collaborative Wellness Scale

The collaborative wellness scale (scale) was intended to support assessment and subsequent re-assessment of both progress and the adaptations made to change as a collaboration progresses and the nature of the problem changes in response to applying solutions (Briggs 2007). The starting point for devising scale categories was based on the collaboration concerned with trialing the fuel reduction idea. The findings of this collaboration were assessed and endorsed by Woolworths Limited and this is taken as a collaboration having acceptable collaborative wellness.

This category of "acceptable" was assigned as the midpoint of the scale in Table 31, below. Categories below "acceptable" represented situations where joint value propositions have not met stakeholder expectations. Categories above "acceptable" indicate joint value propositions that have met or indeed exceeded stakeholder expectations. The fuel reduction collaboration enabled the identification of collaborative practices that were used to achieve acceptable outcomes.

In the first Woolworth's case study "only 4 of 20 cost extraction ideas could be quantified in terms of costs and benefits" (Rose, Hawryszkiewicz & Kang 2014, p. 211). Of the remaining 16, activity stopped on 15 as a persuasive joint value proposition could not be devised to continue work. These idea collaborations failed and they characterise the scale's bottom "anchor category" (Peterson 2000, p. 67). On the other hand, the one remaining study, the fuel reduction idea, was considered worthy of further investigation by the stakeholders. Rating the fuel reduction idea at the end of the first study required a scale category between "failed" and "acceptable". This category was labelled "poor" and was distinguished by having a persuasive joint value proposition for remediation subject to acceptance of the assessed degree of risk and uncertainty.

It was conceivable that a collaboration could succeed to the extent that a persuasive joint value proposition for further improvement could not be devised. This "good" category becomes the other anchor category of CWS. This leads to the notion of a new category I called "satisfactory" to be interposed between "acceptable" and "good". A "satisfactory" rating is where a collaboration has satisfied the original joint value proposition, but a persuasive joint value proposition for further improvement could be put forward. The scale values of 1-5 have been assigned to reflect an increasing collaborative wellness gap between the current and desired states of the collaboration as the scale is traversed from the category of "good" to that of "failed". The structure of the scale is shown in Table 31 below.

Table 31 Developing the Collaborative Wellness Scale.

Scale Value	Category	Collaborative Wellness assessment at a particular point in time.	Opportunities for Improvement or remediation.
1	Good	Original value proposition achieved beyond doubt.	New value proposition for improvement cannot be devised to persuade stakeholders to continue.
2	Satisfactory	Original value proposition achieved beyond doubt.	New value proposition for improvement is persuasive to stakeholders despite being subject to risk and uncertainty.
3	Acceptable	Despite there being some doubt that the original value proposition was achieved, stakeholders agree that the outcome is acceptable.	New value proposition to improve outcomes is persuasive. Stakeholders agree identified risk is considered manageable and perception of uncertainty is low.
4	Poor	Original value proposition was not achieved.	New remediation value proposition is persuasive to stakeholders despite a degree of risk and uncertainty.
5	Failed	Activity has stopped.	Stakeholders do not agree to remediation.

The scale was based on a collaboration’s results from the perspective of the stakeholders. Using the scale to compare processes within a collaboration introduces a requirement to understand the circumstances and context of the collaborative wellness assessments (see section 3.9.9 on page 126) in order to ensure comparisons are valid. As mentioned, the case studies used a common research design and implementation methodology. Furthermore, I acted as the assessor of collaborative wellness in each study. This commonality made valid process comparisons possible.

### 5.5.2 Using the Collaborative Wellness Scale (Scale).

Assigning a scale rating is dependent upon the collaborative wellness assessment and the ability to explain, justify and revisit the assessment as required by stakeholders and changing circumstances. The scale relies upon the discovery and updated knowledge to ensure maintenance of interconnections in the collaborative wellness network. The crucial links in the collaborative wellness network necessary to rate



collaborative wellness are the relationships in the collaborative wellness unit (CWU) between the knowledge creator, their knowledge contribution, the value proposition and the stakeholder.

Discovering the critical relationships may take time. For instance, there may be one or more knowledge creators interacting to create a knowledge contribution. This was the case for the fuel reduction idea where the knowledge contribution outlined the methodology and record of trials on how to use the low rolling resistance tyre technology to achieve an 11% reduction in fuel use. This contrasts with the first Woolworths case study where there were initially 20 knowledge contributions each one being a cost saving idea. Each idea was performed as a collaborative wellness unit (CWU) linked to the other idea CWU's through their joint value propositions that were deconstructed from the case study's joint value proposition. The collaboration's joint value proposition was linked via myself and the study convenor to the Chief Information Officer (stakeholder). The conflict of purpose stemmed from another connection of the ideas to the value propositions in some of the managerial roles of Woolworths knowledge creators and in turn their connection to their stakeholders in the logistics business unit (see section 5.3.2.2 on page 172). This is an example of a problem known as "many masters" (Jensen 2010, p. 32) that is the hallmark of wicked problems.

Once the crucial links between knowledge creator, knowledge contribution, value proposition and stakeholder have been identified, the influence either directly or indirectly of the collaborative dimensions on collaborative wellness can be accessed. For example, in the State Government Agency case study, the group types of co-located closed effected the participation of knowledge creators responsible for knowledge contributions on how to implement new processes. Tracking how these links change over time reveals what De Haan & Rotmans (2011) characterised as chains of patterns or "transition paths" (p. 96). Using CWS mandates a concise and repeatable process of recording assessments of collaborative wellness. It ensures transparent reviews and reporting of the collaboration to stakeholders.

### 5.5.3 Questions for Collaborative Wellness Scale Ratings of Process.

The case studies focused on introducing new ideas and processes into mature organisations. In particular, the second Woolworths' case study considered how to identify collaborations that required facilitation for the introduction of new process ideas into existing business collaborations. This investigation informs answers to questions that can be used to rate collaborative wellness of knowledge processes. The four criteria for assessing the need for facilitating the introduction of new ideas and processes into existing collaborations are listed below.

Table 32 Facilitation based on Rose, Hawryskiewicz & Kang (2014, p. 223)

Criteria	Discussion and Guidance
Does the process cross boundaries?	<p>Boundaries exist between groups, business units and organisations. Boundaries can also exist within a group where people perform different specialised tasks. A process that spans boundaries needs coordination. Quite often, this coordination needs to be negotiated and modified to suit local situations. Complex coordination requirements need test runs and tracking of test transactions. The facilitation would implement the coordination and then monitor/ assist/ correct for a period to ensure successful implementation.</p> <p>The case study at the State Government Agency identified processes that crossed boundaries (Rose 2013). The second case study at Woolworths involved the facilitation of a cross boundary process for assessing the introduction of technology to reduce truck fuel consumption (Rose, Hawryskiewicz &amp; Kang 2014).</p>
How novel is the process?	<p>Novel processes are new, original or unusual in the context in which they are being implemented. In practice, novelty is a subjective judgement, and a perception of novelty widens the capability gap. Here, the facilitation group has to negotiate the acceptance of the new process and assist in its adoption. Novelty could be assessed by comparing the existing processes to the characteristics ascribed to the new process. The differences inform a decision on the novelty of the new process.</p> <p>In the Woolworths' case studies we found that the refinement of business-as-usual processes created a capability gap between what was required to perform the existing algorithmic processes and that required to accept and perform new processes (Rose, Hawryskiewicz &amp; Kang 2014, p. 211).</p>
Does the group have capacity to meet new process requirements?	<p>The capacity issue for a new process implementation depends on whether it is an additional process, an extension to an existing process or a replacement of an existing process. Extending or adding processes places</p>

Criteria	Discussion and Guidance
	<p>tensions on staff with high utilisations and may affect the performance of existing processes and negate benefits associated with the new process. It is recommended that the new idea implementation can only be carried out if existing processes are capable of improvement, the new process can be merged into existing processes, and/or existing processes can be rationalised across teams. This requires a negotiated implementation to ensure acceptance by the target group of the changes and difficulties associated with the transition to adopting the new process.</p> <p>This criterion was a reflection of the experience in the State Government Agency study where the high utilisation of key personnel acted as an inhibitor to the capacity of the group to adopt new ideas (Rose 2013; Rose, Hawryskiewicz &amp; Kang 2015).</p>
<p>How well could the group adapt to the new process?</p>	<p>The approach to this complex question is to consider how the group performs their currently assigned processes. If the group has a practice of resolving problems and is active in process improvement through collaboration and idea sharing, then it is in a better position to adapt and accept the implementation of new process without external facilitation.</p> <p>This criterion resulted from the study of the implementation of four ideas within the Woolworth's business unit (Rose, Hawryskiewicz &amp; Kang 2014, p. 221 Table 1).</p>

Using the findings concerning criteria for facilitation can now inform the construction of questions to relate knowledge creation processes and assessments of collaborative wellness.

**5.5.3.1 Is the purpose clearly articulated?**

It is assumed that the purpose can be structured as outlined in section 4.4.3 on page 147. Furthermore, deconstructed joint value proposition can be created that link either individual processes or individual knowledge creators with knowledge

contributions to stakeholders. If this is not the case than the "value-in-use" (Vargo, Maglio & Akaka 2008, p. 149) of knowledge contributions, that depends upon the participation of stakeholders will be compromised.

An ill-defined purpose introduces uncertainty, even if that concerns a lack of knowledge about risks in value realisation. In this situation, the value propositions are less persuasive and collaborative wellness assessments are uncertain.

The "no" answer gives a collaborative wellness rating of "poor".

### 5.5.3.2 Is there a Many Masters Problem?

In the case of the fuel reduction idea of the second Woolworths' case study, there the purpose was clearly articulated. However, in the Woolworths' first case study there was a conflict of purpose caused by knowledge creators having both management responsibilities and a responsibility to devise cost reduction ideas. This had the result that 15 of the ideas had a collaborative wellness rating of "failed" and one, the fuel reduction idea, a rating of "poor".

In the Woolworths' study, the many masters problem of a clash in purpose occurred because one or more knowledge creators had responsibilities to other stakeholders not involved in the project. This situation had not been included in the original negotiations of the joint value proposition. In some situations, a purpose clash can occur when knowledge creators make different interpretations of the same group purpose when performing their role-in-use.

The "yes" answer to the question gives a collaborative wellness rating of "poor" with a likelihood of the collaboration failing.

### 5.5.3.3 Does the process cross boundaries and is the group closed?

As previously discussed, in the State Government Agency case study the new process was to be across the boundaries of two groups of type co-located closed (see Figure 15 on page 105). Each group was focussed on business-as-usual activities and there were no formal arrangements in place for inter-team co-operation, instead reliance was placed on informal ad-hoc arrangements for planning and implementing the new process (Rose 2013). The collaborative wellness rating was "poor" and intervention was required. In contrast, the Woolworths fuel reduction idea was across group and business unit boundaries, but the group structure was open with formal arrangements put in place for co-operation and reporting. This Woolworths collaboration was assessed with a collaborative wellness rating of "acceptable".

The "yes" answer gives a collaborative wellness rating of "poor" with a likelihood of the collaboration failing.

#### 5.5.3.4 Does the group have capacity for new processes?

This was discussed in the context of the research proposals. If the answer to the question is “no” then further investigation is required:

- Do knowledge creators have the traits to satisfy the changed requisite variety? If not, is the knowledge available? A “no” answer gives a collaborative wellness rating of “poor”.
- Is knowledge creator utilisation such that they are unable to adapt their roles-in-use to the new process? A “yes” answer gives a collaborative wellness rating of “poor”.
- Are knowledge creators able to negotiate with other knowledge creators to ensure compatibility between roles-in-use? A “no” answer gives a collaborative wellness rating of “poor”.

If a “poor” rating was assigned, then there could be opportunities to devise a persuasive value proposition to remediate the situation through intervention.

#### 5.5.3.5 Can the group adapt to the new process?

This question is about role-in-use alignment at the group level. It is a focus on the social behaviours and “habits” (Hodgson 2011, p. 593) of the group, that is, their routines of practice. In Woolworths, it was found that in the vendor resizing project Technical Services had shown a capability to adapt their approach so as to solve the problem of developing a joint value proposition (see Table 29 on page 176). However, if the group did not have a history of adapting to solve problems, then they may not be able to adapt to the new process without intervention.

The “no” answer gives a collaborative wellness rating of “poor” and there could be opportunities to devise a persuasive value proposition to remediate the situation through intervention.

#### 5.5.3.6 Further Questions

The questions listed in this section form a guide as to how to apply a collaborative wellness rating. As experience grows in using the collaborative wellness system the collection of questions and answers, will expand and in turn be used to characterise a rated collaboration and to understand what to expect if, for instance, a collaboration is required by management to move from a poor rating to an acceptable rating of collaborative wellness.

## 5.6 Conclusion.

In this chapter, the six research propositions were shown to be verified according to the experiences of the four case studies and the research question “*Do acceptable outcomes result from aligning roles-in-use in collaborations purposed with creating knowledge for process and/or product innovation?*” was answered in the affirmative.

## Collaborative Wellness Through Dynamic Role Alignment

The case study experiences validated the collaborative wellness system and the research design developed in Chapter 4.

The case study experience has been used in association with the research design, the framework and underpinning theory to develop a collaborative wellness rating scale as shown in Table 31 on page 186. Currently, the scale can be used as a basis for comparing knowledge creation collaborations. Case study experience was used to propose using the scale for rating knowledge creation processes in future research.

## **Chapter 6 Discussion of Research Outcomes.**

There were many common experiences in the conduct of the four case studies that were highlighted by using CWS. This chapter discusses matters that arose from these experiences. In particular, it highlights how CWS has helped to address the issues around the lack of precision for tracking knowledge creation according to the concepts in Organisational Knowledge Creation (OKC) theory (see section 2.8.6 on page 54). The chapter concludes with a discussion of the importance of the joint value proposition and value co-creation to CWS in the context and limitations of the case studies.

### **6.1 Introduction**

The four case studies focused on studying the difficulties experienced by mature organisations when they introduced new ideas and processes. The case studies were designed to deliver a benefit to the hosting organisation. This design resulted in a dual collaboration that consisted of a group that devised improvements and then interacted with the larger collaborations of the host to apply, verify and validate these improvements. In the case studies, the research knowledge creation group varied in size with up to thirteen knowledge creators with additional contributors in the collaboration depending on need (Rose, Hawryszkiewicz & Kang 2015). In these circumstances, simplifying assumptions and averaging techniques were avoided to minimise the risk of missing significant behaviours or distorting analysis and conclusions (Lawrence, Boardman & Sauser 2008; Moss & Edmonds 2005; Shu et al. 2011; Van den Bergh & Gowdy 2009).

The research design was based on my practical experience and assumed that the case studies would apply to collaborations creating knowledge for solving problems in process and/or product innovation. In my experience, these problems were type two wicked problems (see section 2.3.1 on page 18) where each problem was in some ways unique. In this light, the case study design adopted a broad approach and acted more as a guide of suggested approaches rather than being narrow and prescriptive. In turn, the discovery process of the case studies was broad in nature and required several iterations to derive meaningful results (Rose, Hawryszkiewicz & Kang 2014, 2015). Comparing the collaboration experiences of the case studies enabled the construction of a collaborative wellness scale with a core set of questions to help guide the classification of a collaboration's collaborative wellness rating.

The four case studies gave insights into further research into CWS, path dependence between collaborative processes, and the importance of clarity in the joint value proposition in shaping and sharing outcomes. In the concluding chapter, these matters will be discussed in the context of broadening the scope and adoption of the collaborative wellness system.

## 6.2 Collaborative Wellness Scale.

The collaborative wellness networks of the case studies showed similarities in their patterns (Rose 2013). These similarities such as structural holes (Rose, Hawryszkiewicz & Kang 2014, p. 222 Table II) led to identifying issues that were common to all studies. For instance, the occurrence of structural holes inhibited the flow of knowledge in the case study collaborations. My practical experience, reinforced by the case studies, underlined the need for comparing collaborations by asking questions based on the studies' findings. The case studies provided both the evidence for impacts from the lack of good collaborative practices and in the Woolworths' second study, an example of acceptable collaboration where lessons learnt were applied in the fuel reduction verification as detailed in section 5.5.1 on page 185.

The key to developing the scale lay in understanding the importance of the relationships in a collaborative wellness unit (CWU) described in Chapter 3. CWU relationships start with links of the collaboration's stakeholders to the purpose expressed as a joint value proposition. In turn, the joint value proposition is linked to the knowledge creator through acceptance of responsibilities laid out in the joint value proposition. The knowledge creator devises and socialises knowledge by performing their role-in-use. This knowledge is assessed relative to the purpose for its potential value in terms of usefulness. Finally, the CWU relationships are closed by use of the knowledge contributions in a value co-creation process. In the case studies, observations and assessments at a particular point in time of CWS were used to give an indication of the overall collaborative wellness and to highlight aspects of CWS for further investigation.

The second Woolworths' Case study concerned how to identify collaborations needing intervention to facilitate and improve outcomes, that is, improve collaborative wellness. The recommendations for identifying these collaborations are based on a staged approach. "First, undertake a brief appraisal of the idea to estimate the capability gap. This is followed by a decision to either undertake a more extensive impact analysis or implement with or without facilitation. Outcomes from a staged approach will improve as designers learn from their experiences" (Rose, Hawryszkiewicz & Kang 2014, p. 222). The brief appraisal would be a collaborative wellness assessment limited to selected CWU relationships. If the rating was "acceptable", a more extensive assessment would be required, if however the rating was "poor" then a decision could be made for intervention without progressing to a full collaborative wellness assessment involving all collaborative wellness units in the collaborative wellness network. If a decision was made to intervene in the group, then the collaborative wellness assessment describes the baseline for comparison and the collaborative wellness scale provides the means of tracking progress.



### 6.3 Organisational Knowledge Creation Theory

Organisational Knowledge Creation (OKC) Theory investigated in the literature review (see section 2.8.6 on page 54) provided the basis for understanding the knowledge contribution (section 3.8 on page 107). Knowledge creation is a tacit knowing process involving the use of imagination to produce “ideas that are guided by a fine sense of their plausibility” (Polanyi & Prosch 1975, p. 97). OKC theory relies upon tacit knowing and the distinction between tacit and explicit knowledge (Nonaka, von Krogh & Voelpel 2006). In OKC, knowledge creation takes place in context amenable to knowledge creation called Ba through the “SECI” by (Nonaka, von Krogh & Voelpel 2006, p. 1182). “SECI” starts with the socialisation of tacit knowledge amongst knowledge creators. Ba is conceived as a “physical (e.g., office, dispersed business space), virtual (e.g., e-mail, teleconference), mental (e.g., shared experiences, ideas, ideals), or any combination of these” (Nonaka & Konno 1998, p. 40). Ba may be summarised as a “shared context in motion” (Nonaka, Toyama & Hirata 2008, p. 34). The boundary of Ba dynamically changes as knowledge creators join or depart from it, so it can range from an individual to a group or multiple levels of group interactions (Von Krogh, Nonaka & Rechsteiner 2012). I conceived Ba as an innately human attribute, centered upon the human mind in the physical space of the human body. Furthermore, I said Ba expands and contracts according to tacit knowing processes such as indwelling (see section 3.8.7 on page 113). This supposition provided a basis for extending concepts of OKC down to the individual and supporting the fine grained assessments necessary in CWS.

In the four case studies, Ba ranged from the individual Ba of the researcher, through one-on-one interviews (Rose 2013) to group co-located collaborations for refinement of cost savings ideas and finally as a distributed Ba for the fuel reduction idea project (Rose, Hawryszkiewicz & Kang 2014). Refinement of ideas followed Boisot & MacMillan (2007) as shown in Figure 8 on page 50 as ideas went through a justification processes in Ba. While justification of beliefs in an individual is a natural process, in an organisation “justification is a social process” (Nonaka, von Krogh & Voelpel 2006, p. 1183). Nonaka, Toyama & Konno (2000) spoke of the need to ensure Ba is “energised” (p. 25). In the first Woolworths case study, Ba was energised by knowledge creators who prepared briefing materials and slide presentations to focus discussion and arranged for subject matter experts from logistics systems, transport and distribution to brief the collaboration as needed. Despite these positive steps to ensure the demands of requisite variety were satisfied, the conflict of interest caused disruption to the idea refinement process. This situation indicates that no one dimension of collaboration (Figure 6 on page 17) is sufficient to ensure collaborative wellness, rather the path to collaborative wellness lies in the necessity of balancing the dimensions of collaboration.

OKC has been criticised for lacking the precision (Gourlay 2006) to support measures for tracking knowledge creator interactions. The case studies overcame this issue by the re-interpretation of Ba and the introduction of the knowledge contribution, and its assessment of usefulness relative to the purpose of the collaboration. This assessment was based on an enhancement of linkography (Goldschmidt 1990, 1995) to track the refinement of the knowledge contributions according to their effective emergence (page 116). I defined effective emergence as a measure of the number of knowledge moves from the original inception of an idea through refinement to its final presentation and it was important in tracking the progress of the fuel reduction idea in the second Woolworths' case study.

Linkography is based on the analysis of "think-aloud" sessions to record the "designer's 'on line' reasoning" (Goldschmidt 1990, p. 291), in which researchers were present with the designer in a co-located open type of group collaboration. The design move assessments were made at the point of socialisation by the designer of design processes with the researcher. Similarly, in the case studies, knowledge contribution assessments were made during the socialisation phase of the "SECI" cycle (Nonaka, von Krogh & Voelpel 2006, p. 1182). In the first Woolworths' study for example, assessments were made during the workshops and communicated by email to other knowledge creators. The State Government Agency case study placed reliance on email. Here, the SECI process involved the exchange of emails in a distributed Ba and the knowledge contribution assessments, like the co-located collaborations, were made in the socialisation phase. The knowledge contribution assessment utilising Ba and SECI of OKC provides a common methodology for application over multiple types of collaborations.

### 6.4 Purpose and Value Proposition

OKC stresses that each Ba session requires a clear set of intentions and work objectives (Nonaka, Toyama & Hirata 2008). For knowledge contributions to be useful, these intentions and work objectives must necessarily be aligned to the collaboration's purpose. There is always a degree of risk and uncertainty in knowledge creation collaborations for process and product innovation. The purpose should indicate areas of uncertainty and as far as possible evaluate risk. In the collaborative wellness system (CWS), a formal process has been laid down for documenting the purpose as a joint value proposition (see section 4.5 on page 149), that provides guidance as to how the created knowledge will be assessed and value realised through use in the organisation. The first Woolworths' case study was affected by incomplete guidance. Lacking clear requirements for devising estimates, the knowledge creators used their understanding of budget estimates in line with their experience and thereby set the scene for the clash in purpose discussed earlier.

## Collaborative Wellness Through Dynamic Role Alignment

CWS is intended to support carrying out comparative studies of knowledge creation collaborations. The Collaborative Wellness Scale (scale) developed in section 5.5 on page 183 is the means of comparison. CWS provides a structured value proposition for devising, implementing and tracking the set of intentions and work objectives mandated by Nonaka, Toyama & Hirata (2008). The collaborative wellness network (CWN) is a network of collaborative wellness units (CWU) connected through joint value propositions deconstructed from the collaboration's joint "value proposition" (Osterwalder & Pigneur 2003, p. 431) that links the stakeholder and their expectations to the statement of potential value co-creation to the knowledge contribution created by the knowledge creator. The knowledge contribution assessment (see section 3.8.6 on page 113) provides a judgement of the state of the knowledge contribution relevant to the purpose as expressed by the value proposition from the stakeholders.

During planning, this chain of links connecting the CWU's may be used in a top-down perspective to align the proposed purpose with the available capabilities of the organisation or to identify capabilities that need to be secured for the collaboration. An example of the top down approach from the second Woolworths case study was discussed in the vendor pack resizing issue in section 5.3.4.1 on page 176. Here Technical Services (TS) reframed their solution to make their solution approach compatible with the cost expectations of the retail stakeholders. This top-down perspective was used in reframing the fuel reduction idea where I matched the fuel usage and tyre wear verification process to the available trucks and capabilities of the transport business in the logistics unit. The top-down approach was complimented by the application of a bottom-up perspective that ensured the trucks selected were managed in such a way as to deliver the full benefits of savings to Woolworths.

When reviewing either an existing or a completed project, the same chain of CWU relationships forms a reference point for collaborative wellness assessments. If the chain cannot be established, as in the mixed vendor project, then it indicates issues associated with the purpose. In this example, not all stakeholders had been identified and included in the project.

The CWS scale and structured value proposition provides a rigorous methodology for designing, implementing and tracking progress in a collaboration. For collaborations that have been identified as needing facilitation (Rose, Hawryszkiewicz & Kang 2014) the methodology can also be used for a root-cause analysis of all activities.

## 6.5 Path Dependence.

The knowledge creation collaborations in CWS are complex open social systems (see section 3.7 on page 106). Furthermore, knowledge creation is a complex activity (Nonaka & Toyama 2003; Nonaka, Toyama & Konno 2000; Nonaka & von Krogh 2009). CWS with its complex interactions and feedback loops exhibits path dependence whereby current and future states depend on the path of “previous states” (Rotmans & Loorbach 2009, p. 186).

The effects of the conflicts in purpose discussed in section 5.3.2.2 on page 172 show the path dependence of the ideas stemming from the resolution of this situation in the cost extraction study. However, path dependence was not confined to events within this case study. The second Woolworths’ study exhibited path dependence as its purpose was determined by stakeholder decisions in the first study. The first study showed the difficulty of implementing new ideas within the organisation, starting with the planning stage of estimating the benefits of ideas. Based on this experience, the second case study was tasked with answering the questions “(1) how do we identify new idea implementations that need facilitation; and (2) how can these implementations be facilitated?” (Rose, Hawryszkiewicz & Kang 2014, p. 217). The fuel reduction idea was selected by the Woolworths’ steering committee for the second study to use in investigating how to facilitate a new idea implementation.

## 6.6 Dependencies and the Collaborative Wellness Unit.

In the fourth case study at a Commonwealth Government Agency the 22 issues nominated by CGA managers (see appendix on page 210) were mapped to Collaborative Wellness Unit displayed in Figure 30 on page 182 (together with the location of discovered issues from the other case studies). The value of using the CWU was in identifying the location of the problem as the relationships correspond to actual process steps in the human centric information systems being studied. Therefore, issues once positioned, indicated the process requiring investigation and remediation. Tracking anti-clockwise from the location of the problem identified the potential impacts of the problem, while moving clockwise from the problem identifies possible sources of the problem for further investigation.

The case studies’ findings demonstrated that all of the components of the collaborative wellness unit are required for collaborative wellness, for example, the missing stakeholders in the shared vendor idea of Woolworths’ second case study led to the project being cancelled. The fuel reduction verification showed that maintaining an acceptable level of collaborative wellness required a balancing of all the relationships in the dimensions of collaboration rather than concentrating on any one dimension or aspect. The annotated CWS (Figure 30 on page 182) demonstrated the value of comparing collaborative experiences. The comparisons here were valuable

because the studies were designed to complement each other and be performed using the same action plan (Rose, Hawryszkiewicz & Kang 2015, p. Fig 4).

### 6.7 Complex Emergence

The Collaborative Wellness System (CWS) is a complex open system, as such, it is capable of exhibiting emergence in its higher levels stemming from the complex interactions at lower levels such as group emergence from lower level interaction of the knowledge contributors. Emergence in human activities is called "level 5 emergence" (Ellis 2006, p. 14) because humans exercise conscious design and decision making. Did emergence occur at the group level in the case studies?

The test for emergence I adopted was that of Ronald, Sipper & Capcarrère (1999) who based their test on the work of Turing (1950). In this test, emergence is said to have occurred when there is "a cognitive dissonance between the observer's mental image of the system's design ... and his contemporaneous observation of the system's behaviour" (p. 228). That is, the well-informed observer is surprised at the behaviour of the system and is unable to reconcile this behaviour with their expectations based on their knowledge of the system.

In the first Woolworth's case study, I was surprised at the appearance of the conflict in purpose (see section 5.3.2.2 on page 172), and at first, thought that emergence had occurred. However, upon reflection, the issue stemmed from a misunderstanding of the word "budget", that is, there was a deficiency in the joint value proposition, which reflected a lack of understanding of the collaborations' circumstances in the Woolworths context. To me, budget implied an approximation that was used to rank a set of idea possibilities. However, to the other knowledge creators, who were also Woolworths' managers, budget was understood in terms of an operational budget where line items were accurate targets that must be met. In this light, without remediation of the collaboration's purpose, the conflict of purpose was inevitable and the results of the conflict could not be classified as emergent.

In the case of the mixed vendor storage idea discussed in Rose, Hawryszkiewicz & Kang (2014), it was surprising to the Woolworths' manager when the project was cancelled by an external stakeholder, but this was not emergence. On first consideration, it was evident that the discovery process of the collaborative wellness network was incomplete and did not include all stakeholders. However, an alternate viewpoint is that stakeholders were known, but there was a lack of support and involvement by stakeholders because the value proposition was not persuasive either through lack of understanding or through being poorly explained and promoted (Senapathi & Srinivasan 2011). In this light, the reaction of the one or more uninvolved stakeholders were not surprising and emergence had not occurred. I

recommended that the project needed to be reframed and facilitated (Rose, Hawryskiewicz & Kang 2014, p. 222).

The discussions of this section highlights the role of the collaborative wellness unit and the collaborative wellness network in supporting knowledge contribution assessments. There was sufficient detail in the assessments and their linked paths for revisiting and re-assessing situations and outcomes as my experience and knowledge of the Woolworths' context improved over the two years of the case studies.

### 6.8 Limitations

The business purpose of the research case studies was to deliver a benefit to the host organisation with minimal impact on business-as-usual activities, see Table 27 on page 166 for the business purpose in each of the four case studies. The research purpose was that of a trial in which role alignment was the input and collaborative wellness changes the observed output. Through making or observing changes in role alignment and the effects on collaborative wellness would be verified to answer the research question. As discussed, the case study was a business collaboration intermeshed with a research collaboration with myself acting as a boundary spanner between the two. This dual collaboration structure had limitations bought about by both business and research constraints, which is the subject of this section.

#### 6.8.1 Time Constraint

Reflecting my experience, the case studies were to be limited to three or four month's duration. This constraint was interpreted by the organisations as on-site time, which corresponded to Stages 3 and 4 of the action plan in Table 28 on page 167. In the State Government Agency study, there were limited opportunities to gather feedback on proposals through interviews. In the first of the Woolworths' case studies not only was there a constraint on elapsed time, but the workshops and final presentation were scheduled well in advance. In this study, the time constraint affected the outcome of the study as discussed in section 5.3.2.2 on page 172. In the CGA study, staff knowledge creators were active team managers with high utilisation. Organising issue workshops was considered to be of low priority and took time to organise, given the restrictions on time; there was pressure on these face-to-face workshops to produce useful knowledge contributions.

On balance, the time constraint was useful in verifying the collaborative wellness system; it placed limitations on decisions by forcing the choice of strategies within the set time constraints. The conflict of purpose issue in the first Woolworths' case study was a case in point. The time constraints precluded me from seeking to gain knowledge to carry out acquisition of skills necessary to perform a Woolworths' business plan estimate. This experience provided valuable insight into the

relationship of time with requisite variety and role-in-use alignments. The time constraints reflected business activities in which time is a valuable and scarce commodity and pressure is placed on staff to efficiently allocate time and minimise time spent on activities (Fugate, Thomas & Golicic 2012).

### 6.8.2 Participant-Observer

The qualitative nature of the assessments and the tacit knowledge in the SECI knowledge creation processes mandated the presence of myself as an in-situ observer. Furthermore, I was also an active knowledge creator in all four studies. The risks in these studies stemmed from the introduction of bias by myself, which could result in the knowledge contribution assessments lacking objectivity.

In the SGA case study, to minimise bias, the results of meetings and subsequent assessments were reviewed with stakeholders and the final report was socialised with all knowledge creators and stakeholders. In the first Woolworths study, all assessments were circulated and discussed in the workshops. The final report of this study, like that of the SGA study, was circulated to knowledge creators and stakeholders before being discussed in detail at the final presentation. Despite this, my perception was that there remained an element of subjectivity. The subjectivity was addressed in the second Woolworths' study. Here, the assessments of usefulness of the test results were conducted by the tyre vendor and verified by Woolworths. The outcomes of the case study were validated by Woolworths and permission was given to publish the results under the Woolworths name (Rose, Hawryskiewicz & Kang 2014).

### 6.8.3 Specialist Nature of Case Studies

All case studies involved specialist knowledge creators drawn from the same practice community within a particular business unit of the organisation, so cultural diversity did not play a part in the case studies. In the State Government Agency, knowledge creators were data administration experts while in Woolworths, knowledge creators were from the Logistics business unit. The knowledge creators in all the organisations were long-term staff members in managerial roles. The purpose of each case study was agreed with the organisation. The organisation then selected and assigned knowledge creators to the case study collaborations. Although this process was necessary for the case studies, it does mean that findings, recommendations and conclusions need careful validation before application to other contexts.

### 6.8.4 Limitations Reflect Commercial Engagements

"The constraints of time; the necessity to minimise disruption to business activities; the focus on the validation of measures; and the effects of the researcher's role as a participant-observer affected the behaviour of knowledge creators and the progress of collaborations" (Rose 2013, p. 430). However, the case studies were designed to

emulate an organisation engaging an external expert to bring fresh perspectives to problem solving activities. The limitations of the studies reflect real-life experiences in short term external engagements. I opined that the limitations were useful in validating the collaborative wellness system and gave greater weight to the research findings and conclusions.

### 6.9 Summary

In this chapter, the discussion involving the four participatory action research case studies showed that the collaborative wellness system (CWS), its comparative scale and measures overcomes the criticism of Organisational Knowledge Creation theory (Nonaka, Toyama & Hirata 2008) that it lacked the precision to support measures for tracking knowledge creator interactions and did not consider reflective thinking of individual knowledge creators (Gourlay 2006). The case study experiences also showed that the research outcomes could be used to both identify collaborations that needed intervention to improve outcomes and inform devising, applying and tracking improvement strategies.

The discussions involving the fuel reduction project of the second Woolworths' case study demonstrated that structuring the purpose of the collaboration using the collaborative wellness system was effective in aligning the collaboration to the expectations of its stakeholders.



## **Chapter 7 Conclusions.**

This is the concluding chapter of the Thesis. The contributions to research, namely the role-in-use, role alignment and the Collaborative Wellness System are summarised. This is followed by how the research and case study outcomes may be applied to business organisations. The final section identifies four directions for further research. The chapter concludes with a summation of research outcomes.

### **7.1 Contributions to Research**

This research contributes to the information systems of knowledge through the validation of my concept of collaborative wellness and its use in the collaborative wellness system for assessing and fine-grained tracking of the progress of knowledge creation collaborations.

#### **7.1.1 Theoretical Contribution**

A key contribution to theory was the concept of the role-in-use (see sections 3.9 on page 116 and 3.3 on page 96) for studying the dynamics of knowledge creation and socialisation. A role-in-use is created by a knowledge creator using their free will to accept and interpret their responsibilities in a knowledge creation collaboration. I devised role-in-use alignment to assess how well a knowledge creator occupies and performs their role-in-use to align with the purpose of the collaboration. The experience of the case studies informed theory development and led to my concept of the collaborative wellness unit (see section 3.9.7 on page 124) which is the collection of relationships necessary to perform a joint value proposition in a knowledge creation collaboration.

Researchers conceive Ba as a collaborative space that ranges from a physical space such as a meeting space to a virtual space. Ba is a "shared context in motion" (Nonaka, Toyama & Hirata 2008, p. 34). I devised the collaborative wellness framework (CWF) to provide the structure for supporting knowledge creation in Ba. CWF is based on Living Systems Theory (Miller 1978; Miller & Miller 1995a) with updated definitions of the group (see section 3.6 on page 103).

I addressed the criticism of Organisation Knowledge Creation theory (Nonaka & Takeuchi 1995) Knowledge creation theory (Nonaka & Takeuchi 1995) that it is at the level of the organisation without detailed explanations of knowledge processes at the individual or group level (Gourlay 2006) by conceptualising Ba is an innate human attribute resulting from tacit knowing and that the knowledge created in Ba is either "tacit or rooted in tacit knowing" (Polanyi & Prosch 1975, p. 61). This reconceptualization underpinned devising the theory supporting the Collaborative Wellness System (CWS).

### 7.1.2 Methodological Contribution

CWS enables innovation and knowledge researchers to design trials to investigate and compare the complex activities of knowledge creation collaborations using the rigorous and validated methodologies of the collaborative wellness assessment process. Researchers can devise cross-level research propositions between the levels of the knowledge creator, group and organisation. Furthermore, in-level research proposals can be developed. Researchers can apply perspectives to the discovered collaborative wellness network (section 3.9.8 on page 125) to examine relationships, knowledge flows and effects of applied causality from a coarse-grained level of the organisation or group to the fine granularity of individual knowledge creation.

### 7.1.3 Substantive Contribution

The validation of the Collaborative Wellness System (CWS) with its concepts of role and role-in-use alignment by four case studies has provided researchers with the precision required to study human centric knowledge creation processes. CWS supports storing, profiling and comparing research experiences and could be utilised to benefit the research design of new case studies.

CWS may also be utilised in business analytics reporting applications for tracking and modelling knowledge creation systems. CWS would be effective in comparing business system performances for diagnosing issues, helping identify processes areas for remediation and acting as input into designing enhanced collaborative systems.

## **7.2 Contributions to Business**

The Woolworths' case studies examined the issue of the difficulty in introducing new ideas into well-established organisations. Outcome were a set of guidelines for identifying when intervention was needed to guide the implementation of new ideas. Strategies were developed to apply during these interventions together with the means for assessing, tracking and refining outcomes as the collaborations progress. CWS was shown to be affective in highlighting the difficulties associated with cross boundary collaborations.

Outcomes from the case studies laid the basis for the collaborative wellness scale (scale) (section 5.5 on page 183) for comparing and learning from the experiences of improving the collaborative wellness of knowledge creation. Experience in improving collaborations can be leveraged with good effect to design knowledge creation collaborations for collaborative wellness. CWS through its structured approach to the value proposition ensures that stakeholders take ownership and are involved with knowledge creators in the co-creation of value. This aspect of CWS was demonstrated in the second Woolworths' case study in which a collaboration was designed to test the level of fuel reduction from using low rolling resistance tyre technology. The collaboration results showed potential savings of 11% in fuel (Rose,

Hawryszkiewicz & Kang 2014, p. 224). The advantage of CWS was demonstrated by using the collaborative wellness unit to show the context of discovered issues and the ease with which stakeholders comprehended the issues and saw the context.

The outcomes of this practice based research enable businesses to adapt to changing conditions in today's markets to maintain and enhance their knowledge assets and competitive advantage in the market place. CWS will have application in situations demanding quick response to change, such as disaster relief mobilisation and deployment.

### 7.3 Opportunities for Further Research

Reflecting my practical experience, the case studies focussed on knowledge creation in group collaborations. The limitations of the case studies have been discussed in section 6.7 on page 199 and may be characterised as limitations in scope to group collaborations, the necessity of short duration and the limitations imposed through having low priority in the host organisation compared to business as usual activities. Despite these limitations, the feedback from case study experiences have pointed to opportunities for further research. Furthermore, CWS was developed on a synthesis and extension of well accepted theories and these provide an excellent base for expanding both the theoretical base and application of CWS to different types and sizes of knowledge creation collaborations.

Five directions have been identified for future research. To a degree, these overlap and it is a matter of devising perspectives and boundaries to focus the research effort. My research has shown that it is the relationship from the interplay of the collaborative dimensions that is more important than any one particular dimension. Choosing a direction for future work, will inevitably include the need to consider the other directions. Pragmatically, the choice of a direction is best considered as choosing a focus or perspective with which to approach research.

#### 7.3.1 Direction One: Extending the Collaborative Wellness System

A collaborations of groups was presented in Figure 2 on page 3. This collaboration was then viewed using the perspective of the collaborative wellness system as four collaborative wellness units sharing knowledge contributions and linked by the commonality in their joint value propositions (see Figure 4 on page 6). In keeping with my case study experiences, all of the CWU's were in the same collaborative wellness framework (CWF) of an organisation. However as the group type moves from co-located to distributed or virtual types, there is no reason why they should share the same CWF. Figure 31 below shows the four CWU's collaborating together but in different CWF's.

## Collaborative Wellness Through Dynamic Role Alignment

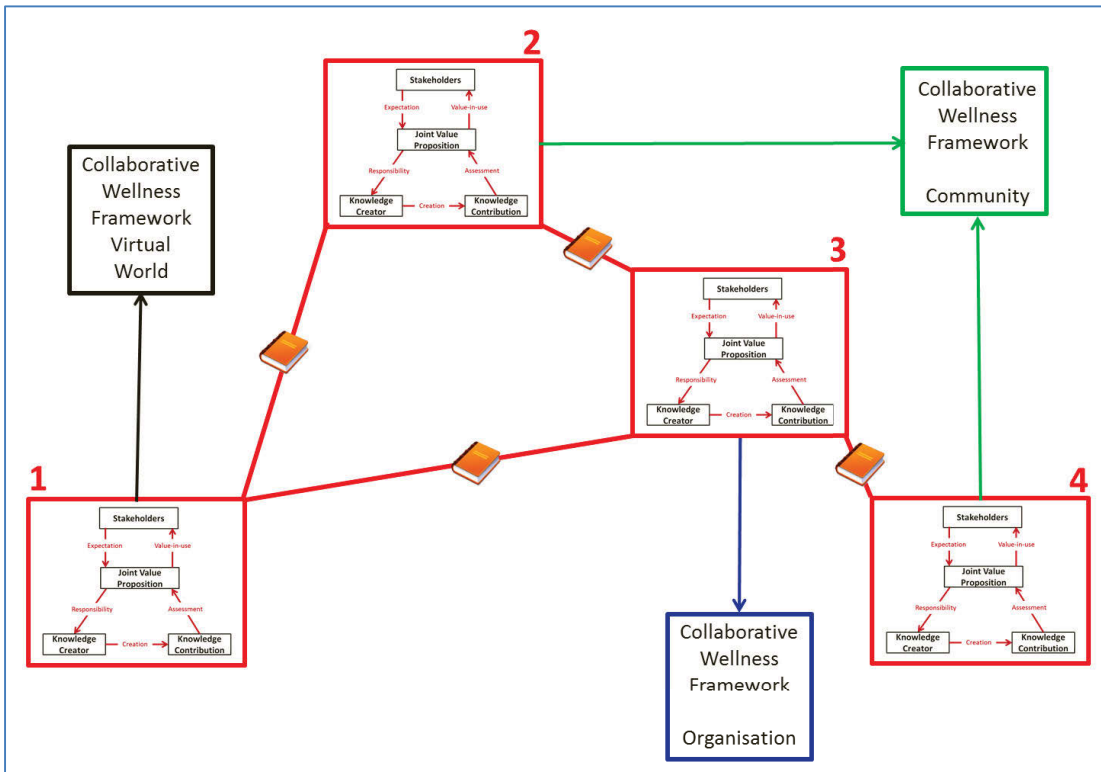


Figure 31 The Extended Collaborative Wellness System.

Introducing multiple CWF's requires greater attention to the design of cross-boundary processes. In the above figure, CWU 3 is within an organisation, and collaborates across organisational boundaries with CWU's 2 and 4. These latter CWU's exist in a community such as Facebook (Berger-Wolf, Tantipathananandh & Kempe 2010). In contrast, CWU 1 is in a virtual world (see Table 17 on page 104) and collaborates with CWU 2 that is distributed and CWU 3 that is in an organisation. This conceptualisation can be taken further, because any stakeholder or knowledge creator in a CWS may be in their own CWF context. For example, the stakeholders may represent different corporations in a geographically disbursed cluster collaboration (Erden & von Krogh 2011; Porter 1998). My research design for the case studies caters for these different circumstances and the section on the types of groups (See section 3.6 on page 103) shows the prominence of the collaborative dimensions for investigating these differences in structural contexts.

### 7.3.2 Direction Two: Investigate Larger Scale Collaborations

The second direction is to investigate larger scale collaborations of different types ranging from the co-located closed and open groups of the case studies to virtual open groups. Given today's ubiquitous internet, the virtual collaboration is considered to be a research priority particularly in collaborations including non-human actors. Researching different types of collaboration introduces matters of time zones, cultural differences and the dependence on technology that may or may not be appropriate

to the collaboration's purpose. This direction of research necessitates considering how different Ba spaces interact and affect collaborative outcomes.

### 7.3.3 Direction Three: Introduce Cultural Diversity

The third research direction is to introduce cultural diversity into the collaboration research and assess how cultural diversity influences collaborative outcomes. This direction overlaps the first, for example, a collaboration using teleconferencing may be dispersed across multiple countries with different cultures and languages. This direction introduces the effect of culture and ethnicity on the sorts of choices available too and made by knowledge creators in interpreting their responsibilities and then creating, occupying and performing their roles-in-use. It is conjectured introducing cultural diversity will have a similar effect on the knowledge contribution assessment process.

### 7.3.4 Direction Four: Examine the effects of Causality

The fourth direction is to examine the effects of causality on collaborative outcomes. Examples include bottom-up causality exerted through the choice of technology and media to support IT knowledge management services, top down from the influences of market forces, same level from relationships between knowledge creators and the effect of the local environment on knowledge creator wellness and subsequent flow-on effects to the knowledge contribution. The concepts of eWellness and eImmunity (see section 2.10.5 on page 73) would be excellent candidates for use in studying changes in role-in-use alignments.

### 7.3.5 Direction Five: Examine Effects of Organisational Circumstances

The fifth direction is dictated by the necessities required to support knowledge creation collaboration. That is, how would the circumstances of an organisation determine the use of CWS in designing, implementing and tracking of a knowledge creation collaboration? Case study experience pointed to the need for IT support to maintain such things as the changing relationships in knowledge contribution assessments.

## 7.4 Concluding Remarks

The collaborative wellness system was devised for studying and improving knowledge creation collaborations and their outcomes for use in innovation. The research question "*Do acceptable outcomes result from aligning roles-in-use in collaborations purposed with creating knowledge for process and/or product innovation?*" was posed to validate not only the theory supporting CWS but also its practical application. The outcomes of four case studies, two hosted by Woolworths Limited, one at a State Government Agency and the last with a Commonwealth Government Agency answered the research question in the affirmative.

## Collaborative Wellness Through Dynamic Role Alignment

The case studies helped to refine and validate the methodology for applying CWS to not only improve knowledge creation collaborations but to inform the design and implementation of new knowledge creation collaborations for collaborative wellness. The use of CWS resulted in quantifiable benefits to Woolworths Limited and the basis is now laid for expanding its beneficial application to other businesses and government agencies.

## Appendices

### State Government Agency Process Case Study Excerpts

The full report may be made available by request.

#### **2 Study Overview**

The NSW Department of Planning and Infrastructure (DP&I) hosted a research project by John Rose from the Faculty of Engineering and IT (FEIT) of the University of Technology, Sydney (UTS). The study's objective was to devise strategies to facilitate collaboration and performance of processes supporting DP&I planning systems.

Figure 32 Excerpt from State Government Agency Report. Page 6.

### Woolworths Cost Extraction Case Study Report Excerpts

The full report may be made available by request.

#### **2 Introduction**

##### **2.1 Overview**

The ideas, issues and suggestions included in this paper are based on interviews and workshops within the Logistics team. Work has focussed on the Minchinbury Distribution Centre with a view to being able to identify opportunities that could be extended to other sites and nationally.

A SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis was carried out and discussed at a Minchinbury workshop on May 29<sup>th</sup>. The SWOTs are included in Section 6 on page 16 for Transport and Section 7 on page 17 for Operations. The workshop resulted in a list of ideas and opportunities that was compiled and distributed for evaluation to group participants. On July 2<sup>nd</sup> a further workshop was convened at Minchinbury to finalise the ideas. The ideas and recommendations are summarised in Section 3 on page 4.

The study showed the complexity associated with evaluating ideas for implementation into an established site that had mature organisational practices, for example see the fuel farm ideas discussed in Section 4.2.4 on page 13. Savings from implementing some existing cost reduction initiatives need to be evaluated before further opportunities can be exploited (see section 4.2.3 on page 12).

The study considered how opportunities were formulated and evaluated within the time constraints of the study. From this perspective of knowledge management some opportunities have been identified for follow up work in the areas of: knowledge availability; evaluation; and identification of expert resources (see sub-section 2.3 below).

Figure 33 Excerpt from Woolworths Cost Extraction Report. Page 2.

## Woolworths Idea Management Case Study Excerpts

The full report may be made available by request.

### **1 Executive Summary.**

The 2013 idea process case study arose from a recommendation following the completion of the 2012 cost extraction case study. The recommendation was to devise and recommend methods to improve the processing of ideas and utilisation of knowledge. There was general agreement at the final presentation of the first case study on Friday 5<sup>th</sup> July, 2012 that this present study should look at a facilitated approach to improve idea process outcomes in the Logistics business unit.

Figure 34 Excerpt from Woolworths Idea Management Report. Page 3.

## Commonwealth Government Agency General Approach

The full report may be made available by request.

### **1.2 General Approach to Resolving Issues.**

In this study, our objective is to put forward recommended approaches for investigating the issues raised by managers. In general, our strategy is to characterise the impact of the issues on both sides of the collaborative process that is both the provider (e.g. IT) and consumer (e.g. Business). The impact assessment will seek to quantify the monetary and social costs of not addressing the issue and contrast this with the situation in which remedial action has been taken. It may well be that our investigations of issues may not find improvements that could resolve the issues and meet business case requirements.

The following points are indicative of the general tasks in the investigation:

1. Select typical cases of completed projects that have exhibited the issue.
2. For each project:
  - a. Estimate issue impact on Application Team.
  - b. List work-around strategies used and any on-going issues.
  - c. Identify characteristics specific to the project and systemic to general work practices.
3. Review work processes of engagement between teams from both the perspective of both supplier and consumer
4. Socialise review individually with relevant managers and then appropriate joint workshops.
5. Devise facilitation strategies and estimate value proposition.
6. Socialise findings

Once the findings have been socialised and recommendations updated, the recommendations can be prioritised and formal business cases prepared.

Figure 35 Excerpt from Commonwealth Government Agency Issues Report. Page 3.

## Commonwealth Government Agency (CGA) Issues Summary

The excerpts in this section have been subjected to de-identification. The heading and issue numbers have been maintained to be consistent with the original case study report.



## Study Roles.

Stakeholders: Stakeholder 1. Chief Information Officer, CGA  
Stakeholder 2. Manager, IT Service Delivery, CGA Information Technology Services

Facilitator: Facilitator 1. Executive Assistant to Stakeholder 2, CGA

Contributors: Stakeholder 2.  
Manager 1 - Application Development  
Manager 2 - Converged Networks  
Manager 3 - Infrastructure Operations  
Manager 4 - Disaster Recovery  
Manager 5 - Business Intelligence  
Manager 6 - IT Security  
Manager 7 - Service Management  
Manager 8 - Registry

UTS John Rose. Co-Chief Investigator, FEIT.  
Dr Kyeong Kang. Co-Chief Investigator, FEIT.  
Professor Igor Hawryszkiewicz. Study Mentor, FEIT

### 1.1 Issue Matrix

The issue matrix is intended to inform the process of structuring future projects to address the issues identified in the study. Projects may be structured according to defined work areas or to cover common themes such as developing and facilitating understanding between business and IT. The issue matrix will be refined in the light of socialisation of the issues with the team managers.

Issue Category	Issue Type				Totals
	Internal to Team	Inter-Team	Inter-Silo	CGA External	
Change Management plus CMMI/QMS		5.2; 6.1; 6.2;	2.2		4
Application Support			2.3		1
Workflow	3.1 9.3	5.1	4.4 5.1 8.3 9.1		7
Capability			4.1		1
Business Case Development			4.2		1
Application Support			4.3		1
Resource Management	7.1	10.1	8.2		3
Collaboration		8.1	9.2		2
Group Initiatives		10.2 10.3			2
Total	3	8	11	0	22

## 2 Application Development

### 2.1 Inadequate Support Funding

Issue	Description
Manager's Statement	Business cases for new systems underestimate build and ongoing support costs [and inflate benefits]. This results in projects de-scoping deliverables with an expectation that the gaps can be filled with existing "BAU" resources; delivering applications for support without delivering the tools, functions or complete documentation required for support; replacing applications without considering or funding the related decommissioning of the legacy applications; etc.
Type	Inter-Silo. (IT – Business)
Category	Business Case Development.
UTS Initial impressions	We would consider that a strategy of facilitation is appropriate to tackle this issue. The facilitation would take place from the evaluation and development of the project business case to ensure relevant factors are taken into account and that teams are aware of budgetary decisions and their implication. The facilitation would involve monitoring of progress to agreed goals and a post implementation assessment to develop learning-by-doing knowledge for future projects.

### 2.2 Prioritisation.1

Issue	Description
Manager's Statement	Inconsistency in business prioritisation of required changes. There are a few factors. Budget allocations are finite and insufficient to meet internal demand. Business units tend to plan initiatives independently of each other and where the initiatives require IT resources each has one or more "number 1" priorities. Within business units there can be several people each with their own set of "number 1" priorities. Often a commitment to delivering on a number 1 priority is immediately followed by requests to deliver another, without any recognition of the opportunity cost or that there is a zero sum game where the budget is fixed. Business units often do not build into their planning the lead time for the IT effort but commit to a delivery time.

Issue	Description
Category	Change Management
Type	Inter-Silo. (IT – Business).
UTS Initial Impressions	Our approach is to focus on integrating change management into planning with sufficient lead time given to allow for impact analysis that includes not only the effects of the change but also the effort required to produce, implement and co-ordinate the change in the context of multiple teams and requests. We would see this as an extension to the facilitation strategy discussed in 2.1

### 2.3 Hidden cumulative inefficiencies.

Issue	Description
Manager’s Statement	Inadequate functionality delivered by COTS applications causes "hidden" organisation inefficiencies. The visible large cost of customisation is avoided but invisible minor inefficiencies are imposed on end users. These accrete with additional systems and progressively effect overall productivity and morale.
Category	Application Support
Type	Inter-Silo. (IT – Business)
UTS Initial Impressions	Assumption is that the acronym COTS means “computer off the shelf”. Our thinking is to conduct workshops to discuss the issues around COTS software. This would enable us to categorise the sources of inefficiencies and put forward suggests like user experience resources (e.g. on-line Q/A); in-house training that could include one-on-one help sessions. The approach would need to consider how COTS applications are acquired, versions-in-use, and what vendor support is available. Depending upon findings, consideration could be given to recommending CGA process changes to minimize identified inefficiencies.

## 3 Converged Networks

### 3.1 Process Heaviness

Issue	Description
Manager’s Statement	Process heaviness - In and of themselves they generally do not sink the boat but add them all together and they steal a lot of time and focus. Examples:

Issue	Description
	<ul style="list-style-type: none"> <li>- Change</li> <li>- Access to data centres</li> <li>- Procurement</li> <li>- Bill payment</li> </ul>
Category	Workflow
Type	Team-Internal
UTS Initial Impressions	We would suggest a work flow analysis to highlight congestion points and provide detail of the issues. A value proposition can then be constructed to identify benefits of process rationalisation, spreading work-load and/or recruiting additional staff to manage load.

## 4 Infrastructure Operations

### 4.1 Service Capabilities

Issue	Description
Manager's Statement	There is a mismatch for afterhours support requirements, business expectation, actual SLA's, and staff agreements are not in agreement.
Category	Capability
Type	Inter-Silo
UTS Initial Impressions	Our approach would be to consider a requirement gap analysis to identify expectations versus implemented capability agreements from the perspectives of business and IT. Where possible, the work would involve the evaluation of the impact of gaps on operational budgets. We foresee that a workshop between IT and Business may be required to understand how to resolve the gaps and the effort involved in the resolution.

### 4.2 Lack of Business Engagement

Issue	Description
Manager's Statement	The project portfolio is driven by the business and therefore very business focused, to the exclusion of infrastructure projects. As a result the impact of major infrastructure projects is not well understood by the business, and infrastructure projects are

<b>Issue</b>	<b>Description</b>
	typically prioritised lower and sometimes deferred, leaving very short timelines for infrastructure projects.
Category	Business Case
Type	Inter-Silo
UTS Initial Impressions	We suggest that the starting point is to detail the impacts from selected previous projects. This analysis would inform a discussion with business and we would seek to understand the related impacts on the business side. A decision may be made to implement a facilitation process between the teams to aid in business case development and implementation planning

### 4.3 Application Deployment and Support

<b>Issue</b>	<b>Description</b>
Manager's Statement	Business procure and request to deploy individual apps that may or may not work in the environment. This adds a significant load to the infrastructure team, as by default we support these small apps. Typically they have no renewal or maintenance budget.
Category	Application Support
Type	Inter-Silo.
UTS Initial Impressions	This issue is the same issue discussed in Section 4.2 but from a different perspective. The two issues could be combined and considered together.

### 4.4 Resource Requests

<b>Issue</b>	<b>Description</b>
Manager's Statement	Resource requests do not always follow the chain of command. Normally in problem resolution, project deadlines or missed requirements, people go directly to the relevant resource rather than via their direct manager. This makes it difficult to deliver to deadlines or project schedules.
Category	Workflow
Type	Inter Silo
UTS	This is a related issue discussed in 3.1. We suggest that the two issues be combined.

<b>Issue</b>	<b>Description</b>
Initial Impressions	

## 5 Disaster Recovery

### 5.1 DR Work Flow

<b>Issue</b>	<b>Description</b>
Manager's Statement	Delays are being noticed during the DR planning phase whereby teams are not providing the requested information/actions on time - During the DR planning meetings, teams are assigned actions and are requested to submit information by a certain agreed date. All items discussed during the meetings are formally captured into the meeting minutes and distributed. I am finding there is a need to send chaser reminders to get the action items closed out which results in further delays and introduces unnecessary risk to DR projects.
Category	Work-flow
Type	Inter Silo, Inter Team
UTS Initial Impressions	There is an established process for DR planning and DR team involvement. We consider an investigation as to why other teams are not meeting work-flow requirements is appropriate. The investigation would include an impact analysis of the current situation and look at areas including priorities and the capacity of other teams to respond and so on.

### 5.2 CMDB

<b>Issue</b>	<b>Description</b>
Manager's Statement	CGA currently lacks a CMDB - There is no centralised database that contains all of CGAS IT systems and infrastructure. By not having access to a CMDB, it is difficult to know exactly what systems are hosted in each data centre from a recovery and audit point of view and requires lots of back and forth communication between various teams to obtain pieces of information. Whilst requesting this type of information from teams, at times it is impossible to get all required details and a lot of time and effort is needed to follow up.
Category	Change Management

Issue	Description
Type	Inter Team
UTS Initial Impressions	<p>CMDB is at the heart of change management systems and requires a stable, well established process environment to support it. Our approach would be to look at short and long solutions. The first task would be to identify requirements – are they limited to information sets about infrastructure or is a full change management system required? Secondly, information about systems needs to be gathered into an ontology that can be updated and used to inform a decision concerning the CMDB. If the requirements were for full change management then an investigation would be required to examine CMDB implementation and management in other agencies. The ontology can be imported into the CMDB system.</p>

## 6 Business Intelligence

### 6.1 Organisational Maturity

Issue	Description
Manager’s Statement	<p>Two issues from Manager 5 have been combined:</p> <p>Maturity of the Organisation when it comes to technology in general, particularly working with IT in a collaborative partnership model.</p> <p>Maturity of the IT Organisation, to deliver services in a consistent repeatable and integrated fashion.</p>
Category	Change Management (CMMI and QMS)
Type	Inter Team (initially).
UTS Initial Impressions	<p>It is fair to argue that many of the issues discussed in this document fall under a more general category of implementing Quality Management Systems (QMS) and Capability Maturity Model Integration (CMMI). In the context of the current organisational changes, the initial approach would be to investigate processes and work flows to discover general issues and problems that may be addressed with partial implementation of aspects of QMS (based around ISO 9002) and CMMI.</p>

### 6.2 Quality Management

<b>Issue</b>	<b>Description</b>
Manager's Statement	Operational effectiveness of the IT Finance process, the current process has high amounts of errors.
Category	QMS
Type	Internal Team.
UTS Initial Impressions	We would approach this issue by firstly identifying the data processes involved in the system and where errors are occurring. This allows the establishment of "quality gates" for monitoring data and supports investigation of root cause. A QMS can then be established once the system is characterised so that all processes are transparent and users are fully aware of issues. A remedial program can be planned with involvement of users to prioritise fixes and address data quality issues.

## 7 IT Security

### 7.1 Resource Management

<b>Issue</b>	<b>Description</b>
Manager's Statement	The issues covered by Manager 6 are interdependent and we thought to treat them all together. Resourcing for hot skills Resource and task scheduling with projects Retention of staff with hot skills
Category	Resource Management
Type	Internal Team.
UTS Initial Impressions	Competition for people with "in-demand" skill sets is common in the IT industry. There could be three possible approaches: <ol style="list-style-type: none"> <li>1. Consider alternative technology that meets functional requirements but is more easily supported.</li> <li>2. Establish what actions have been taken to date in the context of CGA recruitment policies. For example, is there the flexibility for considering contract versus permanent roles?</li> <li>3. Can the roles be performed as support contracts through the vendor?</li> <li>4. Investigate the possibility of limited outsourcing of the roles.</li> </ol> <p>All of these suggestions would have varying costs, so we would suggest the need to investigate the cost to CGA if continuing with</p>



Issue	Description
	the current state. The establishment of a business case can therefore be used to investigate the suggested alternatives.

## 8 Service Management

### 8.1 Collaboration.

Issue	Description
Manager’s Statement	Being able to work more efficiently across teams
Category	Collaboration
Type	Inter-Team.
UTS Initial Impressions	Our approach would be to have a facilitator observe some of the team’s selected collaborations. Based on these observations, the facilitator would be able to devise strategies to assist the team and apply them on a “learning-by-doing” basis with full-team involvement. It could well be that some processes may be found in need of modification in order to improve collaborative outcomes.

### 8.2 Resource Request

Issue	Description
Manager’s Statement	Resource request from PM
Category	Managing Resource Requests.
Type	Inter-Silo
UTS Initial Impressions	This issue seems to be similar to 4.4. Our approach would be to characterise the problem, identify similarities with the other resourcing issues and identify common remedial actions.

### 8.3 Resource Management

Issue	Description
Manager’s Statement	<PROJECT NAME REMOVED> process between Business and IT
Category	Work-flow
Type	Inter Silo

<b>Issue</b>	<b>Description</b>
UTS Initial Impressions	This issue seems to be similar to 5.1 We would suggest combining the two investigations.

## 9 Registry

### 9.1 Enhancement priority

<b>Issue</b>	<b>Description</b>
Manager's Statement	Enhancement prioritisation - current challenge is that business makes decision on priorities before any consultation with IT and then unclear requirements are sent to IT for estimation of work. Sometimes less priority work items get delivered and high value add stay in the backlog for a while. It will be good to explore better solutions to establish early engagement with business and guide them through options before we even do estimation for the work. This way a number of unwanted work effort can be saved plus value add enhancements are delivered ahead.
Category	Work-flow
Type	Inter Silo
UTS Initial Impressions	This issue seems to be similar to Issues 2.2 and 4.2. We would suggest including Manager 8's team into these other investigations.

### 9.2 Collaboration Skills

<b>Issue</b>	<b>Description</b>
Manager's Statement	Collaboration - guidelines for teams to effectively communicate with internal and external stake holders for e.g. if a developer is working in a project he/she should be sensible in their communications to PM(s), testing team and business. Lot of the times developer sits quite in meetings and don't escalate things in advance. This can cause delivery challenges.
Category	Collaboration

<b>Issue</b>	<b>Description</b>
Type	Inter Silo
UTS Initial Impressions	This issue seems to be similar to Issue 8.1. However, there is a focus on personal communication skills development. We would suggest that the approach of a facilitator observing a collaboration would be effective in identifying areas for: identifying appropriate reporting chains; personal development; and team mentoring.

### 9.3 Workflow Diversity

<b>Issue</b>	<b>Description</b>
Manager’s Statement	Self/team prioritisation - Given my teams support both BAU and projects they always needs to juggle between priorities; some are good with it but some are not; Good to understand a team process that can be established to manage the demand and prioritise the work within teams; this could be more for team leads first.
Category	Workflow diversity
Type	Team-Internal
UTS Initial Impressions	This issue is about paradoxical thinking, that is managing competing and contradictory demands. Our suggestion is to characterise these opposing demands and identify how best to manage these processes across and within the teams. Areas to consider are resource pooling and cross-skilling.

## 10 IT Service Delivery Group

### 10.1 Project Resourcing

<b>Issue</b>	<b>Description</b>
Manager’s Statement	Project resourcing requests not based on detailed planning from PM resulting in late requests for support
Category	Workflow
Type	Inter-Team, Inter-Silo
UTS Initial Impressions	This issue is similar to 4.4 and 8.2, but in this instance has impacted the group as a whole. Our suggestion is to study examples of this issue at the group level and see if causes can be traced back to team issues. We think that the approach to this

Issue	Description
	issue involves a facilitation across the teams and could be undertaken as an extension of the work on team issues.

## 10.2 Initiative Engagement

Issue	Description
Manager's Statement	Lack of inter team support and team support for initiatives that will deliver improved business outcomes
Category	Initiatives
Type	Inter-Team
UTS Initial Impressions	We think that the issue stems from introducing new ideas into groups with high utilisation that have been optimised to process BAU activities. We suggest an investigation to ascertain the capability and capacity of teams to accept new ideas. The results will then allow us to tailor a facilitation strategy to the knowledge needs of the group. The initiatives may require a degree of rationalisation of the existing processes.

## 10.3 Prioritisation of Initiatives

Issue	Description
Manager's Statement	Non-strategic initiatives diverting effort away from strategic deliverables
Category	Initiatives
Type	Inter-Team
UTS Initial Impressions	This is a different aspect of the prioritisation issues raised by team managers (see 2.2 and 9.1). We suggest that examples of initiatives be examined to ascertain the level of understanding of the initiative, its acceptance and competing demands with business as usual expectations. Our approach would be to consider facilitation based on the investigation.

## Glossary of Terms

The literature review has a concept map keyed to the dimensions of collaboration in Figure 6 on page 17 of Chapter 2. A guide to theory development is provided in Table 15 on page 94 of Chapter 3. The glossary below, in alphabetical order, is a summary of key concepts from theory developed to support the collaborative wellness system.

The suggested reading order for the terms, starts with Collaborative Wellness (CW). CW is supported by the collaborative wellness system (CWS) that provides a framework (CWF) to support the collaborative wellness unit (CWU). The network formed of CWU's is called the collaborative wellness network (CWN). Collaborative wellness assessments (CWA) outline how to assess CW. CWA relies upon the concepts of the knowledge contribution, role-in-use, and role-in-use alignment. The concept of effective emergence of a knowledge contribution is important in considering how to compare knowledge creation processes using the scale of collaborative wellness.

<b><u>Term</u></b>	<b><u>Description</u></b>
Collaborative Wellness (CW)	CW is an assessment of the current state of collaboration relative to the state that would come about if the collaboration's purpose was fulfilled. Improving CW leads to enhancing the value realised in using the collaboration's outcomes. See section 3.9.4 on page 120.
Collaborative Wellness Assessment (CWA)	A CWA is the answer to "how does a particular circumstance, at a particular place and point in time, affect the collaboration's ability to fulfil its purpose?" See section 3.9.9 on page 126.
Collaborative Wellness Assessment (CWA) Process	The CWA process starts at the knowledge creator level with a narrow scope of the individual knowledge creator and their knowledge contribution. Lower level CWA's inform wider scoped CWA's at higher levels. Collaborative Wellness is the peak and final assessment with a scope over the whole collaboration. See section 3.9.4 on page 120. For recording assessments, see section 4.5 on page 149.
Collaborative Wellness Framework (CWF)	CWF is the social, physical and technological structure that makes-up and supports the collaborative spaces used by knowledge creators to fulfil the joint value

## Collaborative Wellness Through Dynamic Role Alignment

<b><u>Term</u></b>	<b><u>Description</u></b>
	proposition of the collaboration. See section 3.1 on page 92.
Collaborative Wellness Network (CWN)	CWN is the set of collaborative wellness units (CWU) linked through the relationships of their joint value propositions. See section 3.9.7 on page 124.
Collaborative Wellness System (CWS)	CWS is composed of all entities both human and non-human, activities and artefacts that affect or may affect collaborative wellness. See section 3.1 on page 92.
Collaborative Wellness System (CWS) discovery process	CWS is discovered by in-situ observation using the dimensions of collaboration (See Figure 1 on page 2) as perspectives, namely SOCIAL (Who?), PROCESS (How?) and MEANS (With what?). See section 3.1 on page 92.
Collaborative Wellness Unit (CWU)	CWU is the collection of relationships necessary for knowledge creators and stakeholders to perform a joint value proposition. See section 3.1 on page 92.
Effective Emergence of a Knowledge Contribution	Effective emergence of a knowledge contribution is the measure of the number of CWA's applied to the knowledge contribution to assess usefulness between the ancestral assessment that identified the original knowledge contribution and the current assessment.
Group Types	The type of group is determined by considering the location of knowledge creators and whether the group's boundaries are open or closed. See section 3.6 on page 103.
Joint Value Proposition	A clearly stated joint value proposition is crucial to a collaboration's ability to satisfy its stakeholders. The joint value proposition is created jointly by stakeholders as an expression of the collaboration's purpose (see section 3.8.4 on page 110). It is a request to perform a service; it outlines responsibilities, expectations,

## Collaborative Wellness Through Dynamic Role Alignment

<b><u>Term</u></b>	<b><u>Description</u></b>
	methodologies and resources to be used. See section 2.7.2 on page 43.
Knowledge Contribution	Created knowledge becomes a knowledge contribution when it is assessed for its usefulness in fulfilling the collaboration's purpose as expressed in the joint value proposition. A knowledge contribution transforms the state of knowledge in the subject domain of collaboration and informs decisions to take actions. See section 3.8.6 on page 113.
Knowledge Creation Collaboration	Organisations create knowledge creation collaborations for the purpose of solving problems. In my research, that purpose is to create knowledge for use in process and/or product innovation. See section 3.7 on page 106.
Knowledge Creation Process.	Knowledge creation is a tacit knowing process involving the use of imagination to produce "ideas that are guided by a fine sense of their plausibility" (Polanyi & Prosch 1975, p. 97). See section 3.8.2 on page 107.
Knowledge Creator	A knowledge creator is one who creates knowledge for use in product and/or process innovation. See section 3.4.2 on page 100.
Role-in-use	The role-in-use is created by a knowledge creator from their free will interpretation of their assigned responsibilities expressed by a joint value proposition. They perform the role-in-use such that all interactions affecting collaborative wellness are through their role-in-use. See section 3.9.1 on page 116.
Role-in-use Alignment	Role-in-use alignment is an assessment that encapsulates three CWA's at a particular point in time. Namely, the knowledge creator's level of wellness versus expected wellness, the degree to which a knowledge creator satisfies the requisite variety of their role-in-use, and lastly the usefulness of their knowledge

## Collaborative Wellness Through Dynamic Role Alignment

<b><u>Term</u></b>	<b><u>Description</u></b>
	contributions relative to that required for fulfilling the joint value proposition. See section 3.9.3 on page 119.
Scale of Collaborative Wellness (scale)	The collaborative wellness scale (scale) is intended for comparing collaborations. The category of acceptable collaborative wellness is the midpoint of the scale. Categories below “acceptable” represent situations where joint value propositions have not met stakeholder expectations. Categories above “acceptable” indicate joint value propositions that have met stakeholder expectations. See section 5.5 on page 183 and Table 31 on page 186 for an explanation of categories.



## Conferences and Publications

During the course of my PhD candidacy I attended the following conferences:

Table 33 Conferences and Publications.

Paper presented at	Notes
<b>ECMLG 2013</b>	<p>9th European Conference on Management Leadership and Governance (ECMLG 2013), held at Klagenfurt, Austria between 14<sup>th</sup> and 15<sup>th</sup> of November 2013.</p> <p><u>Citation:</u> Rose, J. F. (2013). <u>Tracking interactions in collaborative processes</u>. 9th European Conference on Management Leadership and Governance, Alpen-Adria Universität Klagenfurt, Austria, Academic Conferences and Publishing International Limited, Reading, UK.</p>
<b>ACIS 2013</b>	<p>24th ACIS held at the City campus, RMIT University, Australia. Between 4<sup>th</sup> and 6<sup>th</sup> December 2013.</p> <p><u>Citation:</u> Rose, J. F., et al. (2013). When and how to facilitate the introduction of new knowledge processes in organisations. 24th Australasian Conference on Information Systems. RMIT University, Melbourne, Australia, RMIT University.</p> <p>This paper received an award as runner up for the Best Knowledge management paper. It was subsequently published by emerald and endorsed by Woolworths' Limited:</p> <p>Rose, J. F., et al. (2014). "When and how to facilitate the introduction of new knowledge processes in organisations." Vine 44(2): 210-227.</p>
<b>PACIS 2015</b>	<p>19th Pacific Asia Conference on Information Systems (PACIS 2015) will be held at Singapore on the 5<sup>th</sup> – 9<sup>th</sup> of July 2015.</p> <p><u>Citation:</u> Rose, J. F., et al. (2015). Evaluating information systems for collaborative wellness. To appear in proceedings of 19th Pacific Asia Conference on Information Systems (PACIS 2015), Singapore.</p>

## References

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