

THE ALCHEMIST AND THE MAGICIAN:
QUALITY IMPROVEMENT THROUGH
EMPATHY AND LEARNING
IN COMPLEX SYSTEMS

A Thesis

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In Partial Fulfillment

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in

Quality Assurance

by

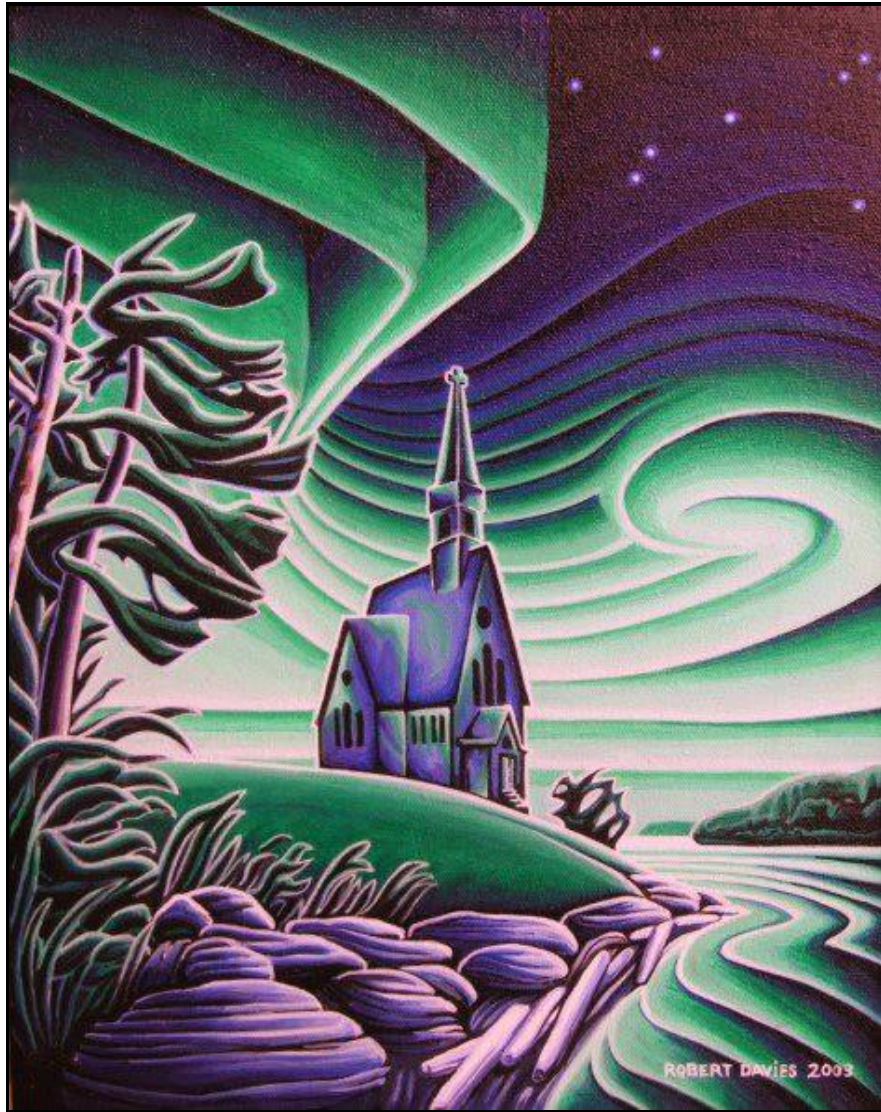
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This thesis is dedicated to every person that I have learned from.

The experience of magic arises through wonder, imagination and revelation.



$$\text{Symphony of Mind} = \left[\frac{\left(\text{Community} + \frac{\text{Variation of Mind}}{\text{Mind}} \right) * \text{Learning} + \text{Goodness}}{\text{Empathy} \bullet \text{Strategy} \bullet \text{Systems}} \right] \text{Wonder \& Imagination}$$

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We are a part of all things.

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ABSTRACT

At the heart of Quality Assurance is *Qualia*, man's ability to understand one other as a species. Understanding the customer requirements of a product or service requires empathy. This thesis will explain how quality assurance permits laboratorians to work effectively within healthcare systems, understand the voice of the customer and meet their requirements.

A questionnaire was used to obtain information from medical laboratory professionals employed in Canada. Four psychometric instruments were used to determine if: (a) Autistic personality types are prevalent, (b) Machiavellian personality types are prevalent and, (c) the cultural characteristics of the workforce.

Personality styles point to learning system archetypes in the human brain. A neurocognitive model called the *Triadic Adaptive Learning System* (TALiS) is proposed. A vision for humanity, called *The Quality System of Goodness*, is presented. This cybernetic system is supported by the ethics, science and philosophy of *Integral Permaculture*. Opportunities for further research are discussed.

CHAPTER 1

INTRODUCTION

Emperor Joseph II: *My dear young man,
don't take it too hard.
Your work is ingenious. It's quality work.
There are simply too many notes, that's all.
Just cut a few and it will be perfect.*

Amadeus Mozart: *Which few did you
have in mind, Majesty?*

Amadeus, by Milos Forman, 1984

Background

Laboratory medicine in Canada is undergoing unprecedented changes, due to internal and external forces influencing the organization, economics, and quality of all medical laboratories. Personnel employed in medical laboratories are experiencing increasing operational pressures to reduce cost and improve productivity while maintaining compliance with new regulations and quality standards (Li & Adeli, 2009). These changes are occurring in the face of a looming human resources shortage of laboratory technologists across Canada (Davis, 2002). Due to economic pressures, the laboratory system has evolved over time into a regional service model, resulting in complex social structures (Plsek & Greenhalgh, 2001). Therefore, during quality improvement initiatives, resistance to organizational change and social complexity is of ethical concern for quality assurance professionals when managing people with different personality types and meeting customer needs.

Understanding the Medical Laboratory Workforce

Several studies have brought to the surface some personality traits of the medical laboratory technologist. As an introduction, Table 1 offers the reader some historical evidence relating to the workforce characteristics. The evidence published to date is thought provoking. Noteworthy are the lack of Canadian psychology research studies on the medical laboratory workforce. However, this lack of evidence should not be surprising, when the research on the workforce to date, is seen in a greater context on workplace psychology in Canada.

Industrial-Organizational Psychology as a profession has a greater presence in the United States compared to Canada. In addition to a smaller profile in Canada, research productivity measured in terms of published journal articles, seem to suggest possible resource challenges and a need for greater research funding (Beiler, Zimmerman, & Clark, 2014). Caution should be taken with the evidence in Table 1, due to the instruments used within each study, their limitations, sample sizes and sampling methods. However, the 2009 study from Taiwan is troubling (Lee, Lee, Liao, & Chiang, 2009). Employee health has a direct impact on productivity, quality and customer perceptions of care. Therefore, medical laboratories can have greatly improved working conditions if more is known about the social dynamics within the laboratory and their relationships within a greater health service organization.

Table 1

Studies of the Medical Laboratory Workforce (1983-2009)

| STUDY DETAILS | RESULTS | SOURCE |
|--|---|--|
| US Study (Houston, TX) <ul style="list-style-type: none"> ➤ Eysenck Personality Test (EPI) ➤ 83 MTs, 57 Science Teachers | <ul style="list-style-type: none"> ➤ Study found that there was a significant difference between the two groups with medical technologists showing higher score for neuroticism | (Kazi & Piper, 1983) |
| U.S. Study <ul style="list-style-type: none"> ➤ Multivariate Personality Inventory (MPI), ➤ MTs (3 males, 28 females) | <ul style="list-style-type: none"> ➤ Compulsive scale most endorsed by MTs ➤ Technologists are drawn to the occupation for its technical qualities such as clear, concrete direction on tasks. | (Magaro & Ashbrook, 1985) |
| ASCP US longitudinal Study <ul style="list-style-type: none"> ➤ 101 Male MTs ➤ 303 Female MTs | <ul style="list-style-type: none"> ➤ Study investigated perceived gender discrimination in a female-dominated occupation, medical technology. ➤ Female MTs perceived higher gender discrimination than male MTs. | (Tatum & Bleau, 2000) |
| Study done in Finland <ul style="list-style-type: none"> ➤ 674 Males, 4981 Female ➤ Data on sickness absence collected ➤ Bullying and predictors of health measured | <ul style="list-style-type: none"> ➤ Workplace bullying is associated with an increase in the sickness absenteeism ➤ Targets of bullying seem not to belong to any distinct group when results were interpreted by researchers. ➤ Laboratory technologists included | (Kiyimaki, Elovainio, & Vahtera, 2000) |
| US Study, Georgia <ul style="list-style-type: none"> ➤ Moral reasoning among MLTs ➤ 47 participated in the study. ➤ Defining Issues Test, (DIT-2) | <ul style="list-style-type: none"> ➤ Study found that moral reasoning was “lower” than that of other health care professionals. ➤ no relationship between moral reasoning, Age, and gender, | (Kukoyi, 2007) |
| Study conducted in Taiwan <ul style="list-style-type: none"> ➤ 38 Males, 107 Females ➤ Brief Symptom Rating Scale (BSRS-5) ➤ Job Satisfaction Questionnaire (JSQ-40) | <ul style="list-style-type: none"> ➤ Prevalence of psychiatric morbidity defined by BSRS-5 was 34.33% with: <ul style="list-style-type: none"> a) Insomnia 28.36%; b) Depression 25.37%; c) Hostility (24.63%); d) Anxiety (23.13%), and; e) Inferiority (20.15%). | (Lee, Lee, Liao, & Chiang, 2009) |

Asperger's Syndrome and Autism Spectrum Disorders

Asperger's Syndrome (AS) is an autism spectrum disorder (ASD), that affects approximately 1 in 88 people based on the DSM-IV criteria, with as many as 1 in 54 males affected (Centers for Disease Control and Prevention, 2013). It is a neurobiological condition characterized by rigid, restricted, and repetitive patterns of behaviour and interests, atypical use of spoken language, significant difficulties with social interactions, and distinct cognitive differences (Alvarez, 2012). In addition to social and behavioural abnormalities that are characteristic of AS, individuals with the condition often have sensory issues, those being highly sensitive and possibly intolerant to certain sounds, light, and other sensory stimuli (Tavassoli, Miller, Schoen, Nielsen, & Baron-Cohen, 2013). It is important to note that AS falls within a spectrum of symptoms described as autistic in nature. Not all individuals with AS present the same clinical symptoms or severity (Alvarez, 2012).

There has been an increase in the level of publicity about Asperger's Syndrome in recent years. One reason for this increase in awareness is that it is believed that many affected by Asperger's Syndrome have special *savant* skills (Pring, Hermelin, & Heavey, 1995) or possess a gift of "genius" in them (Fitzgerald, 2002). Famous people speculated to have been affected by AS include Albert Einstein, Sir Isaac Newton, Michelangelo, and Amadeus Mozart (Fitzgerald & O'Brien, 2007). Individuals with AS, who can overcome the symptoms of Autism, have been found by researchers to be employed in the physical sciences, computer science, healthcare, and engineering occupational groups (Grandin, 2008). However, statistics supporting the *prevalence* of high-functioning

autism and Asperger's Syndrome in specific industries are not well documented, through large-scale studies of highly specialized occupational groups such as medical laboratory technologists. As well, generations such as the "Baby Boomers"¹ and "Generation X" group,² who were born before 1980 are largely undiagnosed (Baron-Cohen, 2007).

Cognitive traits of individuals affected with Asperger's Syndrome, as "candidate laboratory employees" will include: 1) strong systems thinking; 2) excellent eye for detail; 3) perfectionists; and 4) rigid adherence to process and routine. These behaviours that are demonstrated by individuals with AS can be reasoned to be "cognitive gifts" and required for analytic quality in laboratory medicine. For these reasons, technologists who may have AS are reasoned to be effective "process controllers" as a system *personality archetype*.

Machiavellianism and Change Management

The personality profile of a *Machiavellian* is credited to the literary work of Niccolo Machiavelli, a political advisor to the Medici Family in Florence, Italy in his book *Il Principe (The Prince, 1513)*. In popular culture, some traits and behaviours paint the Machiavellian personality type in a dark light. These personality characteristics may be due to a misunderstanding of literature and media sources. Machiavellianism, psychopathy, and narcissism is seen by clinical psychologists as part of a triad of subclinical personality traits known as the "Dark Triad" (Paulhus & Williams, 2002). For this reason, Machiavellianism carries a socially negative stigma (Rayburn & Rayburn, 1996). Many literature sources referenced the book *Studies in Machiavellianism* by

psychologist researchers Richard Christie and Florence L. Geiss, published in 1970. However, there is a great discrepancy between the evidence published in this book and what is understood today. Therefore, it is questioned by this author, if research since 1970, has revealed new clues about the true nature of the Machiavellian.

There has been great concern expressed by scholars about the “misrepresentation” of Machiavellianism within management. Researchers Grace and Jackson published an article in the journal *Philosophy of Management* stating this concern:

In the name of intellectual honesty and sound scholarship, we urge management scholars to take note of this distortion of Machiavelli, and where possible address it, and that the users of the Mach-IV scale distinguish the man, Machiavelli, and his works from this instrument. (Grace & Jackson, 2014, p. 51)

Researchers Grace and Jackson urged that individuals, who use the Mach-IV test in education, training, consulting, and research, ensure that they make the distinction between the real Niccolo Machiavelli, his works, the Mach-IV test and the distorted misconception of him. For the reader, it should be noted that Christie and Geiss discussed this issue in their book and admitted that the term “Machiavellianism” might be seen as inappropriate. However, Christie and Geiss stated that the research ideas came from *The Prince (1513)* and *The Discourses (1517)*. Therefore, they reasoned that credit should be given to these literature sources (Christie & Geis, 1970).

The reader should note that *Studies in Machiavellianism* is a significant body of work by Christie and Geiss, which spanned from 1954 to 1970. These researchers investigated Machiavellianism from a psychological perspective, leading to the development of two personality questionnaires, called the *Mach-IV* and *Mach-V* tests (Christie & Geis, 1970). Both psychometric instruments still hold validity, with high predictive value today. Christie and Geiss found the following behavioural characteristics of individuals who had high Machiavellian scores, called “High Machs”:

- 1) High Machs were successful manipulators, through coalitions and their structures, not through individuals;
- 2) High Machs do not bend to social pressures, unlike low Machs;
- 3) No relationship was found between High Mach scores and race relations;
- 4) High Mach behaviour is purely objective in nature and not linked to high or low achievement goals, rather more their *manner* to achieve them, and;
- 5) Researchers stated that Machiavelli was the “realist par excellence” (Christie & Geis, 1970).

Machiavellianism is not a clinical condition; it is merely a personality type. Researchers Christie and Geiss carefully screened out individuals with clinical conditions, before their studies (Christie & Geis, 1970). The researchers did discover that there was a minor correlation between anxiety and the Mach-IV test (Christie & Geis, 1970). Also noted was a correlation between the Mach-IV test and Siegel’s Hostility Scale. However, the researchers admitted that this relationship should be treated with scrutiny. High Machs are not more hostile than Low Machs, but rather can more readily recognize and admit their hostile impulses (Christie & Geis, 1970).

The researchers found that Machiavellianism is not necessarily linked to any personal drive to climb the corporate ladder or to seek absolute power (Christie & Geis, 1970). High Mach personality types were found to be apolitical in their behaviour. To support this argument, researchers conducted studies to determine if there was a relationship between Machiavellianism and Authoritarianism. Christie and Geiss found no statistically significant evidence to support this notion when investigating political preferences and Mach-IV scores. They clarified the differences between an Authoritarian personality type and a Machiavellian personality type:

Both contain an unflattering view of man and this might lead to the expectation of a slight correlation. There is a subtle but important difference in the consequences of this unflattering view. A high-authoritarian view might be paraphrased, 'People are no damn good, but they ought to be'. A high Machiavellian might well agree with the premise about people but would give a twist to the implications of such a view. 'People are no damn good. So what? Take advantage of it.' (Christie & Geis, 1970, p. 38)

High Mach personality types were found to be flexible, opportunistic, adaptable, with an ability to take advantage of moments of general confusion within a group and test their limits (Christie & Geis, 1970).

High Mach personality types were also found to be excellent at coalition forming and breaking within groups. However, no evidence was found by the researchers, to support the notion that High Machs were insensitive to emotional involvements (Christie & Geis, 1970). Therefore, based on this extensive body of work and taking an amoral,

third-person perspective of the personality style, this author reasons Machiavellian personality attributes and cognitive strengths represent an effective “Change Agent” as another system personality archetype.

The Machiavellian Change Agent versus the Autistic Process Controller

Both Machiavellianism and Autism may have social implications, from the perspective of industrial-organizational psychology and human resources.

Misunderstanding may arise because the personality styles share a common behaviour; both are thought to have social cognitive deficits with empathy. With respect to this workforce study, this author emphasizes that “social cognitive deficits with empathy” does not mean *lack* of empathy or care. All medical laboratory personnel do care about the patient and the quality of their work. The problem reasoned by this author is that the word “empathy” and its demonstration, has a different meaning to many people. The concept of “empathy” will be clarified later in this thesis. A Google Scholar word search was performed on April 18, 2015, using keywords to scan the database and obtain the number of search engine hits. This data is presented in Table 2.

Table 2

Google Scholar Search Hits (April 18, 2015)

| KEYWORDS | GOOGLE SCHOLAR HITS |
|------------------------------|---------------------|
| “Asperger” + “Empathy” | 16500 |
| “Autism” + “Empathy” | 36300 |
| “Asperger” + “Social” | 560000 |
| “Machiavellian” + “Empathy” | 14400 |
| “Machiavellian” + “Social” | 44100 |
| “Asperger” + “Machiavellian” | 507 |
| “Autism” + “Machiavellian” | 3220 |

The reader will note that there are two very large bodies of published material in Table 2 where Autism and Machiavellianism have been studied in relation to *social cognition*. What about the relationship between Autism and Machiavellianism? The body of knowledge to date, based on the number of Google hits, appears to be small in relation to the other published sources. Therefore, there is potentially a great opportunity for future research based on this evidence.

It is reasoned by this author that if any new ground is to be gained in understanding the relationship between Autism and Machiavellianism, “empathy” and “conventional morality” must be placed aside briefly. However, both concepts will be discussed later in this thesis. It is questioned if there has been a misunderstanding of the two personality types simply because both are reasoned to think in the *third person*.

Empathy requires thinking in the *second person*. However, ethics considers *all vantage points*. Thinking in the third person means that the *individual is not considered* in either mindset.

This author proposes that there are several ways of conceptualizing the relationship between the Autistic and Machiavellian personality types:

- 1) The two personality types can be seen as *distinct antagonists*;
- 2) All personalities can be viewed as a *spectrum of behaviours* between the two;
- 3) They can be visualized as perfectly *rational agent types*, game pieces, or;
- 4) *Automata* within a *clockwork system*.

Christie and Geiss explored Machiavellianism in experiments where it applied to *Game Theory* (Christie & Geis, 1970). Expanding on this idea, this author proposes that a two agent cooperative model can be conceptualized, using “Autistic Process Controller” and “Machiavellian Change Agent” game pieces. Using perfect logic, the two agent types must work together to deliver the greatest payout within a production system. However, their actions must both use the least amount of resources (time, personnel, equipment and inventories) in a game of strategy to maximize utility as *Homo economicus*. When a hospital or healthcare authority is visualized as a cross-functional map, it becomes a “chessboard.” Therefore, the system when changed will produce different payouts of increasing value.

Autistics look at a system, as a series of inputs and outputs and focus on details, numbers, objects and patterns (Baron-Cohen, 2008). This mindset suggests that a narrow cognitive lens is used and by its nature is conscientious of *variation* in a process as a

process controller. However, Machiavellians as change agents, look at the *functional group* structures within the system as a “game of chess” (Hallinan, 2005). Machiavellian perception also suggests that a distant vantage point is used with a “big picture” mindset. Machiavellians as change agents are adapted to “gaming” the system and seeking “moments of truth” to achieve a greater operational goal (Nelson & Gilbertson, 2010). The operational goal, depending on the requirements of the customer, can be a novel product, service or a hybrid of both business models. However, with QMPs, six sigma methodologies and system optimization, the greater quality improvement goal may be the *Transfer Value* [$Y=f(X_n)$] (iSixSigma, 2015). Therefore, it is reasoned by this author, that both personality archetypes interact with one another as opposing forces, permitting change to occur efficiently and safely, to produce knowledge and value within a complex system.

For this heuristic model, this author proposes that process controllers and change agents see the laboratory as a system from different vantage points (see Figure 1). For changes to be made within a complex system, both agent types cannot work as well without the other. It is reasoned that two distinct cognitive lenses are being used to study the opportunity for improvement. It is also important to note that both agents will perceive the flow of time differently based on: 1) their relative vantage points; 2) the area within the system being studied for improvement; and, 3) The passage of time of the area being studied in relation to other areas of the system. Therefore, neither agent has access to *perfect information*.

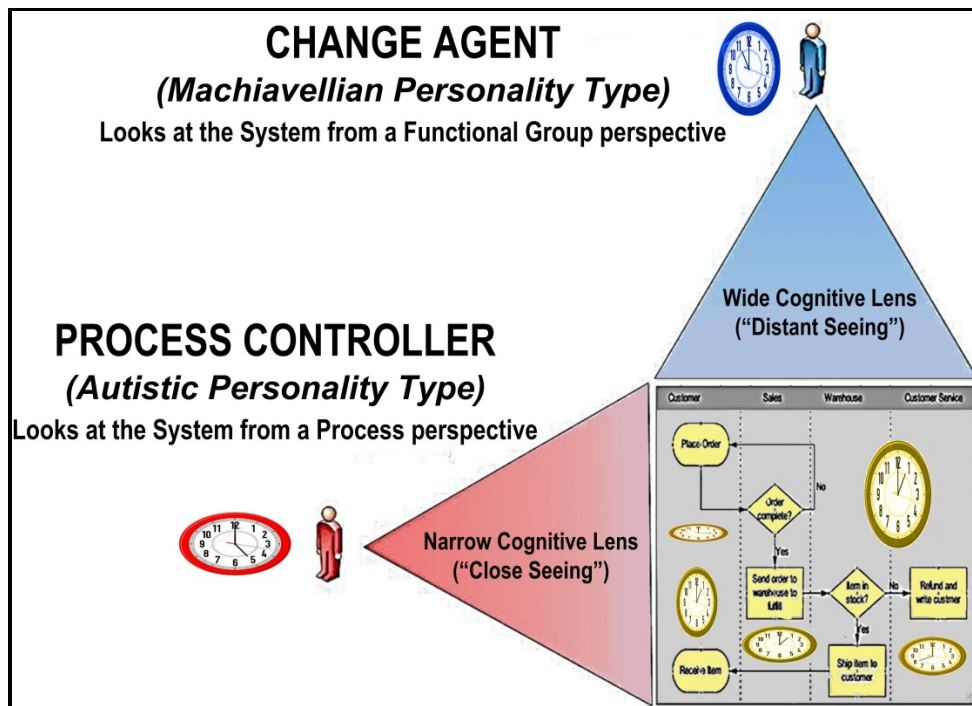


Figure 1. Autistic and Machiavellian vantage points of a complex system.

To promote understanding and correctly frame the opportunity for improvement as a lens and entry point into a system, *perception* by its nature comes at a cost of an *inability to see other things*. Therefore, both agents are reasoned suffer from a type of “blindness” due to their personality archetypes. For a change to occur that benefits both parties within a production system, both agent types require an information exchange. This process called *learning* results in *knowledge* as a *stock*. This knowledge is the *end product* of two different types of “seeing.” Therefore, both agents, as personality types, are two *learning system archetypes* that interact with one another to produce knowledge through *Variation of Mind*. However, to produce knowledge, these learning system interactions require *empathy*. This conceptual model in system dynamics will be expanded upon by this author in the Literature Review, Chapter 2.

Statement of the Problem

Medical laboratory technologists who may have Asperger's Syndrome (AS), a form of high-functioning Autism, are thought to be employed in the medical laboratory industry. However, little is known regarding the prevalence of those employed with the condition. Individuals affected by AS may have workplace challenges when dealing with social complexity and organizational change. These difficulties are of concern to the quality assurance professional, where effective social relations are critical to the success of change management initiatives and customer needs. Quality improvement plans may span multiple functional groups within a complex system. QPMPs could lead to *Lewin Social Space* project team sizes that exceed the *Dunbar's Number*, which may result in obstacles or challenges with knowledge transfer. Therefore, a new conceptual model for quality, with improved planning methodologies and tools for learning, are required to overcome the difficulties during change management initiatives as a knowledge-based learning system.

Purpose of Study

This thesis will investigate both the pervasiveness and population distribution patterns of high-functioning Autism and Machiavellianism within the medical laboratory workforce employed in Canada. The purpose of this population study is to determine the characteristics of the medical laboratory workforce, within a regional service model, based on the two personality types using the four psychometric questionnaires.

The study will propose a new conceptual model for quality assurance based on Qualia and its relationship to Social Cognition, Autism and Machiavellianism. This model, called the “Triadic Adaptive Learning System” (TALiS), will be used to explain the dynamics within the Juran Trilogy and the Deming PDSA Cycle, illustrating how the learning system archetypes work together to share and transfer knowledge. Expanding upon this model, the concept of the *Learning Space* and knowledge transfer during a change initiative will be discussed, along with several opportunities for future research.

Using evidence from the literature review and the laboratory workforce study, this author will critique four quality guidelines published by the CLSI and recommend:

- 1) Laboratory facility design improvements, using the latest research published on autism, to improve working conditions and quality;
- 2) New approaches promoting empathy and understanding between technologists, their healthcare peers and the patient;
- 3) New approaches to accommodate different learning styles of the technologists who are on the autistic spectrum, through improved training programs, competency verification, and;
- 4) A new vision of “goodness” for quality, based on the ethics, philosophy and science, of *Integral Permaculture* in Quality Assurance.

It is the aim of this author, to produce knowledge which will benefit the medical laboratory workforce and the broader healthcare communities. Through this knowledge, it is believed that better understanding will arise, thus promoting the “quality culture of goodness.”

Theoretical Bases and Organization

The laboratory workforce study was based upon prior studies by researchers who have investigated Asperger Syndrome and Machiavellianism. There are many journal articles published on the two personality types. Upon review of these journal articles, it was found by this author that:

- 1) There is limited research which investigates the prevalence Asperger's Syndrome and Machiavellianism in a highly specialized *occupational* group;
- 2) The questionnaires used in this study, to detect AS in conjunction with Machiavellianism, has never been performed before in a prior study;
- 3) Neither Asperger's Syndrome or Machiavellianism have been investigated in a *large-scale* study of an occupational group, and;
- 4) The *distribution patterns* of Asperger's Syndrome and Machiavellianism, within a regional health service governance model, have not been investigated.

This research is reasoned to be novel, in that all four gaps in knowledge will be satisfied through this study.

Research Questions and Exploratory Hypotheses

Research Question and Exploratory Hypothesis 1

Are Autism Spectrum Disorders prevalent in the Medical Laboratory Industry?

Based on the literature evidence, it is unclear if there will be a significantly higher percentage of the medical laboratory workforce that meets requirements for Autism Spectrum Disorders when compared to the general population. The predominant workforce gender is female. Autism Spectrum Disorders are more frequently found in males than females. However, individuals with Autism Spectrum Disorders, who can

overcome the symptoms of Autism, are found to be employed in the sciences. Therefore, it is hypothesized that the workforce will have slightly higher values in comparison to the general population.

Research Question and Exploratory Hypothesis 2

Is Machiavellianism prevalent in the Medical Laboratory Industry? It is hypothesized, based on the literature evidence, that there will be a slightly higher percentage of the workforce, which meets requirements for Machiavellianism, when compared to the *general population*, since the predominant gender is *female*. It is thought that Machiavellianism is another form of systemizing, where the system is viewed through its silhouette, from a distant vantage point.

Research Question and Exploratory Hypothesis 3

Is there a relationship between the Empathy Quotient (EQ), community and laboratory facility size? It is hypothesized, based on the literature evidence, that the Empathy Quotient for this workforce population sample will detect a *positive correlation* with community and laboratory facility size. It is thought that the EQ is related to Dunbar's number and Lewin social space size.

Research Question and Exploratory Hypothesis 4

Is there a relationship between the Autistic Quotient (AQ), community or laboratory facility size? It is hypothesized, based on the literature evidence, that the Autistic Quotient for this workforce population sample will detect a *negative correlation* between the AQ, community and laboratory facility size. It is thought that individuals

with Autism Spectrum Disorders may prefer rural communities with smaller social circles.

Research Question and Exploratory Hypothesis 5

Is there a relationship between the Systemizing Quotient (SQ-R), laboratory and laboratory facility size? It is hypothesized, based on the literature evidence, that the Systemizing Quotient (SQ-R) for this workforce population sample will detect a *positive correlation* between the SQ-R, community and laboratory facility size. It is thought that the SQ-R is related to the cognitive capacity to use systems thinking when understanding quality goals.

Research Question and Exploratory Hypothesis 6

Is there a relationship between Machiavellian personality test (Mach-IV) and community laboratory facility size? It is hypothesized, based on the literature evidence, that the Machiavellian scores for this workforce population sample will detect a *positive correlation* with community and laboratory facility size. It is thought that the Mach-IV relates to the capacity to use systems thinking, where they relate to supplier-service chains, flow of work and value streams.

Research Question and Exploratory Hypothesis 7

Is there a relationship between the psychometric scores of the workforce population sample and the TALiS model? It is hypothesized, based on the literature evidence, that the medical laboratory workforce sample, being a highly *specialized occupational group* in the health sciences, will *lean* towards one of the three dimensions of the TALiS model, based on their *intercorrelations*. The workforce will lean most

strongly to the Systemizing Quotient (SQ-R). It is thought that the SQ-R psychometric relates to thinking in terms of complex systems, procedures, inspection and control.

Limitations of the Study

It is reasoned by this author that the medical laboratory workforce study should be seen as a preliminary investigation. The psychometric instruments used for *detecting* high functioning Autism (AQ, SQ-R and EQ) and Machiavellianism (Mach-IV) are *self-reports*. Also, the questionnaires are designed to pick up *personality traits*. For the reader's clarity, the questionnaires are *not diagnostic instruments*. There was a relatively small sample size of males who participated in this study. However, this should not be surprising since the predominant gender in the medical laboratory workforce is female (CIHI, 2011). It is also important to note that the Empathy Quotient questionnaire (EQ) cannot differentiate between *affective empathy* and *cognitive empathy* (Rogers, Dziobek, Hassenstab, Wolf, & Convit, 2007). Lastly, the EQ, AQ, SQ-R and Mach-IV questionnaires have not been widely used in assessing personality traits within the healthcare community.

It is recommended by this author that future studies should aim to verify the results of this small study within a regional health services model. Also, these studies should aim to compare the results within multiple healthcare occupational groups. It is possible that if similar studies are performed in the future, these investigations could verify the results in this workforce study. Therefore, what remains to be answered, is evidence to support the hypothesis that the psychometric scores are *relatively consistent*

within the medical laboratory workforce, even if these populations are separated by great geographical distances and employed within different regional health authorities.

Self-Report

The four psychometric instruments (AQ, EQ, SQ-R and Mach-IV) used for this study, through historical evidence, have been demonstrated to have *high predictive value* in psychology. However, the reader is cautioned that the questionnaires are *self-reports*. It is possible, that participants can both *under-report* and *over-report*, in response to the questions in the four psychometric instruments.

Generalizability

The generalizability of the study findings, in relation to the broader workforce populations, should be done so with caution. Due to the small sample size (n=32), the results may not be reproducible with similar *workforce occupational groups*. Also, the results may not be reproducible with laboratory personnel employed in different *geographical areas* and those employed within different *regional healthcare authorities*. Therefore, this author recommends that the findings should be considered thought-provoking, but not conclusive.

Evidence based on Reliability

The questionnaire used multiple choice questions, which were scored using *Likert-Type Scales*, which have the following characteristics (Gliem & Gliem, 2003):

- 1) The scales must contain multiple items that can be combined or summed;
- 2) The items in each scale have a continuum of values that can be quantified;

- 3) Each item has no correct answer;
- 4) Each item does not test for any particular knowledge, skills, or ability, and;
- 5) Each item is a statement from which the participant must provide a rating.

The Cronbach's Alpha reliability coefficient was calculated from the data sets generated by the participant responses. The Cronbach's Alpha value is a measure of internal consistency of a test or scale; the alpha value is based on the response data sets.

Survey results with "acceptable" Cronbach's alpha values may range from 0.70 to 0.95 (Tavakol & Dennick, 2011). However, low alpha values can be due to a low number of questions in the instrument. Also, low Cronbach's alpha values can be due to poor interrelatedness between items or heterogeneous constructs (Tavakol & Dennick, 2011). Psychometric tests which produce alpha values greater than 0.90 might suggest that the questionnaire lengths should be shortened and that there are possible redundancies in survey questions (Tavakol & Dennick, 2011). It has been recommended that when a coefficient alpha value has been reported, the *confidence interval* for the alpha should accompany the alpha estimate (Iacobucci & Duhachek, 2003).

Evidence based on Normative Values

Normative population values were obtained using published data from prior studies that investigated Asperger's Syndrome and Machiavellianism. It should be noted in the literature review that this author was unsuccessful in finding large scale "standardization" studies with "universally agreed" discriminator values for the questionnaires. Data gathered from the four psychometric questionnaires was then compared with several published literature sources. Several population groups were used

for comparison, which included: 1) general population *normative* values; 2) ASD population values; 3) population groups categorized by *academic discipline*; and 4) the *nursing* workforce. The goal is to provide the reader with some sort of vantage point, from which to compare the medical laboratory workforce characteristics against other populations based on the four psychometric questionnaires.

Determination of Cut-off Values

This author was unsuccessful in obtaining “standardized” cut-off values for all four psychometric questionnaires, which were based on population normative values in the literature review. However, for the *Empathy Quotient* (EQ) the cut-off value of 30 or lower was recommended by researchers at the University of Manitoba (Stoesz, Montgomery, Smart, & Hellsten, 2011). The rationale behind the selection of cut-off (discriminator) values is to provide the reader some sense of the percentage of the workforce, which met requirements for each questionnaire (see results and discussions section, Table 6). Information and literature sources used to determine the cut-off values, and the rationale behind their selection is presented in Table 3.

Table 3

Selected Psychometric Questionnaire Cut-off (Discriminator) Values

| SELECTED CUT-OFF VALUE | COMMENT | SOURCE |
|---|---|---|
| Autistic Quotient AQ = 21 or greater | <ul style="list-style-type: none"> ➤ ASC Group Mean (36.5) – 2SD (16.0) = 20.5 ➤ Value selected to avoid <i>false negatives</i> | (Wheelwright, et al., 2006) |
| Empathy Quotient EQ = 29 or lower | <ul style="list-style-type: none"> ➤ EQ score of 30 is recommended as a useful cut score ➤ EQ score of 29 or lower selected | (Stoesz, Montgomery, Smart, & Hellsten, 2011) |
| Systemizing Quotient SQ-R = 101 or greater | <ul style="list-style-type: none"> ➤ People with ASDs have “Extreme S” Brain types based on <i>EMB Theory</i> ➤ ASC Group Mean (77.2) +1 SD (23.8) = 101 selected ➤ Value selected to avoid <i>false positives</i> | (Wheelwright, et al., 2006) |
| Machiavellianism Mach-IV = 60 or greater | <ul style="list-style-type: none"> ➤ Individuals who score 60 or higher are classified as “High Machs” | (Christie & Geis, 1970) |

Definition of Terms

Affective Empathy: Can also be called “emotional empathy”. It is the ability to respond with a socially appropriate emotion to another person’s mental state.

Archetype: is an ideal example, or model, after which other things are patterned. An ISO 9001:2008 Quality Management System would be an example of an archetype. ISO 15189 is based on the ISO 9001 QMS. Therefore, ISO 9001 is an archetypal quality management system, from which *all variations are patterned* (ISO 15189 and others).

AS: Asperger’s Syndrome (AS) is a neurodevelopmental disorder and an Autism spectrum condition. It is characterized by a higher than average intellectual ability coupled with impaired social skills, and restrictive, repetitive patterns of interest and activities.

Automata: Plural for *Automaton*, a moving mechanical device, made in the imitation of a human being, similar to a robot.

Clockwork System: A hypothetical closed system with built in mechanisms similar to a clock, that operates with perfect regularity and precision. Such a closed system would internally have *perfect linear feedback behaviour*. In comparison, *System Dynamics* seeks to understand the *nonlinear behaviour* of complex systems in the *real world*.

Cognitive Empathy: Is the ability to understand another person’s perspective and predict what they might do in a social context.

Personality Archetype: An over simplified but well-understood personality type.

Examples would be the “the absent-minded professor”, the “rock star”, “the philosopher”, etc. It may be a *stereotype*, or used as an *epitome* of an example. Personality Archetypes are easily visualized. They are common in literature as *character archetypes* and repeat themselves as universal models, such as the “damsel in distress”, the “Hero”, the “Mentor”, the “Rebel”, etc.

HFA: High Functioning Autism. The DSM-V reclassified Asperger’s Syndrome as High Functioning Autism in 2013.

Holon: A holon is a process or parts of a system, which can be viewed as a whole and a part. Depending on the *vantage point* of the *observer* and *lens used*, a holon can be seen as a whole or as a set of various sub-systems. Holarchies are created by “bottom-up” processes, whereas *hierarchies* and *heterarchies* are “top-down”. Quality tools act as lenses, permitting individuals to see parts or wholes of systems and areas that require improvement.

Holarchy: A combinational system composed of interacting holons. It can also be called a “holoarchy”. The term “Holarchy” was first coined by Arthur Koestler in his book, *The Ghost in the Machine* (Koestler, 1967). This form of reasoning is used in Philosophy.

Homo economicus: Is a concept used within economics portraying people as rational, self-interested agents who pursue their goals in an optimal manner. Homo economicus attempts to maximize *utility* as a consumer and *profit* as a producer.

System Archetype: A system with feedback loops, which cause characteristic patterns of behaviour. Feedback loops may be regulating or reinforcing. Well known System Archetypes, which produce undesirable behaviours, are called “System Traps.”

Transfer Value [$Y=f(X_n)$]: This transfer function notation used in Six Sigma methodologies is more of a conceptual description, better described as a *heuristic formula*. It is a mathematical way of stating that the “*process output is a function of the inputs.*” The variable Y is a process output measure that is *dependent* on the X process inputs and their quality parameters. However, the transfer value can, in fact, be calculated to model operational and environmental constraints, and predict their impact and dynamics within complex systems. This transfer function can be *simple, polynomial, complex function* or a composition of other *transfer functions*. For this paper, the term is used as a simple conceptual model or heuristic, where the higher level quality requirements at the *program level* are dependent on, the lower level quality parameters of the *sub-systems* (functional holons and their processes) which support it.

CHAPTER 2

REVIEW OF THE LITERATURE

Dr. Kurt Lewin's Theories on Group Dynamics and Social Change

Dr. Kurt Lewin was a pioneering researcher in the early 1900s who developed several theories in the area of social psychology, which was related to group dynamics, culture and social change. Kurt Lewin is seen as the father of modern social psychology. Three of his theories include: 1) Field Theory; 2) Change Process, and; 3) Action Research (Social Engineering). It would not be surprising if Kurt Lewin and other social psychology researchers were inspired by the work of Albert Einstein in addition to the work of Niels Bohr in quantum mechanics. Both Kurt Lewin and Albert Einstein fled from Germany in 1933 to escape from the Nazis. Both Lewin and Einstein immigrated to the United States in approximately the same time frame. Kurt Lewin's work in *Field Theory* built upon Gestalt Theory and cognition. Lewin's models provide a basic conceptual framework, which has applications in quality assurance. Therefore, Kurt Lewin's work applies to customer experiences with a product or service and organizational group behaviours during a change initiative.

Kurt Lewin (1943) explained that, "Field theory is best characterized as method: namely, a method of analyzing causal relations and of building scientific constructs" (Lewin K. , 1997, p. 201); not a theory where there are special laws that are used in scientific disciplines such as physics. Kurt Lewin's model proposed that the behaviour of

an individual, at any given point of time, is a function of the person and their environment. Environmental stimuli affecting the person's behaviour, valence state and future actions, describes a type of "space" called a "phase space." Phase spaces are not three-dimensional physical spaces, but rather constructs of variables in the environment which collectively describe a field around the person that shapes their behaviour, which could have five, twenty, or more dimensions if necessary to model and predict the behaviour (Lewin K. , 1997).

This author reasons that Lewin's "phase spaces" can also be described as "cognitive spheres of knowledge and awareness" within the customer's *learning field* at any given moment of time through a time-space. A simple diagram to explain the Lewin's model and its application to quality assurance is shown below in Figure 2.

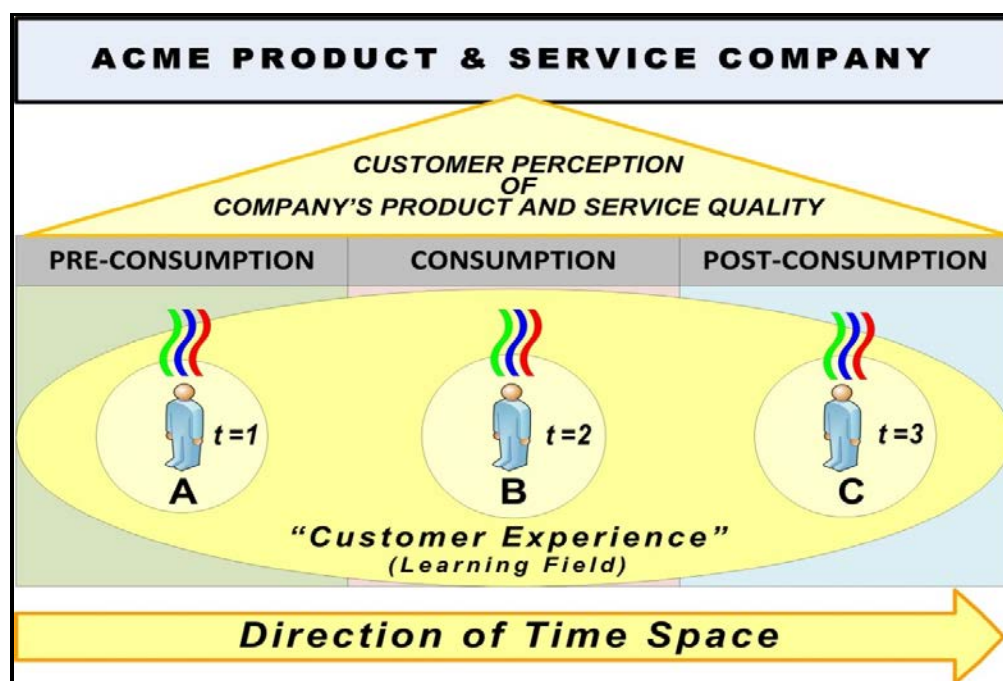


Figure 2. Customer experience, Kurt Lewin's Field Theory and phase spaces.

Expanding upon Figure 2 as a conceptual model, the “ACME Product and Service Company” may be a restaurant chain where the customer intends to purchase a meal.

Before ordering the meal, the customer will note the advertising, the cleanliness of the eating establishment and the general atmosphere in the pre-consumption phase (See Figure 2, Phase “A”), represented by different coloured waves, which for this thesis shall be called qualia. The customer during the consumption phase (See Figure 2, Phase “B”), will then experience the meal, which will affect their perception of the quality of the meal through its taste, texture and aroma. In the final phase, known as the post-consumption phase (See Figure 2, Phase “C”), the customer will then receive the bill. The customer will reflect on the overall experience, the friendliness of the servers and any distinctive features of the restaurant. If the restaurant chain is successful in delivering satisfaction and its distinctive quality features are remembered by the customer, the customer’s experience will result in a change in behaviour, leading to brand loyalty. Therefore, the customer’s perception has been shaped by all phases and their experience of qualia through the three fields within the “time-space.”

Another theory developed by Kurt Lewin called *Change Process Theory*, described social change as a three step process:

- 1) “Unfreeze” – the system is opened from a steady state phase or equilibrium;
- 2) “Change” – the system once opened, is modified or improved, and;
- 3) “Refreeze” – the social system is then closed with a new equilibrium point.

To “unfreeze” a human-based system, Kurt Lewin’s model required that there was a process of “unlearning” in addition to learning that a social system must go through for

change to occur. Within this change process, Lewin's theory stated that the behaviour of the social group was impacted by dynamic forces, affecting the learning "fields" during each phase of the change. These opposing forces were called "driving" and "restraining" forces. It was theorized that they impact the *equilibrium point* of the social group. Kurt Lewin's Change Process Theory led to the development of a quality planning tool called a *Force Field Analysis* which is still used today (ASQ, 2015). Kurt Lewin's conceptual models can be described as "Learning Spaces", which will be addressed in the subsequent chapters in this thesis.

Dr. Donella Meadows and System Dynamics

Dr. Donella Meadows, an environmental and systems scientist, is best known for the book *The Limits to Growth* (Meadows, Meadows, Randers, & Behrens, 1972). She is viewed by environmental movement communities as the "Mother of Integral Permaculture" for her research (Permaculture Science, 2015). For this thesis, *Thinking in Systems* provides the reader a foundation for understanding complex systems and system dynamics (Meadows D. H., 2008). Six of her rules regarding complex systems are as follows:

- 1) A system is an interconnected set of elements that is organized in a way that achieves something. It may exhibit adaptive, dynamic, goal seeking, self-preserving, and sometimes evolutionary behaviour;
- 2) Structures within systems that produce characteristic behaviour are called *Archetypes* or *System Traps*;
- 3) Stocks are the elements of the system that can be seen, felt, counted, or measured at any given time. The accumulation of information is a type of stock;

- 4) A system is in a state of dynamic equilibrium when the stock stays constant. The inflows become equal to the outflows;
- 5) A feedback loop is a closed chain of causal connections from a stock through a set of decisions, rules, physical laws, or actions that are dependent on the level on the stock and back again through a flow to change the stock, and;
- 6) Balancing feedback loops are equilibrating or goal-seeking structures in systems and are both sources of stability and sources of resistance to change (Meadows D. H., 2008).

Expanding upon Lewin's theories in social change and Donella Meadow's rules in system dynamics, a simple conceptual model can be constructed to describe a quality system as a type of *learning system*. A quality system can then be defined as a:

- 1) Man-made closed system consisting of structural archetypes engineered with feedback loops that are self-regulating and equilibrating, with the goal to control variation in an output of a *product* or *service*, and;
- 2) A man-made learning system that has structural archetypes built in, which exhibit adaptive, dynamic and evolutionary behaviour through knowledge accumulation, to deliver increasing *value* and *satisfaction* to the customer.

A human-based quality system, which is in a state of dynamic equilibrium, has a *knowledge stock* that is *constant*. Knowledge is *not accumulating* if the quality characteristics of the output are *constant*. Knowledge is not the same as information.

Therefore, if knowledge is not accumulating, then learning within the organization is not occurring (Deming, 2013).

Dr. Albert Bandura and Social Cognitive Learning Theory

Dr. Albert Bandura is a Canadian Psychologist who is best known for his work in cognitive psychology, behaviourism and social cognitive theory. Dr. Bandura's *Social Cognition Learning Theory* states that a portion of an individual's knowledge is acquired

by observing the behaviours of others and cultural norms within an organization (Wood & Bandura, 1989). Bandura's *reciprocal causation model* is shown below:

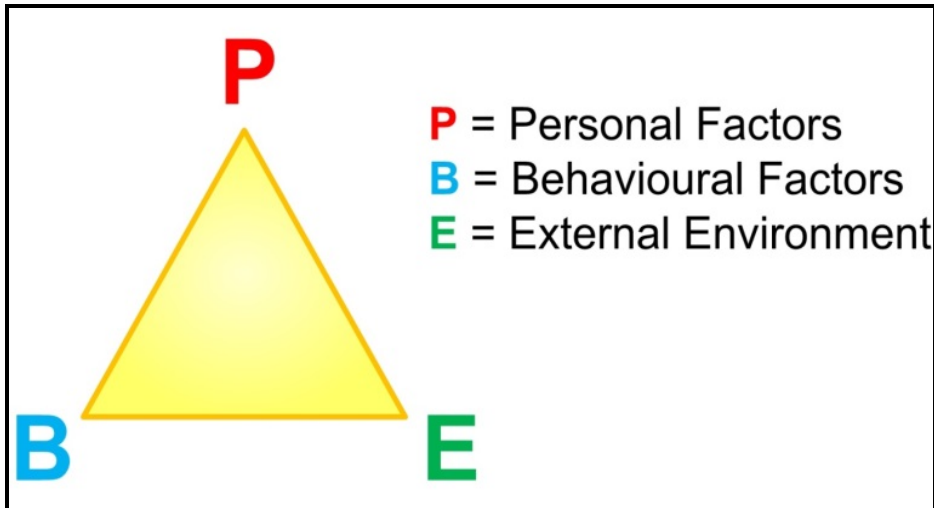


Figure 3. Dr. Albert Bandura's Triadic Reciprocal Causation conceptual model.

Bandura's learning model is similar to Kurt Lewin's Field Theory but proposes that there are two key mechanisms involved with social learning:

- 1) *Self-Efficacy*: It is the central core and measure of an individual's personality and ability to complete tasks, motivation to achieve goals and environmental adaptations. This means that the internal motivations affect the individual's actions, and;
- 2) *Vicarious Learning*: It is the process of learning from other people in social groups and involves mechanisms of reward and punishment for perceived mistakes made through an individual's behaviour (Bandura, 1989). It allows Individuals to avoid making mistakes by observing others if they see them completed successfully. (Bandura, 1989)

Building upon the reciprocal causation model, Dr. Bandura proposed that a person's behaviour involves *feedback mechanisms*, called "reciprocal determinisms." Bandura's social cognitive model is known as the *Triadic Reciprocal Determinism* model of social learning (Bandura, 1989).

It is known that 50% of an individual's personality type is due to their genetic predisposition (Plowman, 2006). This connection between human biology and personality type is an important consideration for an employer to keep in mind when understanding an employee's behaviour, their learning requirements and determining the support systems that they may require to meet quality goals. Other influences also shape the person's behaviour, such as their upbringing, educational level and their prior work experience (Levy, 2010). An employer, therefore, should be aware of the personal and the behavioural determinants of a new employee and possible learning requirements, with regards to customer service at the time they are being oriented and trained in their new job. Also, an employer should also consider how the orientation and training program is aligned with their greater organizational goals (Wood & Bandura, 1989). Therefore, employers should consider in the *design* of their orientation training program *feedback systems* which recognizes these differences in employee personality and learning styles. With the appropriate learning supports and feedback systems, organizations can align their employees' talents with customer service performance and the strategic goals of the organization. (Wood & Bandura, 1989)

Dr. Robin Dunbar, Primate Behaviour,
Language and Social Evolution

There is a greater relationship between Kurt Lewin's *Field Theory* and Dr. Bandura's *Triadic Reciprocal Determinism* model of social learning. These theories are related to the *social group size* of workforce populations employed within large organizations. Dr. Robin Dunbar, an anthropologist and evolutionary psychologist,

proposed that there is a social cognitive limit to the number of individuals that any one person can have to maintain a stable relationship (Dunbar, 2010). Dr. Dunbar studied the differences in primate brain morphology and compared them to social group sizes. Dr. Dunbar found a close relationship between the brain size and social group size. This discovery led to a model proposed by Dr. Dunbar that there was an evolutionary need for large groups, which led to the sudden and rapid development of language (Aiello & Dunbar, 1993).

Dr. Dunbar proposed that language developed as a bonding mechanism to reduce the amount of time for *social grooming* among non-human primates. Language permitted social time to be used more efficiently and permitted humans to exchange information about individuals who were *not immediately present*. Dunbar predicted that the social limit for anatomically modern humans to be a group size of 148 [95% confidence limits = 101-231] (Aiello & Dunbar, 1993). Dr. Dunbar stated that there was considerable evidence in modern and historical human societies. More recently, studies of social networks (Leskovec, Lang, & Mahoney, 2009) and user activity twitter networks have validated Dunbar's number (Goncalves, Perra, & Vespignani, 2011).³

Dr. Dunbar theorized that to overcome social limit in social group size there had to be an overwhelming need for the social groups to do so. This basic human need required a change in population groups from egalitarian organizational constructs (*Gemeinschaft* social system) into highly stratified societies of people with specialized social and functional roles (Aiello & Dunbar, 1993). This social transition led to modern organizational systems of today (*Gesellschaft* social system). Dunbar's number may be

important with employees who are on the Autistic spectrum. It has been found that individuals on the Autistic spectrum have differences in neural connections in their neocortex, which may result in social difficulties in large groups (Chomiak & Hu, 2013). If there are in fact, a high number of medical laboratory personnel who are on the autistic spectrum, laboratory leaders should consider the Dunbar's number within in a regional health services model. Therefore, this evidence leads this author to question if there are, in fact, differences in the "Dunbar number" for social group size within occupational groups, which may impact the dynamics of social-functional holarchies and knowledge transfer within complex systems.⁴

The Human Brain, Qualia and Consciousness

What is Quality and how does it relate to Qualia? The word "quality" can be traced back to the Latin word *qualitas*, meaning "a property" or a "distinguishing characteristic" (Merriam-Webster Dictionary, 2015). When speaking of a particular product or service, quality is a characteristic or set of characteristics that sets it apart from other similar products. However, the word "qualia" has a different meaning, though it is closely related to quality. Qualia, the plural form of "quale" refers to a product or service characteristics that must be *experienced* by the customer through consumption in the *first person* for its distinctiveness to be clearly understood. Qualia are characteristics of a product that must be experienced by the customer as a *learning system*. In this light, the "eye of quality" assesses a product or service characteristics from all vantage points,

including the eye of the customer, which is accomplished through *empathy*. Therefore, empathy is the key to product or service distinctiveness.

Qualia have been the source of considerable research and debate among philosophers, cognitive neuroscientists, psychologists and physicists (Crane, 2001). This ongoing debate has led to many theories which relate to human consciousness and cognition, including theories that suggest qualia is, in fact, a real phenomenon. Philosophy has failed to explain the human experience of qualia, such as the colour red, or the distinctiveness of the taste of a fine wine. However, physicists have proposed that the experience of qualia and consciousness can be explained at the *quantum level* if the human brain is modeled as a quantum learning system (Rapparini, 2008). Dr. Roger Penrose, a theoretical physicist, and Dr. Stuart Hameroff proposed a model in 1994 called the *Orchestrated Objective Reduction* (Orch-OR) model of consciousness, which suggests that quantum information processing occurs in the microtubules of neurons within the human brain (Hameroff & Marcer, 1998).

The Orch-OR model of consciousness has been harshly criticized over the years. However, in 2014 evidence was found to support six predictions of the Orch-OR theory (Hameroff & Penrose, 2014). More recently, evidence of wireless communication of axons via *vibration synchronization* can occur between neurons in the entire brain (Ghosh, Sahu, & Bandyopadhyay, 2014). The Orch-OR model implies that the experience of and transfer of Qualia, as quantum information, is instantaneous within biological systems. Qualia as knowledge are not bound by the speed of light, once within the human brain.⁵ This insight then raises a very important question in quality assurance

if there is a possible biological superiority of this mode of knowledge transfer, over man-made information systems. However, qualia transferred through neuron microtubules, based on the Orch-OR model, are reasoned to be limited to very small distances. Therefore, it is reasoned that the mechanisms of knowledge transfer through mirror neuron systems and the Orch-OR model may be very important in quality assurance.

Is the recent work of Hameroff and Penrose useable in quality assurance today? This author proposes that the concept of qualia as an *object* can be used in quality assurance as a model if qualia are visualized as “quantum waves.” For use in developing new heuristic models in quality assurance, this author submits that a product or service can be easily visualized emitting “quantum waves of quality.” In this light, the “aura of distinctiveness” through qualia is detected and shaped by the customer’s perception. The first person experience during consumption, leads to satisfaction, thus shaping the customer’s behaviour. What is very important, is that information transfer and perception is occurring instantaneously, based on the Orch-OR model. Dr. Penrose and Dr. Hameroff gave this quantum information a name; they called them “qubits” (Hameroff & Penrose, 2014). Integrating the Orch-OR model into the theories proposed by Lewin, Bandura and Dunbar, the customer’s gestalt sphere will detect distinct types of qualia as they proceed through the three phases of a service discussed earlier (see Figure 2). Therefore, the human experience of qualia through all three phases, as well the customer’s emotional state, help make up the *learning space* of the customer and shape their behaviour.

If the customer is satisfied with the product or service, the customer may share their experiences with others in their social space, thereby changing the behaviour of the whole social group as a community. Qualia as “qubits” of knowledge has thus been both transferred and understood within the minds of the social group that the customer belongs. In this light, a quality system is reasoned to be “cybernetic”; a neural extension of the TALiS and Orch-OR models. Through its methodologies and tools, a quality system captures qualia from the *voice of the customer* and translates them into qubits called *customer requirements*. A quality system then replicates this knowledge to produce and improve the characteristics of a product or service. Therefore, if the design of the quality system is effective at the capture, codification, replication and transfer of these qubits of knowledge, the same first-person experiences of qualia are realized during consumption of a product or service, thus producing consistent customer satisfaction. This consistency in output characteristics results in a change in behaviour of the whole market as a community.

Qualia, Empathy and fMRI Studies

To be fully understood by a business or healthcare service, the subjective human experience of qualia by a customer during the consumption of a product or service requires empathy. Empathy is *second* person thinking, which closes the gap between the *first* and *third* person mindset of two or more individuals. Baron-Cohen and Wheelwright stated that:

Empathy is without question an important ability. It allows us to tune into how someone else is feeling, or what they might be thinking. Empathy allows us to

understand the intentions of others predict their behaviour and experience an emotion triggered by their emotion. In short, empathy allows us to interact effectively in the social world, drawing us to help others and stopping us from hurting others. (Baron-Cohen & Wheelwright, 2004, p. 163)

Empathy can then be expanded upon and applied to healthcare service quality. Empathy closes the gap between the clinician and the patient, where a feedback loop occurs that not only benefits the patient but the caregiver as well. The patient's first person experience and emotional state of a service or product not only will create satisfaction for the patient but will create a sense of satisfaction for the caregiver. In addition to satisfaction, the care provider gains a sense of purpose and importance. If the patient is a routine patient, the learning space diminishes between the care provider and the patient, which can lead to bonding. Therefore, empathy can lead to a sense of community between the clinicians and their patients.

Empathy and social cognition have been investigated using diagnostic imaging techniques. Advances in magnetic resonance imaging (MRI), have led to breakthroughs in the fields of neurology, providing investigators evidence of neural systems in the act of performing specific functions by direct observation. In particular, there have been numerous studies since the 1990s using functional MRI scans (fMRI).⁶ This research has revealed clues about the underlying neural systems and their functions in the human brain. Also, fMRI studies have revealed how these neural systems work together to solve problems and achieve a goal. With perception, studies have demonstrated that human

vision is not handled by one general area of the brain. Neural systems which process vision are scattered across different regions in the human brain such as:

- 1) *Face processing* (Bystritsky, et al., 2001);
- 2) *Hand movements* (Prado, Clavagner, Otzenberger, & Schelber, 2005), and;
- 3) *Body movements* (Downing, Jiang, Shuman, & Kanwisher, 2001).

Studies have also found that there are neural systems, which can differentiate *biological motion* from *non-biological motion* (Grossman & Blake, 2002). Also, Autism and Asperger's Syndrome has been the subject of extensive research using fMRI studies as well, revealing clues about social perception.

Machiavellianism has also been investigated using fMRI imaging techniques. Studies have investigated brain functions related to strategy, risk assessment, collaboration and competition (Decety, Jackson, Sommerville, Chaminade, & Meltzoff, 2004). Experiments using fMRI studies have provided evidence suggesting that Machiavellian thinking is "left-brained," with strongest activation in the left lateral orbital gyrus region (Nestor, et al., 2012).⁷ The ability of the brain to qualitatively compare relative measures (right hemisphere) and perform higher level arithmetical calculations (left hemisphere), has also been studied and verified using fMRI technology (Castelli, Glaser, & Butterworth, 2006). Therefore, cognitive processes associated with traits linked to Machiavellianism appear to involve many neural systems, providing evidence that Machiavellianism is a high-level cognitive process, which is influenced by environment, genetics and most importantly, evolution.

Differences in personality types point to different perceptions, cognitive styles and learning needs. This learning needs includes both the customer and the care provider. However, empathy is reasoned to work only within shorter social distances and smaller numbers of people. How does the healthcare organization deliver quality and the perception of care if both the community and organization exceeds the Dunbar's number? What if the services for care are separated by large geographical distances? It is reasoned that quality assurance provides structural supports, tools, information, and systems which permit the organization to overcome the limitations of the human brain. It can then be reasoned that quality tools and supports act as "neurocognitive prosthetic devices," permitting organizations to understand the requirements of the customer and transfer that knowledge to meet customer requirements across large distances. Therefore, a quality system can be reasoned to be an extension of the human brain as a type of cybernetic "neural system."

Mirror Neuron Systems and Action Learning

Empathy involves a feedback loop of information between two individuals, called "mirroring" that result in understanding. Mirror Neuron Systems were first discovered in Macaque monkeys by researchers in 1996 (Rizzolatti, Fadiga, Gallese, & Fogassi, 1996). Ever since the discovery of mirror neurons in 1996, their findings have been confirmed and widely published. However, there is growing evidence of mirror neuron systems through fMRI studies which suggests that a much wider mirror neuron network exists in the human brain (Matlin, 2005). Mirror Neuron systems have been found linked to:

- 1) Face processing and empathy (Schnell, Bluschke, Konradt, & Walter, 2011);
- 2) Hand movements (Corina & Knapp, 2006);
- 3) Foot movements (Buccino, Binkofski, & Riggio, 2004)
- 4) Hearing and language (Corballis, 2010);
- 5) Body perception and motion (Peelen & Downing, 2007), and;
- 6) Music (Molnar-Szakacs & Overy, 2006).

It is thought by researchers that there is a genetic and evolutionary basis for the development of these neuron systems, which implies that they evolved from very ancient and primitive learning systems (Heyes, 2010). Mirror Neuron Systems are thought to have given primates, such as *Homo sapiens*, a survival advantage, through tool making and cooperation (Oberman, Pineda, & Ramachandran, 2007).

Mirror neurons are associated with *action based learning* (Rizzolatti & Craighero, 2004). If a person directly observes another person performing some task, both brains, in theory, will be seen using an fMRI scan to “activate” in the *same neural region(s)* as if *both* are doing the same task at the same time. This neural activity has been demonstrated in experiments (Buccino, et al., 2004). Mirror neurons facilitate altruistic behaviours between actors, permitting them to behave as a unitary “closed system.” With this insight and considering the new evidence supporting the predictions of the Orch-OR model, it is questioned by this author if qualia “qubit knowledge transfer” may be occurring through mirror neuron system activation. It is also questioned if the reciprocal feedback in the flow of information, through mirror neuron activation, can lead to *neural microtubule vibration synchronization* within the neural systems of two or more persons. If this is

true, it can be reasoned that two or more individuals have become in a sense “one minded” as a *unitary conscious system* through neural synchronization. Also, if Kurt Lewin’s theories are considered, it is questioned if each actor’s “internal clock” in their brains is in fact synchronized to the *group’s perceived time* within their learning field.⁸

Linking this mode of biological information transfer closely to quality, variation in the output of a process is controlled through *action based reciprocal learning* within a *functional holon*. Therefore, reduction and control of variation is accomplished by regulatory feedback loops (Meadows D. H., 2008) if two or more individuals can directly see each other’s actions through reciprocal learning, visualized in Figure 4. The discovery of mirror neuron systems linked to hand movements has potential significance in laboratory medicine and quality assurance. They are associated with *implicit* and *tacit knowledge transfer*.

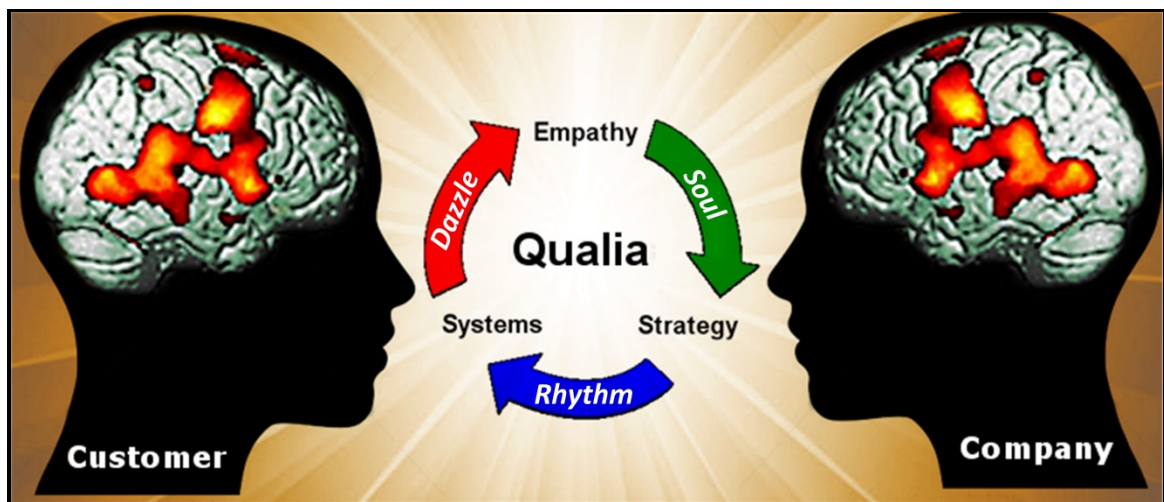


Figure 4. Qualia, mirror neuron activation, empathy and action learning.

If variation due to equipment, inventories, and environmental conditions are ruled out, issues with analytic quality may be due to variation in hand technique among technologists. Control of variation in hand technique in a laboratory testing process, can therefore be achieved between two or more technologists hand movements through action-based learning (Buccino, et al., 2004). To be completely assured that a laboratory testing procedure is being executed consistently among technologists within a health authority, all employees must *directly see* the technique performed by an expert trainer.⁹ Quantum knowledge necessary for analytic quality is then transferred by the trainer to other employees through mirror neuron activation. However, due to differences in mirror neuron systems among employees, several attempts with observation and feedback may be required to ensure that the appropriate areas of the learners' brains have activated properly in the same neural regions. Therefore, knowledge transfer through hand movements and technique must be monitored closely.

Expounding upon this discussion of mirror neuron systems and hand movements, if one considers a regional health service model involving rural satellite labs versus a central regional laboratory; two common analytic quality-related issues may come to surface:

- 1) Precision differences between laboratories in IQC, and EQA and;
- 2) Bias differences between laboratories in IQC and EQA.

Differences in laboratory external proficiency testing results, when compared with peer groups (that are using identical test methodologies), may suggest different cultural norms and practices between laboratories due to mirror neuron systems. However, there is *no*

empirical evidence to support this idea. Rule-bound ISO regulated environments are reasoned to be a countermeasure to offset any differences. Good precision in analytic test quality may suggest that a laboratory has personnel that can work closely together as a team. However, if their results are compared to other groups in different communities, the technologist group may have an analytic test bias, simply because mirror neurons and quantum transfer of qualia as knowledge do not work across large geographic distances. Therefore, quality assurance tools in laboratory medicine provide *neurocognitive supports* to help leaders and trainers overcome this distance barrier and transfer knowledge to people within complex systems.

Mirror neuron systems are thought to have arisen within all vertebrates in nature through evolution (Oberman, Pineda, & Ramachandran, 2007). Mirror Neuron Systems provide a fast and effective method for biological systems to remain together as a community, as illustrated in Figure 5.

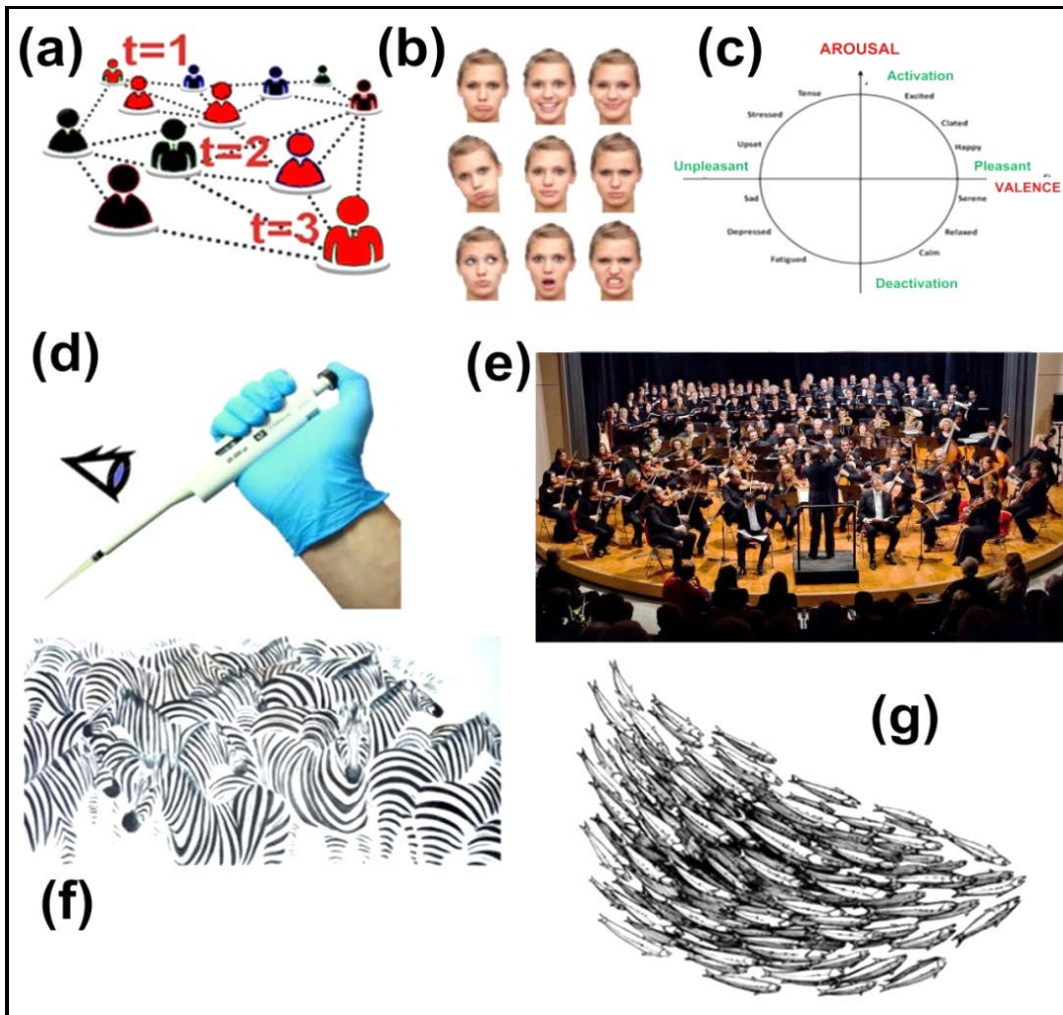


Figure 5: Mirror neuron systems, action learning and group conformity.

Group conformity within the Lewin Social Space (Lewin, 1947) is maintained through effective mirror neuron systems specialized in social cognition (Figure 5, see images “b” and c”) and the handling of tools (Figure 5, see images “d” and “e”).

Additionally, as a system there is *time delay* in knowledge transfer (Figure 5, see image “a”), even if the mirror neuron systems are functioning perfectly, a characteristic of a *closed system* (Meadows D. H., 2008). From the perspective of evolutionary defense

mechanisms, effective mirror neuron systems permit the social group or “herd” as a biological system to react to danger through panic effect (Heyes, 2010). With effective camouflage they can use “stripe dazzle” (Figure 5, see image “g”), through their collective movements. This behaviour is a function of mind, to confuse any predators that trying to target and lock in on one individual within the group (Figure 5, see image “f”) (Stevens, Yule, & Ruxton, 2008). Therefore, mirror neuron systems, which have evolved over millions of years, have a mode of *knowledge transfer* within living systems, providing them with the capacity to *self-organize* into *complex structures*, with *hierarchies* (Meadows D. H., 2008).

The Triadic Adaptive Learning System:
An Evolutionary Learning System

Up to this point in the literature review, field theory, social learning theory, Dunbar’s number, qualia and mirror neuron systems have all been explored and discussed. Using this body of current knowledge and bringing it to a specific focus, a new conceptual model for learning is proposed by this author for Quality Assurance. A neurocognitive cybernetic model called the *Triadic Adaptive Learning System (TALiS)*¹⁰ is presented by this author as a human-based knowledge system for quality assurance, healthcare, social services and business excellence. An “infographic” to help the reader understand the model has been provided by Figure 6. This conceptual model will be used to produce knowledge and a new vision for Quality Assurance using the evidence presented in the results and discussions section in Chapter 4.



Figure 6. The Triadic Adaptive Learning System (TALiS): a human evolutionary learning system conceptual model based on hunter-gatherer tribal societies. Adapted from “Beautiful Beetles” *Super Mosaic* [Digital file], by Christopher Marley, (2014). Retrieved from <http://www.pheromonedesign.com>. See Appendix H.

All of humanity is recognized and symbolized in the TALiS conceptual model (Figure 6), with distinct personality types, cognitive styles, and voices.¹¹ This model proposes that within the human brain, three major *learning system archetypes* are present, which has led to the ascent of Man as a dominant species. These learning systems are reasoned to have evolved within Homo sapiens, from simple hunter-gatherer tribal societies in the distant past and today are still essential for quality assurance in modern civilization. Collectively, the learning systems shape the person's gestalt sphere and their understanding of the world around them. The *personality archetypes* suggested within the triad, which make up the TALiS model, are "windows" which are reasoned to point to these three underlying neural learning system archetypes from which *all variations are patterned*. This includes the well-known variation of behavioural traits described by clinical psychologists as the "Dark Triad" (Rayburn & Rayburn, 1996); which is in a sense, the TALiS model's "shadow." Therefore, each learning system archetype, as a "neurocognitive lens", is reasoned to have a *distinct mindset* with *consciousness* which understands different types of knowledge.

The human brain is a conscious, reward seeking learning system. The three learning system archetypes within the TALiS work together towards a reward, such as a quality objective. The three learning system archetypes are as follows:

- 1) *The Social-Tribal Learning System (STLS)*;
- 2) *The Autistic-Gathering Learning System (AGLS)*, and;
- 3) *The Machiavellian-Hunting Learning System (MHLS)*.

Each neural system has a distinct mindset with different functions. Also, each learning system has specific aptitudes and limitations with the transfer of knowledge. Therefore, variations within these learning system archetypes result in characteristic behaviours and personality types.

Each learning system within the TALiS model produces a distinct payout or reward based on their different mindsets. The term “mind-blindness” has been used by the psychology community to explain ASDs and other social cognition conditions (Synapse, 2015). However, the term “mind-blindness” may be misleading; it means different things to many people. Also, there is a difference between *affective empathy* and *cognitive empathy* (Rogers, Dziobek, Hassenstab, Wolf, & Convit, 2007). Individuals with AS may not have “mind-blindness” but may be reasoned instead to have a specific type of “neurocognitive social astigmatism” when using the TALiS model.¹² As neurocognitive lenses, the triad within the TALiS model is proposed to have distinct forms of perception, which by their nature, are reasoned to come at a cost of astigmatism. To keep the TALiS model very simple for practical applications in quality assurance; it is proposed that the brain has “three eyes of quality” with three distinct mindsets. Therefore, these neural system archetypes, with their astigmatisms, shape the customer’s mindset and perception of a product or service. Through qualia transfer, the customer’s experience during consumption thus influences their behaviour.

The *Social-Tribal Learning System* (STLS) is the first neural learning system archetype proposed by this author to exist within the human brain. This learning system thinks in the *second person*, using a narrow “close seeing” cognitive lens, with mirror

neurons specialized in the processing of human faces and language. The STLS archetype hears and understands language and can detect the emotional state of another person through the tone of voice. Using empathy, the learning system's reward is to understand another person's *first-person* emotional state, their point of view and to predict what the person will do within a social group or "tribe." It seeks to understand another person's experience of qualia in a product or service. However, the STLS by its nature as an archetype has a form of neurocognitive astigmatism:

- 1) The learning system only works at *physically close distances*;
- 2) It's effectiveness is limited to the Dunbar's Number in social group size;
- 3) It cannot see or hear the collective background sound and motions of the tribe;
- 4) It cannot see or hear *beyond the social boundary* of the tribe;
- 5) The learning system cannot see hands or silhouette, and;
- 6) The learning system can only detect qualia experienced by another person.

A person with an effective empathy learning system is reasoned to have an ability to penetrate into the *centre* of the "tribe" and overcome "social cognitive stripe dazzle" between different personality types within the group. By doing so, the STLS can focus specifically on the needs of another individual and deliver quality service and care. More importantly, these social transactions also help shape the customer's *perception* in a very distinct manner. The customer perceives oneself to be *favoured*, important in *relation to other people* and thus, positioned at the *centre of the group*. Therefore, these needs or wants can be reciprocal because mirror neurons provide a feed-back loop of qualia,

resulting in *both* the customer and the healthcare employee experiencing satisfaction and importance and thus positioned at the centre of the tribe.

The STLS learning archetype seeks a reward of belonging, protection from outside forces and care within the tribe. For the TALiS model, empathy is reasoned to be a specific type of *systemizing*. Empathy provides social feedback loops, which permits the group to establish a *social hierarchy*. However, the STLS archetype and its behaviour are reasoned to be directly related to the *Selfish Herd Theory* (Hamilton, 1971).

Transactions occurring between two individuals may not benefit the tribe. Their actions may, in fact, go against the goals of the tribe and the larger organizational goals spanning multiple tribes. From an evolutionary perspective, empathy is related to *deception* and *manipulation* of others (Smith, 2006). Empathy is associated with *favoritism* (Harris, Herrmann, & Kontoleon, 2009), *nepotism* (Decety & Cowell, 2014) and in its darker form, *racial bias* (Forgianini, Gallucci, & Maravita, 2011). Empathy is also related to Authoritarianism, prejudice and social dominance (Backstrom & Bjorklund, 2007). Therefore, empathy can be counterproductive and lead to undesirable outcomes within an organization and its quality goals.

Empathy is a very complex topic in psychology, ethics, philosophy and group dynamics (Decety & Cowell, 2014). Also, it appears that *cognitive empathy*, *affective empathy* and how they are related to *Theory of Mind*, are not fully understood or entirely agreed upon by psychology researchers (Rogers, Dziobek, Hassenstab, Wolf, & Convit, 2007). However, it is reasoned that there is a relationship between social cognition and Machiavellianism based on the TALiS model. Empathy and Machiavellianism are two

different types of *social learning systems*. Keeping the model simple for quality assurance, Machiavellianism is reasoned to offset tribal behaviour as an “opposing social force” bringing all employees to a *common goal*. Therefore, there is a relationship between social cognition and Machiavellianism within system dynamics that apply to knowledge transfer, change management and quality assurance.

The *Autistic-Gathering Learning System* (AGLS) is the second neural system archetype proposed by this author. This learning system is reasoned to think in the *third person*, using a narrow “close seeing” cognitive lens with mirror neurons specialized in the processing of hands, hand motion and gestures. The AGLS sees colours, small details and patterns. It is limited to vision, taste, touch and smell to detect qualia at *close distances*. To be clear to the reader, this author proposes that “taste” “touch” and “smell” are different types of “close seeing”. It is reasoned that there are two types of neural learning networks within the AGLS: 1) A tool or product assembling learning system; and, 2) A harvesting-measurement learning system. Through close seeing, tasting, touch and smell, the AGLS assesses an object for quality. Inspection, sampling, and measurement provide feedback information (“qualia” or “qubits”) as knowledge within this learning system.

Through organizing, counting, careful *hand technique* and timing, the inputs are brought into a sequence called a “process”, which leads to a “final product”. Through learning, the system in the external environment (functional holon) is then “closed” using feedback loops to regulate and control the inputs. A set of feedback loops is proposed to flow between the two learning systems (inspection and control). Therefore, the payout is

the reduction of variation through *inspection, measurement* and *control* of a *process* within a *functional holarchy*. These actions lead to *consistency* in the output of a final product.

The AGLS as an archetype has limitations like the STLS. As it is with the Social-Tribal Learning System, the AGLS has a form of neurocognitive astigmatism:

- 1) It only sees hands; not human faces, the individual, or silhouette;
- 2) It can only see small targets and details *within* the social-functional holon;
- 3) It cannot see the “the big picture” *outside* the social-functional holon;
- 4) It does not hear language, but can detect *harmonics* in sounds;
- 5) It understands numbers, symbols, and letters, and;
- 6) It seeks safety in what is reproducible, consistent and predictable.

A person with an effective AGLS reasons with logic and seeks the truth through tangible empirical evidence, scientific and engineering reasoning. Therefore, an Autistic behaviour may be better described as “closed-systemizing” through the lens of system dynamics.

The *Machiavellian-Hunting Learning System* (MHLS) is the third and last neural system archetype proposed within the TALiS model. This system thinks in the *third person*, using a wide “distant seeing” cognitive lens, with mirror neuron systems specialized in silhouette and motion detection. It hears only the collective voice of the tribe(s). The MHLS observes and maneuvers from a vantage point *outside* of the boundary line of the social space of a tribe (social-functional holarchy). This social

learning is reasoned to occur within the *common space of the organization*. As a type of social learning system, the MHLS is effective at mimicking the *collective* motions and sounds within the common space of the organization, better described as “organizational citizenship behaviour” (Dietvorst, 2010). The MHLS by its behaviour:

- 1) Seeks to find entry and leverage points within social systems using “moments of truth” to make changes and produce bigger payouts;
- 2) Assesses risk, urgency, and danger *between* a system and its *external environment*;
- 3) Does not see system parts as small pieces, but as “chunks” or *functional holarchies*, similar to playing chess (Charness, Reingold, Pomplun, & Stampe, 2001);
- 4) Can detect *loopholes* as “shadows” within complex systems. It also sees rules and regulations as “trees” “fences” and “gates” within complex systems, and;
- 5) Does not need to spread *misinformation* to gain leverage within a system and reach a payout. It *shares* or *withholds* knowledge if it is *prudent* and *objective* to do so.

Being mindful of its own shadow within the system, the MHLS seeks to make changes in the functional structure within an organization through coalition forming and breaking.

The MHLS’s reward is to bring the tribes together, through altruistic behaviour, to a *common* objective.

The MHLS as an archetype sees people and social groups as *objects*. This author recognizes that the vantage point presented to the reader is an unflattering view of Man as a species. However, to clearly illustrate the mindset of the MHLS to the reader it is to be considered in the context of big business, large-scale healthcare systems and supplier chains. The evolutionary connections between hunting behaviour, “herdsmanship,” warfare and Machiavellianism can be expounded upon by proposing the “Rules of Herds”

in quality assurance and system dynamics. These heuristics are reasoned to support both Kurt Lewin's theories on social engineering (Lewin, 1947) and Hamilton's *Selfish Herd Theory* (Hamilton, 1971) from a distinct vantage point. It is thought that these rules can be verified by future studies investigating Machiavellianism and proxemics using fMRI technology and be applied to system dynamics:

- 1) If the *silhouette* of the *herd* is observed moving in a common direction over time, the group is behaving like a *system*. The herd is *organized* and *reward seeking*;
- 2) If the *motions* and *sounds* within the silhouette of the herd are *periodic*, the group is behaving like a *closed* system;
- 3) If the silhouette of the herd moves at a *constant speed* and in a common direction, with periodic motions observed to be at a *constant frequency* (neither *accelerating* or *decelerating*), the system is in a state of *dynamic equilibrium* and *control*;
- 4) Agents who walk with the herd, make motions and sounds like the herd, are *invisible* within the silhouette of the herd;
- 5) An agent's *footprints* (not *handprints*), which are *different* than the herd, will be detected;
- 6) An agent's *intentions* and *future actions* are better predicted over time, whose footprints do not follow a *defined sequence* of steps within a *process flow*;
- 7) Motions and sounds within the common direction and collective sounds of the herd, point to *functional holarchies*, not *social hierarchies*;
- 8) *Motion dazzle* observed within the silhouette of the herd, is a *motion cue*, which points to *entanglement* in process flows, *functional silos* and the *Forrester Bullwhip Effect* within the *supplier-service chain*;
- 9) If a *fire* breaks out, the herd will *panic*. Motion dazzle will be visible, and the risk of a *stampede*. The system will open, with *runaway escalation*, and;
- 10) If the *same type* of fire repeats itself, motion dazzle will not be seen, since the herd is a *learning system*. The herd will *evolve* over time into a different *cultural archetype*.

The silhouette of an army in a parade, with “all eyes forward” and “quick marching” in perfect cadence, much like an arrow towards an objective, is an optimized social system that is in a state of dynamic equilibrium. Through *operational definitions* (Deming, 2013), a business can better optimize its internal processes and align them with its greater aim (Deming, 2013). Operational definitions permit businesses to leverage the strength of the MHLS into optimized *functional holons* and *supplier-service chains*, seen in Figure 7.



Figure 7. Video file showing the arrival of the Canadians at Fort William Henry Harrison, Helena, Montana in the United States. The Devil's Brigade was an elite American-Canadian commando unit in World War II. The scene show the motions of the actors from different vantage points, which indicate closed, versus open systems. Adapted from *The Devil's Brigade* [Motion Picture] by Andrew V. McLaglen, 1967. Retrieved from https://www.youtube.com/watch?v=g1awwAgU_t8.

This author questions if the “Rules of Herds” heuristics proposed for cybernetics and system dynamics, could lead to new quality assurance practices.¹³ Industries which could benefit from this insight, may apply to:

- 1) Supplier-service chain quality methodologies;¹⁴
- 2) Patient workload or case management practices;¹⁵
- 3) Stock market behaviour;
- 4) Monitoring of regulated industries, such as banking;
- 5) Behaviours of competing industries and customer markets;
- 6) Evolutionary robotics with improvements to autonomous robot design, and;
- 7) Anti-terrorism technologies for public areas with high social traffic.

The MHLS archetype, supported by the “Rules of Herds” is therefore, reasoned to be another form of *systemizing* and a type of *social-functional* learning system. The MHLS as an archetype, however, also has a type of neurocognitive astigmatism, like the STLS and the AGLS. Through “distant seeing” the MHLS only sees the silhouette of the system. This includes employees as *functional groupings* and the customer as a *market*.

The MHLS is blind to social hierarchies. It can only see functional-holarchies from its distant vantage point *outside* the social space, whereas the STLS from its vantage point in a “tree” (hierarchy) can better see the “power constellation” *within* the herd’s social space. The MHLS can only see a process as it flows through the work environment *from a distance*. Therefore, the MHLS by its behaviour and third person mindset may be better described as “open-systemizing” through *scanning*; targeting loopholes, flows and

functional holons within systems, when compared to the AGLS, through the lens of system dynamics.

Machiavellian and Autistic behaviour, as two driving forces facilitating organizational change, are reasoned to exist within the TALiS model. Both mindsets work together like two neurocognitive “pistons” within the “quality system engine” to produce change within complex systems. As dynamic learning systems, these changes improve process flows and lead to ever larger payouts. The Machiavellian mindset might view Autistic behaviour as “chasing one’s tail” as well as being over preoccupied with details. Also, a High-Mach might think that the Autistic personality type is overly cautious and having tunnel vision. However, the cognitive strength and gift of the Autistic’s mindset, in relation to the Machiavellian, is its sharp focus and high attention to procedural details through *inspection* and *control*. Therefore, Autistic behaviour and actions result in tight negative feedback loops to *minimize variation* within a *process*.

The Autistic’s opinion of the Machiavellian mindset would be quite different, especially through the lens of physics. Albert Einstein is famous for his quote regarding *quantum entanglement*, found in the *Born-Einstein Letters*.¹⁶ In his letter to Max Born, dated March 3, 1947, Einstein stated, “I cannot seriously believe in quantum theory because it cannot be reconciled with the idea that physics should represent a reality in time and space, free from spooky action at a distance” (Einstein, Born, & Born, 1971, p. 158). Einstein did not believe that two elementary subatomic particles, separated by large distances, could have an influence on one another, known as “quantum entanglement.” He was found later to be wrong. It is imagined that if Einstein were alive today, he might

offer words of advice regarding differences in cognitive styles and perceptiveness between people, and the problems that might arise during quality improvement initiatives if the TALiS and Orch-OR models are considered.

It is imagined Einstein might advise the reader that the movements of the Machiavellian could be perceived as “spooky actions at a distance” by an Autistic personality type due to the Machiavellian’s *relative* vantage point *outside* the Lewin social space. With *imperfect information* obtained through a very narrow *frame of reference*, these observed behaviours might lead an Autistic to believe that a High-Mach’s possible motivation is to avoid “entanglements.” However, it is also possible that the Autistic might be lacking in *mindfulness*. The Autistic may not realize that it is merely detecting its own shadow in the distance, in the way *it sees other people*. An Autistic could also have a Machiavellian mindset at the same time. As a consequence, cultural obstacles to learning might arise within a group, because when thinking in the *third-person*, the various *cognitive styles* of the team members can be very different. Also, the differences in the actors’ *relative vantage points* and their *perception of time* can be very different. Empathy through *second-person* thinking facilitates *understanding* within the group as a unitary and conscious *first-person* learning system.

Einstein however, might go one step further. Einstein might add that Machiavellian perception, using a distant third-person vantage point, can also be reasoned to be a *type* of “spooky watching at a distance” as well. Looking at big business, banking, and other financial industries, actors within the hierarchy, who undermine quality goals of the organization through their personal interests and privileged access to

knowledge, need to be mindful that they are not entirely invisible. Detection and prediction of the future movements of an agent, through effective monitoring systems, and controls within *procedures* (“Rules of Hands”, AGLS) and *processes* (“Rules of Feet”, MHLS) does not require *cognitive* or *affective empathy* (“Rules of Faces”, STLS). Therefore, it is questioned if there are fundamental weaknesses with the *Theory of Mind*, if the TALiS and Orch-OR models are used and where they relate to Social Cognition, Autism and Machiavellianism (Meltzoff, 1999).

Two or more actors in an organization, who are separated by large distances, can produce undesirable system archetypes, all the while undermining greater organizational quality goals. Using the “lens of Einstein and Born,” *the behaviours of actors and the consequences of their actions are not diminished by physical distances within closed systems*. The actions of all actors are *interdependent*, which through *feedback controls* within *defined processes*, are fundamental requirements to keep a *system closed* and in a state of *dynamic equilibrium*. As an extension of the TALiS, a quality system’s effectiveness at delivering quality is only as good as the actors’ understanding and respect of this knowledge. It is in this light, that the greater wisdom of Dr. Deming can be better appreciated. Dr. Deming stated that a system alone “cannot understand itself” (Deming, 2013, p. 61). Quality Systems require people to cooperate as a *unitary conscious system* and *share knowledge* to reach a greater organizational *goal*.

It can also be reasoned that Quality systems are engineered to clear information entanglement, orchestrating flows of codified knowledge as qubits that are synchronized between actors, not unlike programmable *automata* within a *clockwork system*. This

knowledge transfer is accomplished through the use of rules and defined sequences within processes. However, quality systems, being human-based knowledge systems, are not perfect. The “Voice of Einstein and Born” is a quality warning. If the knowledge, processes and rules are not understood, respected and followed by the actors, a “panic within the herds” can arise, which can throw the system out of a state of dynamic equilibrium.

To better illustrate the risks of information entanglement, panic and escalation, the *2007-2008 Global Financial Crisis* is a glaring example and warning (Helleiner, 2011). Dr. Donella Meadows dubbed this system rule as the “eleventh commandment,” stating “thou shalt not distort, delay, or withhold information” and warned that actors can “drive a system crazy” by “muddying its information streams” (Meadows D. H., 2008, p. 173). Therefore, quality systems can overcome the physical distances between businesses and can clear information entanglement, if the employees appreciate and respect the value of knowledge.

The Quality Leadership Learning System

The Orchestrated Objective Reduction model, developed by Sir Roger Penrose and anesthesiologist Dr. Stuart Hameroff, explains the biology of human consciousness and is stirring. The latest evidence supporting the Orch-OR model expands the human imagination and has profound implications within quality assurance. Dr. Penrose's and Dr. Hameroff's research seeks to find scientific evidence of human consciousness and evidence that all biological systems, which make up the Earth's biosphere, are part of a greater cosmological quantum consciousness. In this light, human consciousness and the subjective experience of qualia are reasoned to be both shaped and constrained by the limitations of the three neural learning system archetypes that make up the TALiS. For ease of use within Quality Assurance, it is reasoned by this author that the TALiS can be symbolized as the "Pharos of Quality," whereas the Orch-OR model can be symbolized as the "candle" or "flame" of the person's consciousness or spirit within the TALiS. Therefore, these models can represent a lantern or beacon, to symbolize the collective consciousness of employees and their customer market as a *community* when working together towards a *higher goal*.

The Orch-OR and TALiS models are reasoned by this author to provide important links between the: 1) empirical, rational mindset; 2) intuitive, imaginative thinking; and 3) subjective human experience. These "dimensions of mind" suggest that quality leaders may have a greater importance within the organizations and the communities served. Human needs such as *hope* and *optimism* are important with respect to employee morale during periods of operational hardship, uncertainty and change. It is reasoned by this

author that Quality leaders are, in a sense, both *knowledge* and *spiritual* leaders. As “shepherds,” quality leaders could use a spiritual, holistic and ethical approach to quality assurance like a magician, shaman or *metaphysician*, with the capacity to reach within the organization and facilitate social change. This form of learning arises through a process of *self-reflection*, *wonder* and *imagination*, which leads to a *revelation*. It is in this light that quality leaders require *talismans*: quality systems, tools, methodologies, and standards to lift and transform organizations into a greater level of collective consciousness. Quality systems are reasoned to be extensions of the Orch-OR and TALiS models, which use information frameworks, tools, methodologies and standards to capture, codify and share knowledge. This knowledge results in product-service satisfaction for the customer. This altruistic behaviour results in customer loyalty within the community. Therefore, it is reasoned by this author that quality assurance strongly supports a growing discipline called *Organizational Neuroscience* (Becker & Creopanzano, 2010).

It is thought by this author that quality leaders should have an intrinsic dimension of *charisma*, possessing a special social talent to bring people together as a community. Using imagination and transcendental thinking, the quality leader can shape and project “the dream” for the organization to understand its greater purpose as a community. This process is accomplished by the use of a “talisman” called the *vision statement*. The vision statement plays an important role by shifting and projecting a cognitive lens to energize and expand the gestalt sphere of the organization into a higher state of mindfulness. This is accomplished through the careful use of language (Meadows D. H., 2008).

Transcendental thinking is the first step towards establishing a new purpose within the organizational community, leading to solidarity. Through collective engagement of all minds to the “cause” and fully understanding their identity and purpose, the organization can begin the process of transformation as a learning system. Through a process of organizational learning, a discovery within the group leads to a revelation, which results in a *cultural transfiguration*. Therefore, it is through revelation that the organization as a community evolves into a *new cultural archetype*.

The vision statement is closely linked with the *beliefs statement* and *values statement*. All three quality tools are “talismans” that bind the organization and its employees as a community. The vision, beliefs, and values statements are linked to organization’s identity, purpose and the employees’ relationship with their customers as a community. As a *lodestar*, a consistent theme with all three statements should be the “goal of goodness.” Quality Assurance is reasoned to support the philosophy, science and ethics of *Integral Permaculture* (Figure 8).

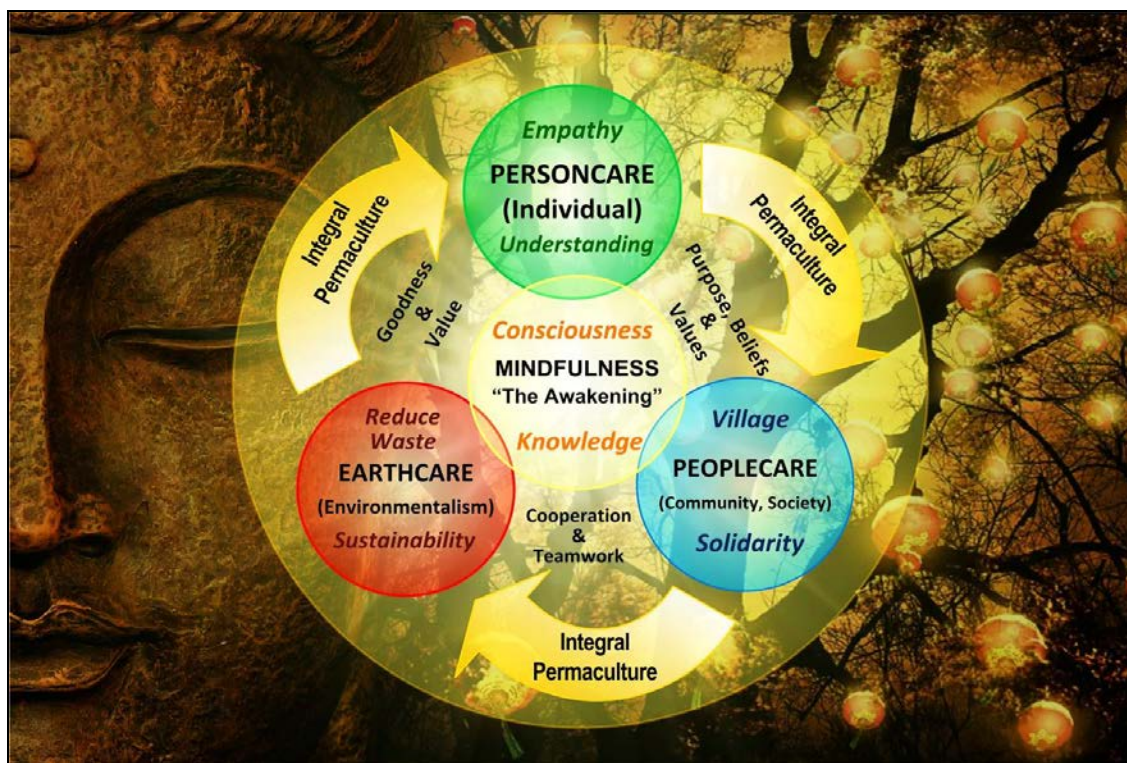


Figure 8. TALiS, Integral Permaculture and the vision of goodness. The Pharos of quality assurance, for greater understanding of the dynamics within complex systems. It is a beacon representing the consciousness of humanity, Earth's biosphere and the cosmos. Adapted from "Anchored Paper Lanterns" [digital mosaic]. Yes Event Solution, 2011. Retrieved from <http://blog.4yes.com/2011/06/alternatives-to-tangled-themed-sky.html>.

Quality Assurance tools, frameworks, methodologies and standards, provide the means for organizations to nurture and expand the "culture of goodness" through empathy, learning and mindfulness. Integral Permaculture can be applied within medical laboratory environments and integrated within current quality programs. In this light, four published guidelines by the *Clinical and Laboratory Standards Institute* will be examined. This critique will use the evidence and models presented in the literature review, the research findings and the wisdom and spirit of Dr. Donella Meadows, the Mother of Integral Permaculture.

CHAPTER 3

METHODOLOGY

Design of the Investigation

This exploratory cross-sectional study of the medical laboratory workforce utilized a descriptive correlative design. This study involved the collection of data using four psychometric questionnaires to determine cultural characteristics of the medical laboratory workforce. These four instruments are the:

- 1) *Autistic Quotient (AQ) Questionnaire* (Baron-Cohen, Wheelwright, Skinner, Martin, & Clubley, 2001);
- 2) *Empathy Quotient (EQ) Questionnaire* (Lawrence, Shaw, Baker, Baron-Cohen, & David, 2004);
- 3) *Systemizing Quotient-Revised (SQ-R) Questionnaire* (Wheelwright, et al., 2006), and;
- 4) *The Machiavellian Personality (Mach-IV) Questionnaire* (Christie & Geis, 1970).

The participants for this study were recruited online. The questionnaires were administered with the use of an internet survey tool (Qualtrics, LLC, 2015). In addition to the information gathered in the questionnaires, demographic data was collected from the participants.

The three-fold purpose of this study is to:

- a) Detect the presence of Autism spectrum disorders (ASDs) and Machiavellianism;
- b) Define the cultural characteristics within this occupational group based on the four psychometric instruments, and;
- c) Determine if there are relationships between psychometric scores and facility/laboratory size within a regional health service governance model.

All participants in this study were anonymous and completed the electronic consent form.

The participants were recruited through advertisements posted on the SSMLT website (SSMLT, 2015) and the fall 2014 *CMLTM Newsletter* (CMLTM, 2014).

Ethical Approval

Ethical approval was obtained from the Institutional Review Board at California State University, Dominguez Hills (See Appendix E). This author was required to complete the *National Institutes of Health*, internet-based course called “Protecting Human Research Participants” (see the certificate of completion in Appendix F). The participants in this study gave consent electronically through the Qualtrics website by entering a Captcha™ Code (See Appendix G) embedded within the Qualtrics online survey tool (Qualtrics, LLC, 2015). They were given the opportunity to read the terms and conditions of the survey, the disclaimer and how their data was to be used for this thesis.

Sample

Data from a total of 32 participants was obtained. There were 7 Males and 25 females, with an age range of 23 to 62 who completed the online questionnaire. Data was collected from the participants in the provinces of Manitoba and Saskatchewan. Data Analysis was completed using SPSS statistical software. Due to the small male population in the sample, and in order to protect participant confidentiality, the data was aggregated in some instances for further analysis.

Treatment

For this workforce study, demographics such as; age, gender, community and laboratory size were collected along with the questionnaire scores. This information was gathered to determine if there were any relationships between the test scores and:

- 1) Population patterns within regional health service models;
- 2) Opportunities for improvement within the quality systems in place, and;
- 3) Better understand the social dynamics of the workforce.

In some instances, data was aggregated to determine these relationships due to limited sample size and to protect participant confidentiality.

CHAPTER 4

RESULTS AND DISCUSSION

Research Questions, Hypotheses, Results Tables, and Discussion

This study used an online survey questionnaire to detect the prevalence of high-functioning Autism and Machiavellianism in the medical laboratory industry. The purpose of this study was to determine if: (a) Autism spectrum disorders (ASDs) are prevalent; (b) Machiavellianism is present; (c) Determine the cultural characteristics within this occupational group; and, (d) Evidence to support the TALiS model. This author obtained IRB approval at CSUDH for this study on April 10, 2014 (see Appendix E). Due to a low participation rate and to obtain sufficient data for this study, the data collection process exceeded one year. This required IRB approval for an extension. Data from 32 respondents were used for this study.

Workforce Sample and Data Quality Analysis

Table 4 displays the frequency counts for selected variables. A scan was performed to ensure that the sample would satisfy the demographic requirements for this study. The ratio of males to females in the sample is representational of the medical laboratory workforce (CIHI, 2011). There were three times as more females in the sample (78.1%) than males (21.9%). The ages of the respondents in the sample ranged from 23 to 62 ($M = 44.16$, $SD = 12.55$), which is also representational of the medical laboratory workforce (CIHI, 2011). The population size of the communities where the respondents

lived at the time of the survey ranged from “under 2,000 (37.5%)” to “100,001+ (15.6%)” with the median sized community being 3,500. The size of the communities where the respondents were *employed*, ranged from “under 2,000 (34.4%)” to “100,001+ (15.6%),” with the median sized community being 3,500. Two-thirds of the respondents at the time of this survey (68.8%) were employed in labs with 1 to 10 technologists. Almost all of the respondents (87.5%) were unionized employees. The number years of professional activity reported by the respondents ranged from 1 to 41 years ($M = 19.17$, $SD = 13.14$) and the number of years of employment for their current employer ranged from 1 to 40 years ($M = 14.41$, $SD = 12.50$). The number of employees that the respondents worked in their career ranged from 1 to 9 ($M = 2.88$, $SD = 2.14$). Therefore, it appears that there was a good distribution of participants, despite the small sample size.

Table 4

Frequency Counts for Selected Variables (n=32)

| Variable | Category | <i>n</i> | % |
|------------------|----------|----------|------|
| Sex | Male | 7 | 21.9 |
| | Female | 25 | 78.1 |
| Age ^a | 23-31 | 8 | 25.0 |
| | 32-47 | 9 | 28.1 |
| | 48-56 | 9 | 28.2 |
| | 57-62 | 6 | 18.7 |

^a Age: $M = 44.16$, $SD = 12.55$.

Table 4 *Continued*

| Variable | Category | <i>n</i> | % |
|--------------------------------------|----------------|----------|------|
| Size community live in ^b | Under 2,000 | 12 | 37.5 |
| | 2,001-5,000 | 7 | 21.9 |
| | 5,001-10,000 | 2 | 6.3 |
| | 10,001-25,000 | 3 | 9.4 |
| | 25,001-50,000 | 1 | 3.1 |
| | 50,001-100,000 | 2 | 6.3 |
| | 100,001+ | 5 | 15.6 |
| Size community employed ^c | Under 2,000 | 11 | 34.4 |
| | 2,001-5,000 | 9 | 28.1 |
| | 5,001-10,000 | 2 | 6.3 |
| | 10,001-25,000 | 2 | 6.3 |
| | 25,001-50,000 | 1 | 3.1 |
| | 50,001-100,000 | 2 | 6.3 |
| | 100,001+ | 5 | 15.6 |

^b Size of Living Community: *Mdn* = 3,500.

^c Size of Employed Community: *Mdn* = 3,500.

Table 4 *Continued*

| Variable | Category | <i>n</i> | % |
|------------------------------|----------|----------|------|
| Laboratory size ^d | 1-10 | 22 | 68.8 |
| | 11-20 | 3 | 9.4 |
| | 21-30 | 1 | 3.1 |
| | 51-60 | 2 | 6.3 |
| | 61-70 | 1 | 3.1 |
| | 71-80 | 1 | 3.1 |
| | 101+ | 2 | 6.3 |
| Unionized | Yes | 28 | 87.5 |
| | No | 4 | 12.5 |

^d Laboratory Size: *Mdn* = 5.50.

Table 4 *Continued*

| Variable | Category | <i>n</i> | % |
|---|----------|----------|-------|
| Years in profession ^e | 1-4 | 8 | 25.0 |
| | 5-18 | 8 | 50.0 |
| | 19-28 | 8 | 75.0 |
| | 29-41 | 8 | 100.0 |
| Years with current employer ^f | 1-3 | 8 | 25.0 |
| | 4-10 | 8 | 50.0 |
| | 11-26 | 8 | 75.0 |
| | 27-40 | 8 | 100.0 |
| Number of employers over career ^g | 1 | 9 | 28.1 |
| | 2 | 10 | 31.4 |
| | 3-5 | 9 | 28.1 |
| | 6-9 | 4 | 12.4 |

^e $M = 19.17, SD = 13.14.$

^f $M = 14.41, SD = 12.50.$

^g $M = 2.88, SD = 2.14.$

Table 5 displays the psychometric characteristics for the four aggregated scale scores. The Cronbach's Alpha reliability coefficient was calculated from the data sets generated by the participant responses. The Cronbach's alpha value is a measure of internal consistency within the data sets for the four psychometric instruments. Three of the four scales had acceptable levels of internal reliability ($\alpha > .70$), while the Machiavellianism scale had poor internal reliability ($\alpha = .26$) (Saris & Gallhofer, 2007). The Mach-IV scores were further inspected to determine what may have been responsible for the low internal reliability of the data. The Mach-IV test is composed of three subsets, relating to: 1) *tactics*; 2) *views*; and, 3) *morality* (Christie & Geis, 1970). It was found that within *all three subsets*, the data collected was *internally inconsistent*.

Table 5

Psychometric Characteristics for the Aggregated Scale Scores (n=32)

| Score | Number of Items | M | SD | Low | High | α |
|----------------------|-----------------|-------|-------|-------|--------|----------|
| Autistic Quotient | 50 | 22.59 | 9.38 | 10.00 | 48.00 | .90 |
| Systemizing Quotient | 75 | 67.88 | 24.51 | 26.00 | 134.00 | .94 |
| Empathy Quotient | 40 | 39.03 | 13.34 | 8.00 | 69.00 | .91 |
| Machiavellianism | 20 | 59.25 | 5.27 | 44.00 | 69.00 | .26 |

Research Question 1

Are ASDs prevalent in the medical laboratory industry?

Research Question 2

Is Machiavellianism prevalent in the medical laboratory industry?

It was hypothesized for research questions 1 and 2, based on the literature evidence presented in Chapter 2 that the workforce, being a highly specialized group within the healthcare sciences, would have higher SQ-R values, when compared to population normative values. However, for the AQ and EQ scores, it was hypothesized that the workforce overall would have higher rates of autism, therefore the AQ should be higher and the EQ lower in relation to the general population and other occupational groups or disciplines. For Machiavellianism, it was hypothesized that the population would score marginally higher, since the predominant gender is female. Due to a low participation rate and to protect participant confidentiality, the scores of both genders were aggregated for analysis.

To provide answers to both questions 1 and 2, the workforce sample was analyzed based on participants who: 1) met requirements, based on *discriminator values* (Table 3); and, 2) sample comparison based on *normative, ASD, nursing* and *academic* groups. Table 6 displays the frequency counts for the four criteria variables, based on the discriminator values. Stated earlier in Chapter 1, the discriminator values selected for Table 3 were then used to determine the percentage of the workforce that met requirements for the AQ, EQ, SQ-R and Mach-IV questionnaires. The most prevalent criteria met in the sample were Autistic Quotient (53.1%) and Machiavellianism (46.9%).

The total number of criteria met by each respondent ranged from 0 to 4 ($M = 1.31$, $SD = 1.06$). The percentage of the workforce sample which met requirements for the questionnaires ranged from 12.5% to 34.4%, depending on the total criteria met. These figures are noteworthy, in that they appear to relate closely to the prevalence of psychiatric morbidities reported in the study in Taiwan, mentioned in Table 1 in Chapter 1 (Lee, Lee, Liao, & Chiang, 2009). However, 25% of the workforce did not meet any criteria, seen in Table 6.

Table 6

Frequency Counts for Criteria Variables (n=32).

| Variable | Category | n | % |
|--|----------|----|-------------|
| Autistic Quotient Criteria | No | 15 | 46.9 |
| | Yes | 17 | 53.1 |
| Systemizing Quotient Criteria | No | 29 | 90.6 |
| | Yes | 3 | 9.4 |
| Empathy Quotient Criteria | No | 25 | 78.1 |
| | Yes | 7 | 21.9 |
| Machiavellianism Criteria | No | 17 | 53.1 |
| | Yes | 15 | 46.9 |
| Total Criteria Met ^a | 0 | 8 | 25.0 |
| | 1 | 11 | 34.4 |
| | 2 | 9 | 28.1 |
| | 3 - 4 | 4 | 12.5 |

^a Criteria Met: $M = 1.31$, $SD = 1.06$.

The survey results from the AQ, SQ-R, and EQ questionnaires and the mean scores of the medical laboratory workforce were then compared against collated data from several published studies. There were two questions that were addressed, those being: 1) the medical laboratory workforce mean values, compared to normal population means; and, 2) the medical laboratory workforce means, compared to academic or other occupational groups. The published results of the “normal control” group (Baron-Cohen, et al., 2014) are shown in Table 7. The medical laboratory workforce scored higher on the Autistic Quotient and lower on the Empathy Quotient questionnaires, in comparison to the population normative values. The Empathy Quotient mean value of the medical laboratory workforce, when compared to the nursing workforce is significantly lower. This evidence appears to support the hypothesis for research question 1.

It was mentioned earlier in this thesis that the empathy quotient is limited. The EQ questionnaire cannot distinguish between *cognitive empathy* and *affective empathy*; therefore, the values need to be treated with scrutiny. The Systemizing Quotient scores of the laboratory workforce are significantly higher when compared to the normal control values. It appears as that the medical laboratory workforce characteristics, based on the three questionnaires, is most in agreement with the published figures of students in the “physical sciences” (Baron-Cohen, et al., 2014). The physical sciences group, studied by researchers at Cambridge University, included participants from disciplines such as: mathematics, physics, chemistry, computer science, geology, engineering, astronomy and astrophysics (Baron-Cohen, et al., 2014). This statistical evidence is not surprising, considering the high degree of complex technology, which is used in medical laboratories

today. Therefore, the evidence presented in Table 6 and Table 7 appears to support the hypothesis for research question 1.

Table 7

Medical Laboratory Workforce versus Normal, ASD and Occupational groups.

| GROUP | | AQ | | | EQ | | | SQ-R | | | Reference Source |
|--------------------|-------|------|------|------|------|------|------|------|------|------|--|
| | | n | M | SD | n | M | SD | n | M | SD | |
| NORMAL CONTROL | F | 2562 | 17.1 | 7.6 | 2376 | 48.5 | 13.7 | 2261 | 55.1 | 21.1 | (Baron-Cohen, et al., 2014) |
| | M | 1344 | 20.3 | 7.8 | 1253 | 38 | 13.7 | 1197 | 68.1 | 21.6 | |
| AS/HFA | F | 454 | 32.9 | 11.5 | 419 | 26.4 | 17.2 | 397 | 71.7 | 25.7 | |
| | M | 357 | 34.8 | 9.1 | 307 | 20.4 | 12.4 | 295 | 78.4 | 24.3 | |
| Physical Science | F | 159 | 18 | 5.7 | 159 | 44.7 | 11.3 | 159 | 59.9 | 19.4 | (Wheelwright, et al., 2006) |
| | M | 294 | 19.4 | 6.4 | 294 | 35.9 | 11 | 294 | 65.4 | 17.5 | |
| Biological Science | F | 290 | 15.6 | 5.8 | 290 | 48.5 | 11.4 | 290 | 52 | 19.2 | |
| | M | 125 | 16.7 | 5.8 | 125 | 41.6 | 11.5 | 125 | 62 | 17.8 | |
| Social Science | F | 181 | 15 | 5.1 | 181 | 48.7 | 10.8 | 181 | 51.2 | 19.7 | |
| | M | 115 | 16.2 | 5 | 115 | 41.4 | 11 | 115 | 61.9 | 18.8 | |
| Humanities | F | 408 | 14.6 | 5.3 | 408 | 48.7 | 11.2 | 408 | 48.4 | 17.9 | |
| | M | 189 | 15.7 | 6 | 189 | 40.5 | 11.7 | 189 | 53.7 | 20.6 | |
| Nursing | F | na | na | na | 336 | 51.9 | na | 336 | 57.2 | na | (Penprase, Oakley, Ternes, & Driscoll) |
| | M | na | na | na | 54 | 45.2 | na | 54 | 65.1 | na | |
| Med Lab Workforce | M & F | 32 | 22.6 | 9.4 | 32 | 39 | 13.3 | 32 | 67.8 | 24.5 | 2014-2015 Study (Thesis) |

The medical laboratory workforce Mach-IV sample mean score was then compared with collated data from several published literature sources of other groups is seen in Table 8. The Mach-IV results showed *poor internal reliability* (see Table 5). Therefore, the medical laboratory workforce mean should be interpreted with caution. If the mean value of 59.25 is representative of the workforce, it seems to indicate that they are not significantly higher as a group when compared to the general population. However, the medical laboratory workforce mean of 59.25 is close the discriminator value of 60 (Christie & Geis, 1970), which differentiates “High Mach” personality types from “Low Mach” personality types. Therefore, this evidence does not appear to support the hypothesis for research question 2.

Table 8

Medical Laboratory Workforce Mach-IV Values versus Normative Values.

| GROUP | SEX | Mach-IV | | | Reference Source |
|--|-----|-----------|--------------|-------------|--|
| | | n | MEAN | SD | |
| General Population | na | 82 | 55.9 | 7.7 | (Jakobwitz & Egan, 2006) |
| General Public & Students from two universities In England | F | 125 | 49.31 | 5.45 | (Andrew, Cooke, & Muncer, 2008) |
| | M | 125 | 49.30 | 5.56 | |
| UBC Psychology Students | F | 349 | 54.58 | 7.05 | (Sherry, Hewitt, Besser, Flett, & Klein, 2006) |
| | M | 134 | 58.74 | 7.51 | |
| Med Lab Workforce | M/F | 32 | 59.25 | 5.27 | 2014-2015 Study (Thesis) |

It should be mentioned that the evidence presented in Table 11 is very limited. It is not known how the medical laboratory workforce values compare to occupations in finance, marketing, logistics or other professions within large scale businesses. It is quite possible that the medical laboratory workforce means are much lower than professionals employed in these occupational groups in business. Further research into Machiavellianism in laboratory medicine, in relation to other healthcare and non-healthcare occupational groups and their dynamics within quality assurance, is required. Therefore, the findings do not support the hypothesis for research question 2; that the workforce, being predominantly female, has marginally higher Machiavellian scores, when compared to general population normative values.

Research Question 3

Is there a relationship between the Empathy Quotient (EQ), community and laboratory facility size?

Research Question 4

Is there a relationship between the Autistic Quotient (AQ), community and laboratory facility size?

Research Question 5

Is there a relationship between the Systemizing Quotient (SQ-R), community and laboratory facility size?

Research Question 6

Is there a relationship between the Machiavellian personality test (Mach-IV), community and laboratory facility size?

It was hypothesized for questions 3 to 6, based on the literature evidence presented in Chapter 2, that the workforce sample will demonstrate an *inverse correlation* between the AQ scores, community and laboratory size. Also, it was hypothesized that the EQ, SQ-R and Mach-IV scores of the workforce sample will demonstrate a *positive correlation* between community and laboratory size. To provide evidence to answer the research questions for 3 to 6, Spearman correlations were performed, seen in Tables 9 and 10. Also, the individual scores were plotted against community sizes to support the hypotheses in Figure 10.

Table 9 displays the Spearman correlations between nine demographic variables and the respondent's autism and empathy quotient scores. For the resulting 18 correlations, only one was significant at the $p < .10$ level. Specifically, the female respondents had higher empathy quotient scores ($r_s = .31, p < .10$) in relation to males. It should be noted in Table 8 that weak correlations were *detected* for the AQ versus "size of community employed" ($r_s = .21$) and "size of laboratory employed" ($r_s = .21$). The inverse relationship between the AQ and EQ has been well established in prior studies (Baron-Cohen, et al., 2014). However, the correlations are not statistically significant enough in this workforce sample to support the hypothesis for research questions 3 and 4; where it was hypothesized that AQ scores would *decrease*, and EQ scores would *increase* with community and laboratory facility size. The evidence is inconclusive. Therefore, researchers should aim to investigate these relationships in future studies.

Table 9:

Spearman Correlations for Selected Variables with AQ and EQ Scales (n=32).

| <i>Variable</i> | <i>Autism Quotient (AQ)</i> | <i>Empathy Quotient (EQ)</i> |
|---------------------------------|-----------------------------|------------------------------|
| Sex ^a | -.09 | .31* |
| Age | -.10 | .10 |
| Size community live in | .05 | -.09 |
| Size community employed | .21 | -.13 |
| Laboratory size | .25 | -.11 |
| Unionized ^b | .13 | -.23 |
| Years in profession | -.11 | .10 |
| Years with current employer | -.16 | .13 |
| Number of employers over career | -.15 | .28 |

* $p < .10$. ** $p < .05$. *** $p < .01$. **** $p < .005$. ***** $p < .001$.

^a Sex: 1 = *Male*, 2 = *Female*.

^b Unionized: 1 = *Yes*, 2 = *No*.

The relationship between the SQ-R, Mach-IV scores of the workforce versus community and laboratory facility sizes was investigated for research questions 5 and 6. Table 10 displays the Spearman correlations between nine demographic variables and the respondent's systemizing quotient and Machiavellianism scores. For the resulting 18 correlations, there were five correlations were significant at the $p < .10$ level.

Specifically, systemizing quotient scores were higher for:

- (a) Respondents who were male ($r_s = -.35, p < .05$);
- (b) Respondents who worked in larger communities ($r_s = .37, p < .05$);
- (c) Respondents who worked in larger labs ($r_s = .34, p < .10$), and;
- (d) Respondents not employed as unionized employees ($r_s = .51, p < .005$).

In addition, Machiavellianism scores were higher for those respondents who had fewer employers in their career ($r_s = -.31, p < .10$).

Table 10:

Spearman Correlations for Selected Variables with SQ and Mach-IV (n=32).

| Variable | Systemizing Quotient (SQ-R) | Machiavellianism (Mach-IV) |
|---------------------------------|-----------------------------|----------------------------|
| Sex ^a | -.35 ** | .20 |
| Age | -.25 | -.06 |
| Size community live in | .28 | .02 |
| Size community employed | .37 ** | .27 |
| Laboratory size | .34 * | .25 |
| Unionized ^b | .51 **** | .10 |
| Years in profession | -.15 | -.01 |
| Years with current employer | -.24 | .03 |
| Number of employers over career | .18 | -.31 * |

* $p < .10$. ** $p < .05$. *** $p < .01$. **** $p < .005$. ***** $p < .001$.

^a Sex: 1 = *Male*, 2 = *Female*.

^b Unionized: 1 = *Yes*, 2 = *No*.

The survey results were then plotted against community sizes in Figure 9. The purpose of the graphs is to provide the reader a better sense of the spread of values within the workforce sample for all four psychometric tests and to see if there was a relationship

between the results versus community size. Also, it permits the reader to see the interrelationships between the results within the sample. It is important to note that the cut-off values used in this study are not universally agreed upon by psychology researchers (see Table 3). Therefore, these graphs present the scores in a manner which permits other researchers to inspect the graphs and assess the workforce characteristics based on their requirements.

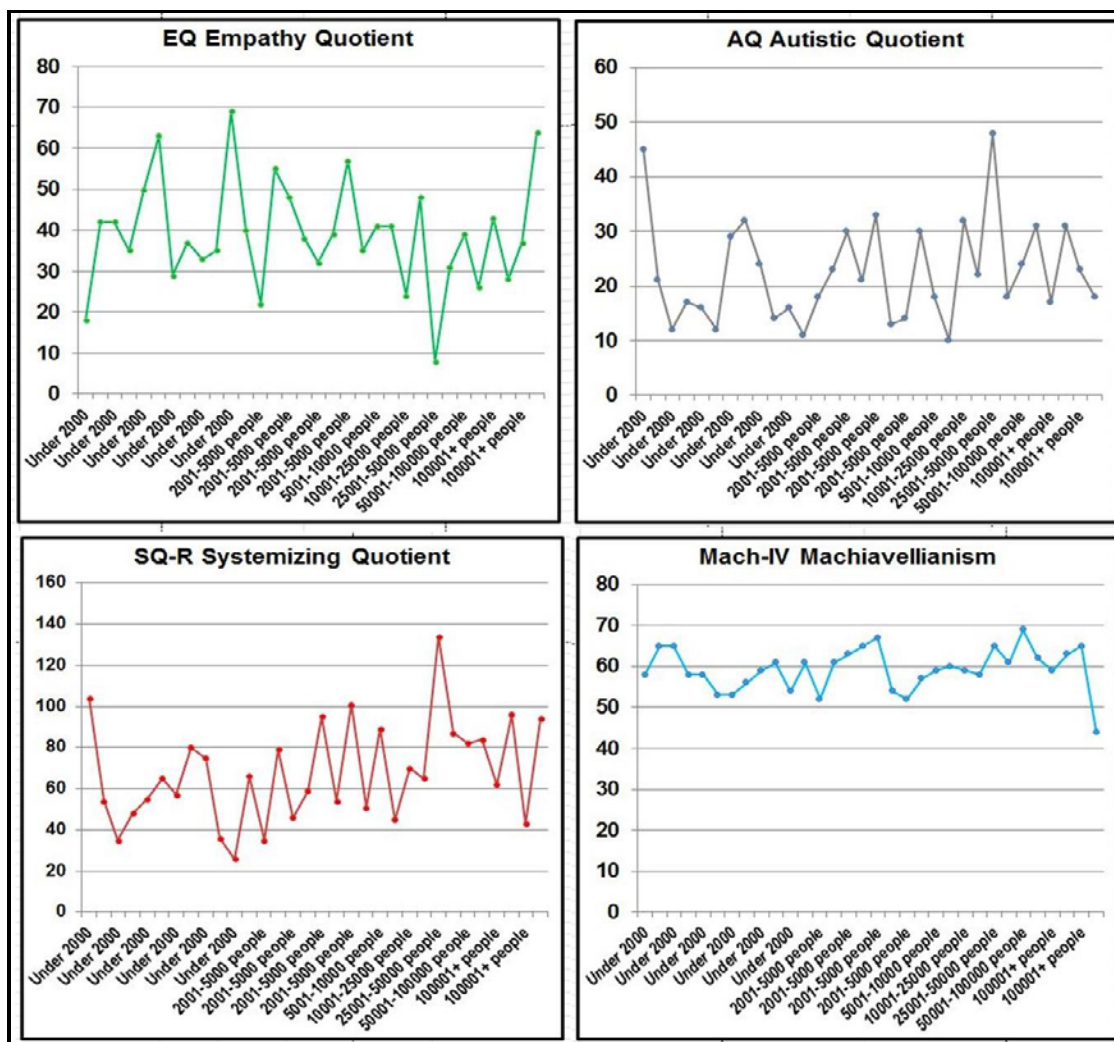


Figure 9. Survey psychometric scores of the medical laboratory workforce sample, versus community Size.

Upon closer inspection of the graphs in Figure 9, there are two graphs that are noteworthy. These graphs are the SQ-R and Mach-IV tests. For the Mach-IV test there is a narrow distribution of scores, despite the wide differences in community sizes. The Mach-IV scores cluster around the discriminator of 60, which differentiates between a “High-Mach” and a “Low-Mach” (Christie & Geis, 1970). The very weak correlations *detected* between the Mach-IV versus *laboratory size* (Mach-IV, $r_s = 0.27$) and the *size of community employed* (Mach-IV, $r_s = 0.25$) suggests that there is little difference between rural versus large laboratories. Christie and Geiss discovered through “ball and spiral” experiments that High-Machs have a more *task-oriented* focus, whereas Low-Machs tended to get more carried away in *group maintenance* encounters (Christie & Geis, 1970).¹⁷ They stated that a “process is not generated *within* each of the participants separately; rather, it develops *between* them – it is an effect of the group as a unitary system” (Christie & Geis, 1970, p. 273). The Mach-IV values could, in fact, be evidence that the workforce thinks like a *unitary system* or as a *supply-service chain* across large distances and community sizes.¹⁸ Therefore evidence presented in the Mach-IV graph (figure 9), along with the evidence in Table 10, partially supports the hypothesis for research question 6.

For the SQ-R questionnaire, there is a clear upper trend with increasing population size in Figure 9. The graph is supported by statistically significant correlations between the SQ-R versus “laboratory Size” (SQ-R, $r_s = 0.34$, $p < 0.10$) and the “Size of community” employed (SQ-R, $r_s = 0.37$, $p < 0.05$). Although all four questionnaires may be important in quality assurance, it appears that the SQ-R test is the most significant. It

is important to consider all occupational groups. A similar pattern may be found with in other occupational groups. This evidence points to the importance of ISO regulated environments. It is thought that other occupational groups might also benefit from this type of quality system framework. Therefore, the evidence presented in the SQ-R graph (figure 9), along with the statistical evidence in Table 10, supports the hypothesis for research question 5.

Research Question 7

Is there a relationship between the psychometric scores of the workforce population sample and the TALiS model?

It was hypothesized for question 7, based on the literature evidence presented in Chapter 2 that the workforce sample will lean towards the SQ-R of the TALiS. To support this prediction of the sample, Spearman rank-ordered intercorrelations were performed and used to construct a linear-structural relationship model to see better the scores. Table 11 displays the Spearman rank-ordered intercorrelations for the four primary scale scores. The alpha level for this analysis was set at $p < .10$, due to the sample size ($N = 32$). Two of the six correlations were significant at the $p < .10$ level. Specifically, the autistic quotient was shown to be negatively related to the empathy quotient ($r_s = -.59, p < .001$) and to be positively related to the systemizing quotient ($r_s = .49, p < .005$).

Table 11:

Spearman Intercorrelations among the Aggregated Scale Scores (n=32).

| SCORE | 1 | 2 | 3 | 4 |
|-------------------------|------------|------|------|------|
| 1. Autistic Quotient | 1.00 | | | |
| 2. Empathy Quotient | -.59 ***** | 1.00 | | |
| 3. Systemizing Quotient | .49 ***** | -.24 | 1.00 | |
| 4. Machiavellianism | .28 | -.22 | 0.08 | 1.00 |

* $p < .10$. ** $p < .05$. *** $p < .01$. **** $p < .005$. ***** $p < .001$.

A linear structural model (Figure 10) was constructed using the Spearman rank-ordered intercorrelations from Table 7, along with proposed “mind maps” for each dimension in the TALiS model. For clarity to the reader, the AQ test is not at the “centre” of the model seen in Figure 9. The AQ test has been projected this way for its relationships to be seen more clearly with the EQ, SQ-R and Mach-IV questionnaire results. Based on the intercorrelations, it appears that the medical laboratory workforce sample within the linear structural model is “leaning” towards the SQ-R, which is associated with *procedures, inspection, and control*, based on the TALiS model.

Also, there is a correlation with the Mach-IV, which suggests that they are *process* focused as well, but not as strongly.

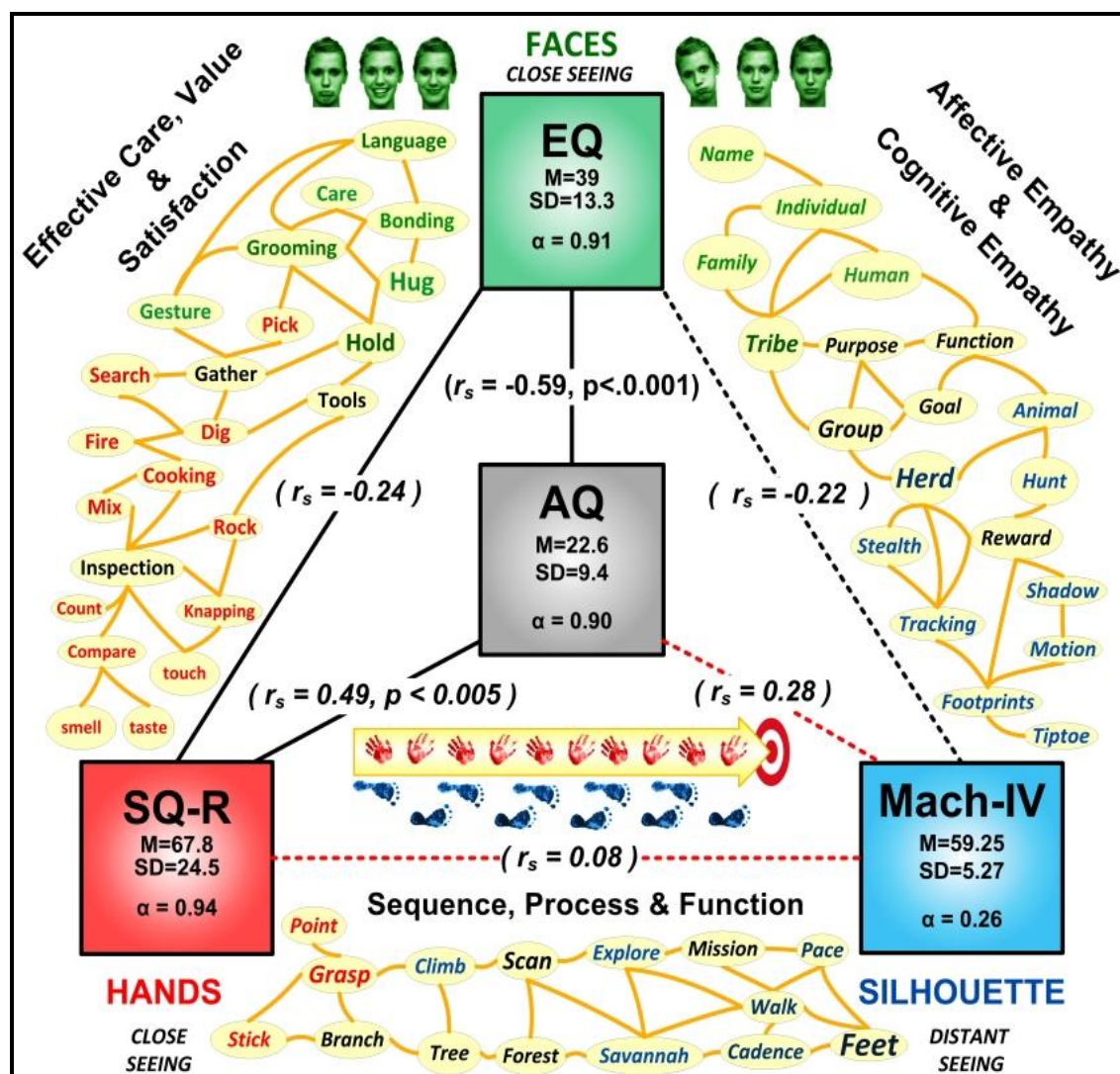


Figure 10. Linear structural relationship model, Spearman intercorrelations and TALiS. Using the TALiS model, the medical laboratory workforce sample, based on its intercorrelations can be seen to lean towards the SQ-R (AGLS). This learning system relates to *procedure, inspection and control*, which are linked to *hands* (“close seeing”).

The reader should note that the Spearman rank-ordered intercorrelations of the EQ, SQ-R, AQ tests, versus the Mach-IV test, have not been entirely supported by prior studies. Intercorrelations not supported by prior studies have been highlighted using red dotted lines in Figure 10. Despite the small sample size, the intercorrelations between the EQ, SQ-R, and AQ tests agreed with prior literature sources (Wheelwright, et al., 2006). Also, the inverse relationship *detected* between the EQ and Mach-IV results (see Figure 10, $r_s = -0.22$), also agreed with earlier findings (Andrew, Cooke, & Muncer, 2008). However, this author was unsuccessful in finding any prior evidence to verify:

- 1) The relationship between the AQ and Mach-IV test, and;
- 2) The relationship between the SQ-R and the Mach-IV test.

Therefore, the Spearman intercorrelations presented in Figure 10 are to be interpreted with caution. These values should be further investigated and verified in future studies. It was discussed earlier in the literature review, that it is well known that individuals with ASDs have deficits with *cognitive empathy*.¹⁹ Therefore, the minor correlation *detected* between the AQ versus the Mach-IV ($r_s = 0.28$) and the minor inverse correlation *detected* between the EQ versus the Mach-IV ($r_s = -0.22$), appear to make sense when considering the nature of this workforce sample.

The absence of a relationship between the SQ-R and the Mach-IV ($r_s=0.08$) is thought-provoking. Stated earlier, this author was unsuccessful in finding prior published research that investigated the relationship between the SQ-R and the Mach-IV tests. Keeping in mind that the sample size was very small ($n=32$) and that the Mach-IV test had poor internal reliability ($\alpha = 0.26$), it is plausible that there is *no relationship* between

the SQ-R and Mach-IV. It is thought-provoking, that all other psychometric measures detected a correlation in Table 11, except the SQ-R and the Mach-IV. It is questioned if the lack of a correlation between the two instruments can be explained by the following:

- 1) *Different neural systems* are being detected by the two instruments;
- 2) There might be Neural system(s), which are *not detected* by *either* instrument;
- 3) There is/are neural system(s) present, that process information based on different *cognitive vantage points*, which are not the same for the two instruments and may relate to *proxemics*;
- 4) The cognitive vantage point of the SQ-R is *within* the Lewin social space, whereas the Mach-IV vantage point is *outside* the Lewin social space
- 5) The Mach-IV test deals with *human systems*, whereas the SQ-R test deals with *non-human* systems, or;
- 6) There is some relationship between the SQ-R, hands, hand motion and technique (procedure, inspection, control), whereas the Mach-IV is related to feet, flows, pacing and cadence (process, direction, target, function).

Although it is conjecture, it is plausible that the SQ-R and Mach-IV questionnaires, by their design, may not produce a correlation, based on the evidence presented in Table 11. Therefore, the lack of a correlation between the SQ-R and Mach-IV needs to be further investigated and verified in a future study.

It was thought that the SQ-R and Mach-IV tests might detect a correlation since both mindsets are reasoned to think in the third person. However, this appears to be unsupported by Table 11. Different neural systems appear to be involved. A third-person mindset may require different vantage points and thus “leans” on different neural systems to understand the quality goal. Concerning social systems, there is a clue through the research studies conducted by Christie and Geiss, which implies that third-person thinking may involve two or more vantage points when analyzing a quality related issue

and this may relate to *proxemics*. Discussed early in the literature review, the researchers studied the relationship between the Machiavellian and Authoritarian personality type (Christie & Geis, 1970). The researchers found *no relationship* between the two personality types, suggesting that the personality types differ by the *height* of their *vantage points* in relation to the social system.

It can be reasoned that the Authoritarian personality type sees the “social tribe” from a high vantage point in the “tree” and *looks down* at the social system as a *hierarchy*. In this light, Authoritarian thinking and perception can also be reasoned to be another form of third-person thinking and systemizing. However, this does not appear to be the vantage point of the Machiavellian personality type. It is reasoned that the “High-Mach” sees the tribe from a distance, as a “herd” on the *same social plane*. There is evidence in Table 10, of a positive correlation between the SQ-R versus “laboratory Size” (SQ-R, $r_s = 0.34$, $p < 0.10$) and the “Size of community” employed (SQ-R, $r_s = 0.37$, $p < 0.05$). This statistical evidence also seems to be supported by very weak correlations *detected* between the Mach-IV versus *laboratory size* (Mach-IV, $r_s = 0.27$) and the *size of community employed* (Mach-IV, $r_s = 0.25$).

These clues suggest that depending on the height of the employees’ vantage points, relative positions and functional roles within the system (i.e. bench technologist versus supervisor) there are differences in job demands, which may also relate to their cognitive style. Different job types are reasoned to place different mental demands on these neural systems, which are detected by the SQ-R and Mach-IV tests. This may be required to better understand the quality goals within a highly stratified social system

such as a health authority and the workflows that relate to these goals. Also, the evidence appears to support the notion that Machiavellianism is “left-brained” thinking, as discussed early in the literature review (Nestor, et al., 2012). It is questioned by this author if the evidence presented in the literature review, the proposed “Rules of Herds” and this workforce study is sufficient to support the argument that the AGLS and MHLS archetypes within the TALiS model are not concerned with social hierarchies, but rather workflows, functional holarchies and supplier-service chains.²⁰ Therefore, the evidence in Table 11, along with the linear-structural relationship model in figure 10, appears to support both the TALiS model²¹ and the hypothesis for research question 7, that the workforce population would lean towards the SQ-R dimension of the TALiS (AGLS).

Introduction to the Clinical and Laboratory Standards Institute

The Clinical and Laboratory Standards Institute (CLSI) is a non-profit organization in the United States, which is committed to developing and improving laboratory practices within the healthcare community. The CLSI was first organized in 1968 and was formerly called the *National Committee for Clinical Laboratory Standards* (NCCLS). The organization uses a consensus-based process for standardization in laboratory medicine. This author has selected four standards published by the CLSI for critique using the literature review and research results on the medical laboratory workforce to produce knowledge.

The CLSI standards are:

- 1) *QMSI4-A: Quality Management System: Leadership and Management Roles and Responsibilities;*
- 2) *QMS06-A3: Quality Management System: Continual Improvement;*
- 3) *QMS03-A3: Training and Competence Assessment, and;*
- 4) *QMS04-A2: Laboratory Design.*

The body of knowledge and conceptual models developed in the literature review, along with the research findings on the workforce, will be used to as a lens to expand on selected themes within the mentioned CLSI published standards.

Quality Leadership in Complex Systems

What is a leader? Edwards Deming described a quality leader as a knowledge leader who has been “transformed” through “knowledge,” suggesting some personal and profound revelation (Deming, 2013). Deming proposed that a leader has the quality of *charisma* with “personality” and “persuasive power.” Deming stated that the leader accomplishes transformation first with a *theory* and how it would bring gain to the organization and its employees. Through a sense of obligation to the people, Deming stated that the leader is compelled to accomplish the transformation and does so through a practical and methodical approach (Deming, 2013).

Deming’s beliefs suggests that a quality leader has in some sense, a set of moral duties to the organization, its people as a community and this important role makes them accountable for the performance of the organization. This leadership role must touch all “dimensions of mind” which make up the culture of the organization. Therefore, being a

quality leader in healthcare is more than a “job” or “profession,” but a “spiritual calling,” with a long-term vision to support a *culture of goodness*.

Translating a vision into a business plan requires a methodology and quality tools to bring all people together and reach operational goals. Quality Assurance requires a basic conceptual framework; a simple structure that is simple and easy to understand. Joseph Juran, one of the fathers of quality assurance, proposed a well-known model called the “Juran Trilogy”. Juran stated that the trilogy itself was a very old model and had been a tried and true methodology, which has been used for centuries (Juran, 1988). Juran described three major processes making up the triad; called *Quality Planning*, *Quality Control*, and *Quality Improvement*. The Juran Trilogy is reasoned to be the most fundamental process framework within Quality Assurance. With regards to organizational change, a fitting semblance would imagine the phases as three movements within a great symphony. All three movements or processes within the Juran Trilogy are interconnected and designed to lead the organization to a goal. They form the basis of system dynamics within business and healthcare.



Figure 11. A conceptual model showing the relationship between the TALiS, the Juran Trilogy and Six Sigma methodologies. Design for Six Sigma (e.g. DMADV) is not a quality improvement methodology; it is focused on process or product design. In contrast, the DMAIC methodology within Lean Six Sigma is a quality improvement approach.

Using the Juran Trilogy as the structural model for a quality system, the TALiS can be incorporated. When the two models are combined, a greater pattern emerges. As a visual aid, Figure 11 has been provided for the reader to understand the relationships.²² The Juran Trilogy, as the foundation of a quality system, provides the TALiS the means

whereby, to both *root itself* and *reach* within a complex system. Quality systems, tools, methodologies, and standards are learning supports that permit organizations and people to “see” effectively, learn and transfer knowledge as “codified qubits” across large distances to meet customer requirements. Therefore, quality tools are instruments that act as extensions of the human brain, serving as “neurocognitive prosthetic devices,” thus providing qubits of knowledge for each user’s learning system in the TALiS (See Appendix B).

The flow of knowledge, using image Figure 10 requires a brief discussion. Beginning with the STLS, Figure 11 depicts a clock-wise flow of cognitive processes. The *voice of the customer* is captured through surveys, interviews, and focus groups, where the *customer requirements*, are understood by the STLS. This requires that the organization invests resources, to talk directly to customers and to discuss their needs within focus groups. Multiple focus groups may be required to hear “multiple voices” (community, organizational, high-level government and regulatory bodies). Since the STLS relies on *spoken language* for understanding the customer requirements, this learning process becomes important when the customer is part of a cultural group that does not speak in the common language of the organization. This is particularly true for the Francophone population, First Nations and Inuit cultures within Canada.

An excellent example of Canada’s “good government” commitment to quality service is the *Government of the Northwest Territories*. Eleven official languages are recognized (GNWT, 2015). Quality requirements can be lost when translating the Voice of the Customer into *Critical to Quality* requirements when using business improvement

methodologies such as *Six Sigma* (ASQ, 2015). Focus groups and interviews offer the quality assurance department the ability to:

- 1) Understand the customer's point of view and mindset, as a learning system with possible learning needs;
- 2) Understand the dynamics of the social spaces (hierarchies, heterarchies) in the communities;
- 3) Better map out the holistic quality requirements for the customer, and;
- 4) Identify system archetypes that might arise, from multiple providers offering services in the *same* community, which are linked to the customer's *total care*.

The customer requirements are then translated from qualia, using *Quality Function Deployment*, where qubits of knowledge are characterized and codified into *technical requirements* (ASQ, 2015). Critical to quality requirements (CTQs) can then be prioritized and specified through tools, such as the *House of Quality* (ASQ, 2015) by the project committee members. For the reader, a simple example of the House of Quality has been provided in Figure 11. It is thought by this author that the TALiS model could lead to improvements in the HOQ, for easier use and greater utility in Healthcare and Social Services.

| CUSTOMER REQUIREMENTS | | | Up | Up | Target | Down | REGIONAL HEALTH AUTHORITY, REGULATORY & GOVERNMENT | | | | |
|----------------------------------|------------------|------------|-----------|-----------------|----------|-----------------|--|------------------|---------------------------------|--------------------------------|-----------------------------|
| S/No | Customer Need | Importance | PROCESSES | EQUIPMENT SPECS | TRAINING | ERGONOMICS, HFE | COMMUNITY HOSPITAL & CLINICS | HEALTH AUTHORITY | REGULATORY ACCREDITATION, & EQA | PROVINCIAL GOVERNMENT MANDATES | FEDERAL GOVERNMENT MANDATES |
| | | | CTQ 1 | CTQ 2 | CTQ 3 | CTQ 4 | Hosp. | Comp A | Comp B | Comp C | Comp D |
| 1 | Waiting Time | 4 | 6 | 7 | 5 | 5 | 2 | 4 | 5 | 6 | 7 |
| 2 | Accurate Testing | 1 | 1 | 1 | 2 | 1 | 1 | 1 | 1 | 2 | 2 |
| 3 | Language Serv. | 2 | 4 | 6 | 6 | 4 | 3 | 2 | 1 | 2 | 5 |
| 4 | Pleasant Staff | 3 | 3 | 6 | 4 | 5 | 6 | 2 | 7 | 2 | 1 |
| CTQ Importance Score | | | 42 | 59 | 45 | 44 | | | | | |
| CTQ Relative Rank | | | 4 | 1 | 2 | 3 | | | | | |
| How Much (Target, Spec Limits) | | | >3SIG | >4SIG | >90% | >75% | | | | | |
| Risk (Organizational Difficulty) | | | 3 | 2 | 4 | 1 | | | | | |

Figure 12. The House of Quality (HOQ), for healthcare and social services planning. The design of the house of quality, depending on the industry, can be highly variable. Also, the use of symbols, notations, and scoring systems can also be variable. Figure 12 is colour coded to illustrate how the TALiS model fits within the house of quality.

The House of Quality (HOQ) is a powerful quality tool for planning in healthcare and social service. It is used for *Design for Six Sigma* (DFSS) and *Lean Six Sigma* (LSS). A roadmap outlining a DFSS QPMP (DMADV) has been provided in Appendix G to give the reader a sense where the HOQ as a learning tool fits within the bigger project picture. The HOQ is reasoned by this author to be the “opera house”; the collective

“ensemble” of all actors’ voices. The HOQ is a tool used by quality leaders to compose and launch “the great symphony.” As the “eye of providence,” the HOQ touches all learning requirements of the TALiS model to gather and codify knowledge. Using Quality Function Deployment, the HOQ translates qualitative user needs (qualia) and quantitative requirements (qualitas), into quality parameters. This codified knowledge flows from the STLS to the MHLS, where the subsystems needed (functional holarchies) to meet customer requirements are determined as a set of targets. This method provides the key entry points to open safely the sub-systems. The MHLS then begins to work with the AGLS to open up the sub-systems, making changes and then controlling the new processes using qubit feedback loops, thus closing the system. Feedback loops through inspection and control are adjusted to improve the new processes to a satisfactory industrial level (symbolized as a zipper in Figure 9). Once this level of industrial control has been achieved, the Deming PDSA Cycle takes over, and through a dynamic control feedback loop, the processes are further tightened by through the strength of the AGLS and brought to a higher sigma value. Therefore, the process sigma value is a measure of the organization’s ability to translate the VOC using QFD and its effectiveness in transferring that knowledge through the TALiS and optimize processes within functional holarchies as a “breakthrough system.”

Reaching great quality goals within complex systems can be an enormous challenge. The dynamics of a complex system may not be seen and understood until it is constructed. Edwards Deming said that efforts by employees across multiple divisions “are not additive”, but “interdependent”. The collective efforts of employees within one

division can undermine the quality goals of another division (Deming, 2013). The Quality Leader and the project team must be mindful of load imbalances and inefficiencies, which can lead to sub-optimization within a complex system during organizational change. Quality tools provide the means to recognize these problems and fix them.

Deming called this “System Optimization” and explained this important concept, stating:

An example of a system well-optimized is a good orchestra. The players are not there to play solos, like prima donnas, each one trying to catch the ear of the listener. Each of the 140 players in the Royal Philharmonic Orchestra, London, is there to support the other 139. An orchestra is judged by the listeners, not so much by illustrious players, but by the way they work together. That’s what counts. (Deming, 2013, p. 60)

System optimization is a very important concept. The quality leader acts as an organizational “maestro,” driving the three movements of the Juran Trilogy as a symphony. Donella Meadows said that with system optimization, the aim is to enhance the *total system’s* properties such as growth, diversity, resilience, stability and sustainability (Meadows D. H., 2008). She stated that one should never maximize parts of systems or subsystems while ignoring the whole. Therefore, it is questioned if Dr. Deming and Dr. Meadows seem to support the argument that *Design for Six Sigma* (DFSS) might be the better approach when planning a new healthcare program.

System optimization and undesirable archetypes are, however, a continual challenge for large-scale systems. Quality Systems are man-made learning systems. Leaders, managers, and medical personnel, with the best of intentions in the spirit of

quality, from their vantage point and actions can produce undesirable behaviours within systems that impact product quality and service. Undesirable system archetypes can be a potentially serious quality issue. Quality assurance cannot stop undesirable archetypes from surfacing within complex systems such as healthcare or business, but it has the means to detect undesirable archetypes with quality tools, better understand their behaviours and dynamics within complex systems and provide effective monitoring systems within the organization. Therefore, a robust quality system permits actors to overcome the effects of undesirable system archetypes and promotes system optimization within an organization.

Some discussion is needed on system archetypes since this is an important topic in system dynamics and quality assurance. An environmental scan of system archetypes was performed using the Google Scholar search engine on May 29, 2015 as a starting point, to get a better sense of the industries' awareness on system archetypes. Keywords were entered into the search engine and used to collect the number of published literature sources in Table 12. The keywords "healthcare," "ISO 9000" and "ISO 15189" in Table 12, suggest that the body of knowledge in system archetypes in laboratory medicine appears to be *very small*. This evidence raises the question if system dynamics, within highly regulated clinical laboratory environments have been studied in depth, since they are very much linked to Quality Assurance. Therefore, the evidence presented in Table 12 is very thought provoking.

Table 12

Google Scholar Word Search May 29, 2015

| KEYWORD | Google Scholar Hits |
|----------------------------|----------------------------|
| “archetype” | 177,000 |
| “system” + “archetype” | 106,000 |
| “business” + “archetype” | 65,500 |
| “quality” + “archetype” | 81,300 |
| “medicine” + “archetype” | 37,900 |
| “healthcare” + “archetype” | 8,210 |
| “ISO” + “archetype” | 26,200 |
| “ISO 9000” + “archetype” | 1,470 |
| “ISO 15189” + “archetype” | 9 |

This author conducted a second internet scan on May 29, 2015 using the website search engines of regulatory and professional bodies that are related to laboratory medicine.

A search for published literature on system archetypes was also made, on the following websites using the key words “archetype” and “optimization”:

- 1) College of American Pathologists (CAP, 2015);
- 2) Institute for Quality Management in Healthcare (IQMH, 2015);
- 3) Clinical and Laboratory Standards Institute (CLSI, 2015);
- 4) Health Council of Canada (HCC, 2015);
- 5) Canadian Institute for Health Information (CIHI, 2015);
- 6) Accreditation Canada (Accreditation Canada, 2015), and;
- 7) Health Canada (Health Canada, 2015).

It was discovered by this author that there was *no evidence* to be found in the website search engines for the terms “archetype” and “optimization.”

In addition to the first two environmental scans, this author went one step further and conducted a keyword search within the *Ontario Laboratory Accreditation (OLA) Requirements, Version 6.0*. It was also discovered that the words “optimization” and “archetype” were nowhere to be found within the accreditation standards (IQMH, 2013). Joseph Juran, Dr. Edwards Deming, and Dr. Donella Meadows were all aware of the importance of system optimization. A basic understanding of undesirable system archetypes, especially the most common scenarios, is important in Quality Assurance. Therefore, the potential payouts quality, service delivery, and cost savings within healthcare, could be significant if system dynamics and undesirable system archetypes are better understood by all healthcare personnel and put into practice.

Dr. Donella Meadows discussed the problems of undesirable system archetypes in her book *Thinking in Systems* (Meadows D. H., 2008). The most well-known, undesirable system archetypes within system dynamics are called “System Traps” (Meadows D. H., 2008). These common system traps are as follows:

- 1) Policy Resistance;
- 2) The Tragedy of the Commons;
- 3) Drift to Low Performance;
- 4) Escalation;
- 5) Success to the Successful;
- 6) Shifting the Burden to the Intervener Addiction;
- 7) Rule Beating;
- 8) Seeking the Wrong Goal, and;
- 9) Limits to growth.











Undesirable system archetypes may be spotted and easily fixed, if the organization or hospital is very small, as it is with many rural hospitals. It becomes much harder for leaders and their employees to spot these problems when the hospitals must work within a regional health service model, which may operate across large distances. A system trap can lead to a proliferation of other system traps. As a closed system, all smaller systems within a healthcare authority are interconnected and have the potential to become “entangled spaghetti systems”. Therefore, healthcare organizations and businesses may be vulnerable to system traps if they are not well understood by employees.

When a system trap is spotted, it may take an organization a significant amount of resources to rectify the problem. Information flows, time delays, policies, procedures and the actions of different actors in the system can lead to the danger of patient harm, regulatory body intervention, lawsuits and the public humiliation of government inquiries. Two well-known examples in Canadian laboratory medicine include the *Commission of Inquiry on Hormone Receptor Testing in Eastern Health*, NFLD (Department of Justice, 2009) and *The Canadian Red Cross Tainted Blood Scandal* (Krever Commission, 2013). The two Canadian catastrophes mentioned, serve as warnings and are humble reminders if undesirable system archetypes are not understood by laboratory leaders and their employees. Therefore, system traps can occur at any time and appear out of the shadows of complexity, in particular, during organizational change.

Examples of system traps in laboratory medicine have been provided in Table 13 for some clarity. These simple examples can be greatly expounded. They can serve as a starting point for discussion, ideas for quality improvement initiatives and organizational learning. Table 13 is essentially concerned with medical laboratory services and suggests where system traps might arise. However, since laboratory services are interconnected with other health services, the problems can potentially surface anywhere in a healthcare authority and also with other services outside the health authority. Therefore, the examples of common undesirable system archetypes in laboratory medicine can be used by all healthcare employees and focus groups representing users of healthcare services, which will lead to greater understanding.

Table 13

Examples of System Traps in Laboratory Medicine

| SYSTEM TRAP | DONELLA MEADOWS | LABORATORY EXAMPLES |
|---------------------------------------|---|--|
| POLICY RESISTANCE | <p> Various Actors try to pull a system stock toward various goals</p> | <p>➤ Can happen between organizations who are not monitoring performances together in a community</p> <p>➤ Critical Results -after hours/weekends/Fridays - physicians, departments</p> |
| THE TRAGEDY OF THE COMMONS | <p> Involves a common service that every user benefits from, but can be abused, leading to increased costs</p> | <p>➤ Patient's deferred to ER Department after clinic hours, leading to higher resource usage, laboratory call-backs. ER seen as convenience service by patients</p> <p>➤ Two or more organizations serving the community have policies or processes that need improvement with patient case management</p> |
| DRIFT TO LOW PERFORMANCE | <p> Permitting performance standards to be influenced by past performance</p> <p> "eroding goals", "Boiled frog syndrome"</p> | <p>➤ NCRs do not lead to any action or investment of resources. Eventually, people give up being diligent with NCRs</p> <p>➤ Budget cuts are always a threat. Organizations may struggle with erosion of empathy due to need for industrial efficiencies</p> |
| ESCALATION | <p> When the state of one stock is determined by trying to surpass the state of another stock, leading into a "arms race", loudness, smear campaigns</p> | <p>➤ A complaint then leads to a counter-complaint, which then escalates into in-fighting between two departments.</p> <p>➤ Inefficient inventory and supplier chain issues. Increased costs of rush shipments. Causing an oscillation in stock flows.</p> |
| SUCCESS TO THE SUCCESSFUL | <p> Winners of a competition are systematically rewarded with the means to win again with the winners taking all.</p> | <p>➤ Department learns of potential equipment funding (foresight), but does not share information to other departments in hospital or other laboratories within the health authority (rural labs) who might be in need of equipment dollars as well.</p> |
| SHIFTING THE BURDEN TO THE INTERVENOR | <p> Shifting the burden, or dependence on a party to do a quick fix that treats the immediate symptoms but disguises the systemic problem</p> | <p>➤ Employers who depend on quality consultants to introduce change but cannot effectively do it themselves as leaders.</p> <p>➤ An employer who deliberately keeps a management position vacant for months, to years, in order to save money, permitting quality to erode in the laboratory.</p> |
| RULE BEATING | <p> Behaviour that gives the appearance of obeying the rules or achieving the goals, but that distorts the system.</p> <p> Usually due to lower levels of hierarchy to over rigid, deleterious, ill-defined rules</p> | <p>➤ Rampant spending at the end of a fiscal year to ensure that budgets are kept intact.</p> <p>➤ Low political momentum in quality committees, quorums,</p> <p>➤ Resources beefed up during accreditation peer inspection years to "appear committed". Momentum drops assessment (also a drift to low performance issue)</p> |
| SEEKING THE WRONG GOAL | <p> System goals are poorly defined or incomplete, leading to unintended results</p> | <p>➤ Can surface in different ways if it is centralized, mixed, or de-centralized model</p> <p>➤ If multiple organizations servicing a community - could lead to imbalances</p> |

It is this author's opinion that the investigation of system traps in laboratory medicine would be an excellent area for research. It is a thought that the *Canadian Institute of Health Research* (CIHR, 2015) might find the importance of such investigations and perhaps may fund research projects in laboratory medicine. The results of the medical laboratory workforce study may also suggest that there is an opportunity for funding and research as well. It may lead one to wonder if the design of the system shapes cultural archetypes. Kurt Lewin's theories on social engineering and group dynamics suggest that there are several forces at work, which shape the overall culture in the laboratory. This understanding appears to be lacking in the current body of knowledge in laboratory medicine. Therefore, the knowledge gained from such studies could be valuable, and this new understanding could lead to new learning supports, internal auditing, and external monitoring tools within a highly regulated industry.

The CLSI document *QMS14-A: Quality Management System: Leadership and Management Roles and Responsibilities* is a guidance document that provides a good starting point for managers and leaders to build a business case for a Quality Management System (QMS). The system conceptual model, proposed by the CLSI, is a process-based model composed of twelve quality system essentials, which are the building blocks of the system (CLSI, 2012). The guideline's intention is to assist laboratories in meeting the leadership requirements, cultural requirements, and functional requirements of a sustainable QMS. It includes "words of wisdom" from the committee on what works when arguing for such a system. The document *QMS14-A*, provides many examples of quality tools that are also endorsed by the American Society of Quality

(ASQ, 2015). A list of the ASQ quality tools and where they are thought to support the learning dimensions of the TALiS model can be found in Appendix B.

For this critique of guidance document *QMS14-A*, this author's goal is not to reinvent what is so well written by the CLSI, but rather to explain the benefits of a quality management system using the TALiS model and its importance in complex systems. The CLSI document in Chapter five provides guidance on making a case for a quality system and presenting the case effectively to key stakeholders. This includes *risk management* and *patient safety*, the *financial* benefits of a QMS, and the *internal* benefits to the laboratory (CLSI, 2012). The *business case* that must be developed to argue for a QMS is reasoned by this author to be the most important document of any Quality Project Management Plan (QPMP). It is reasoned that such an effort requires a significant investment of money and staffing resources. Therefore, the business case requires significant homework and careful preparation to justify the costs, resources and time involved, versus its *benefits*, to win senior management buy-in and employee support before launching a QMS.

The installation of a QMS should not be taken lightly by senior administration. This collective effort and focus becomes important, depending on the size of the organization and its business model. The business model may be centralized, decentralized, or of mixed services. It is reasoned by this author that a QMS supports the TALiS model by "lifting" the current system off the ground and permitting users to see more clearly its "structural silhouette." A QMS's beauty is its ability to *accommodate all business models and sizes* through simplicity of its design. A QMS can be visualized as

the silhouette of a great tree, which can then be better described as the “structural tree of knowledge.” If a QMS is standardized across a healthcare authority, it permits the organization to see beyond the “forest of complexity” and see the “savannah,” where the customer market is located. With the “trees cleared and parted” in a consistent manner, the customer market can finally be seen, measured, monitored and targeted more effectively. Customer markets are never stationary; this author reasons that they should be visualized as *moving herds* that are “reward seeking.” A QMS permits the organization as a learning system to make changes to its operational definitions and to effectively do business at a lower cost with more impact through supplier-service chains.²³

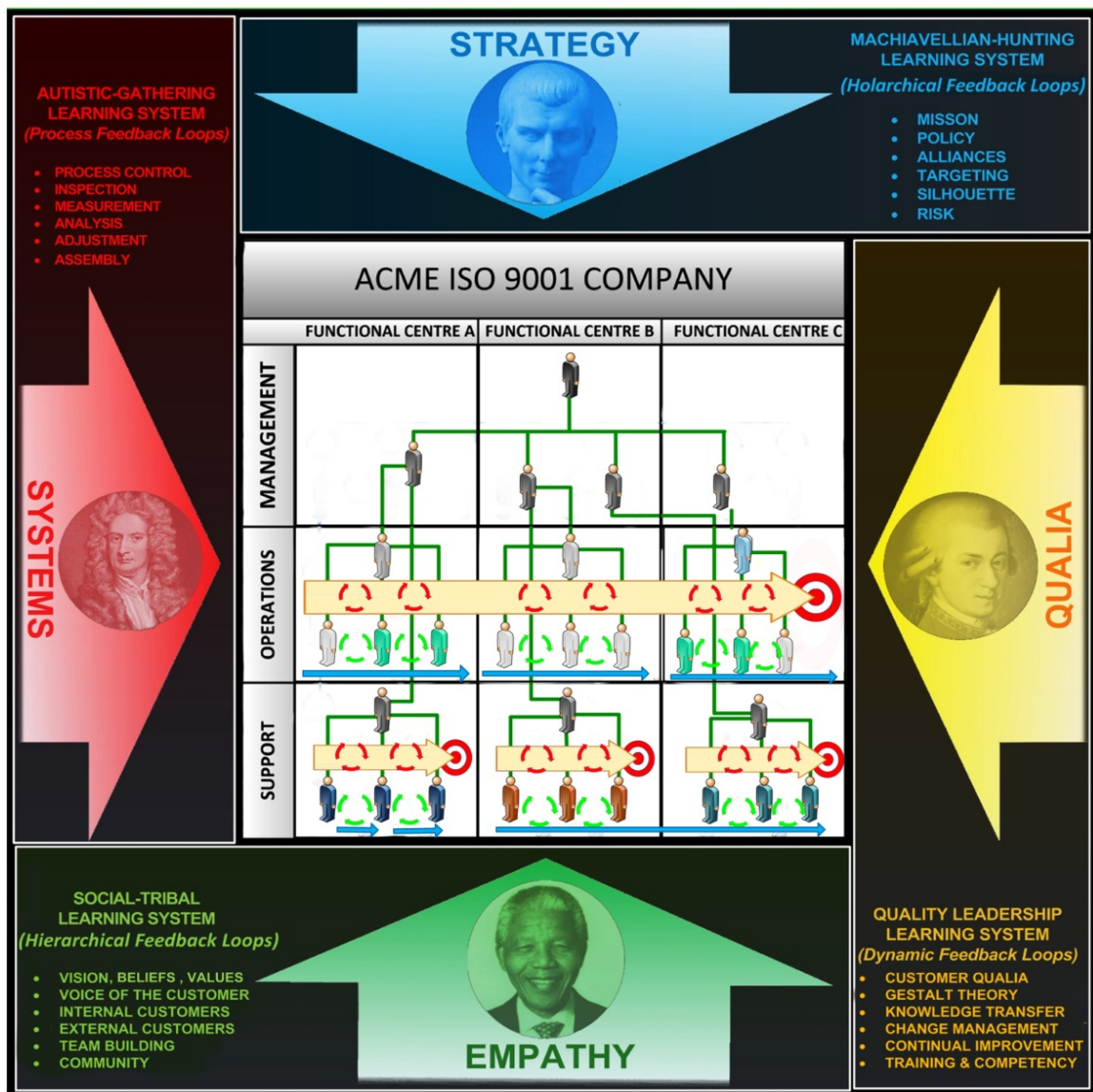


Figure 13. TALiS, ISO 9001 Quality Management System and knowledge qubit feedback information loops. These information feedback loops help all actors keep the system closed, in dynamic equilibrium and control. Also, they help all actors keep the system’s quality goals aligned to the needs of the customer.

Figure 13 delineates feedback information loop types within a QMS, which permits the organizations to meet the requirements of the customer. Without a Quality Management System, the TALiS is reasoned by this author to be “blinded in one eye”

through the MHLS and can only see the work performed as *functional holarchies* at the facility site level. TALiS is then reasoned to be limited in its clarity at the *tribe level*. Therefore, two tribes separated by large distances cannot work together as effectively and efficiently without a QMS, which is required to achieve an optimized supplier-service chain.

If an organization adopts a QMS administrative model and obtains ISO certification, the business can more readily pair with suppliers and manufacturers of products and services that are ISO certified as well. An ISO framework also permits the STLS, within the TALiS, to overcome its limitations at the tribe level by *standardization through language*. Donella Meadows said:

Our information streams are composed primarily of language. Our mental models are mostly verbal. Honoring information means above all avoiding language pollution – making the cleanest possible use we can of language. Second, it means expanding our language so we can talk about complexity. (Meadows D. H., 2008, p. 174)

ISO 9001:2008 and other standards tear down barriers to learning due to language through *terms and definitions*. Therefore, ISO certification leads to a competitive business edge where the healthcare organization can do business and share knowledge with suppliers and service providers, who operate within similar quality systems.

The supplier-service chain can be visualized as a system of industries or “tribes” that work together in a process flow of increasing product-service value for the customer. Supporting the learning requirements of the TALiS model, if the quality systems are

standardized and the tribes speak the same language (STLS), the tribes can begin to make changes within their local functional hierarchies and integrate them into a flow of work in a *value stream* that provides increasing value and satisfaction for the customer. This pattern of workflow permits the tribes to behave like a “herd,” where through altruistic cooperation, the social systems “walk” towards a “reward” in a chain as a “unitary system.” The reward from knowledge transfers between the systems is the increasing value and satisfaction for the customer, leading to brand loyalty.

For clarity to the reader, an example of the benefits of ISO certification is illustrated using a Value Stream Map (VSM) in Figure 14. This hypothetical Value Stream Map shows the ordering process, flow of work and transport of blood supplies. Figure 14 provides a visual aid for understanding this flow of work. A roadmap outlining a DFSS QPMP (DMADV) has been provided in Appendix G to give the reader a sense where the VSM as a learning tool fits within the bigger project picture. These administrative system processes that integrate the flow of work and feedback information between the individual tribes are reasoned to behave like mirror neuron systems. This feedback behaviour permits the supplier-service chain to act as if they are unitary system and permits knowledge to flow freely between them.

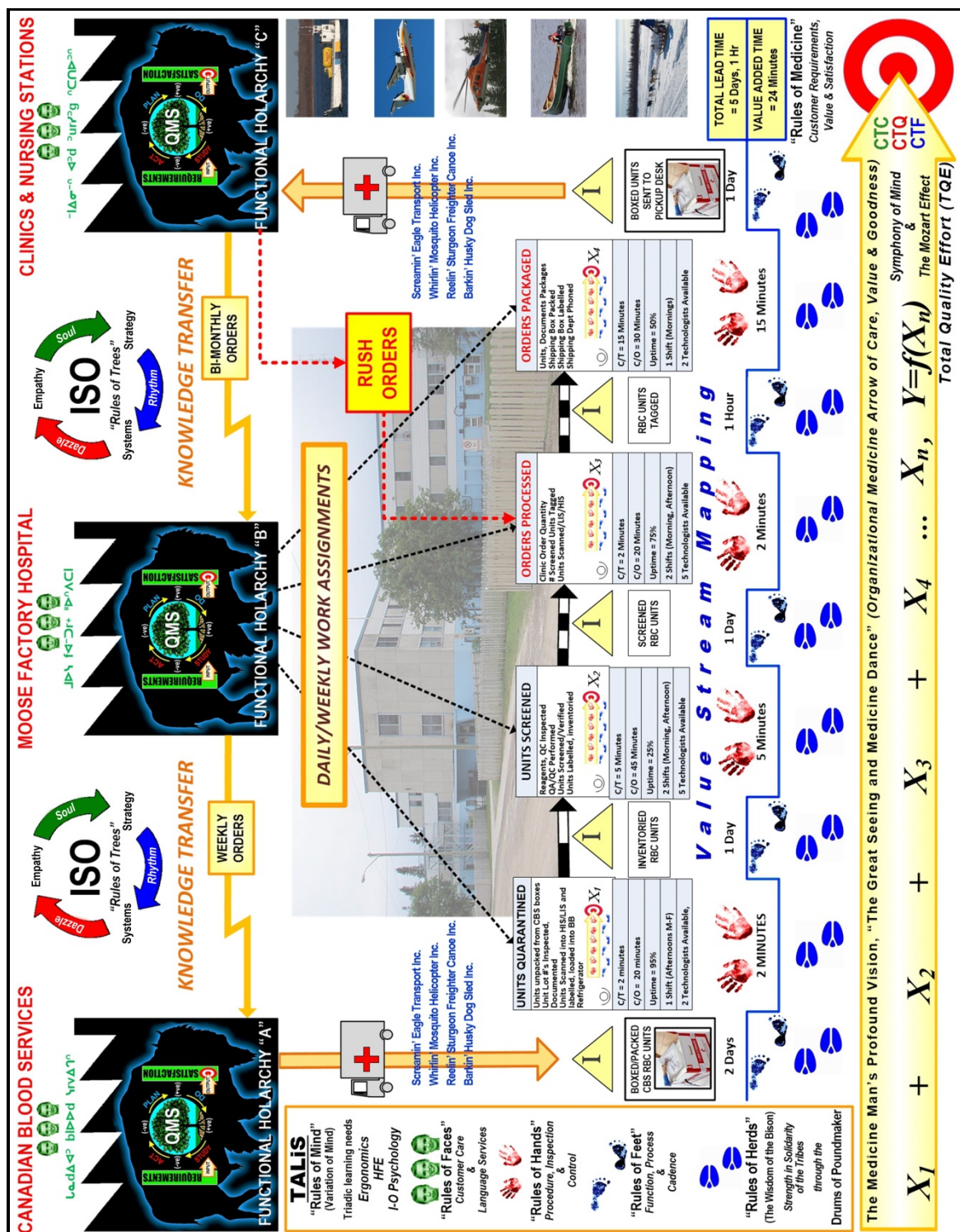


Figure 14. ISO QMS mirroring, supplier-service chains and value stream mapping.

In addition to improved workflows, a QMS provides even greater leverage within the supplier-service chain. A QMS permits the group to *maneuver* with the *changes* in the *customer market* with less effort. This model can easily be visualized when the product-service provider versus the customer market, are seen as two distinct populations within an “open savannah”. Also, by maintaining QMSs, operational risks are reduced. Therefore, the adoption of a QMS supports the learning needs of the STLS, MHLS, and AGLS with the TALiS, to achieve both greater perception of value and care by the customer. Value stream mapping is important in lean systems management when analyzing value added and non-value added activities in a value chain (Quality Progress, 2006).

Organizational Commitment to Quality Improvement

There has been some discussion about undesirable system archetypes and how they impact product and service quality in this thesis. Undesirable system archetypes and their cultures can be resistant to change and quality improvement goals. This thought then leads to the concept of the “zombie system archetype.” A zombie system archetype is indeed very thought-provoking and it is clearly associated with Qualia.²⁴ This author immediately imagines that “zombie” businesses, health or services might be associated with the following:

- 1) Employees, who have worked their entire career with one employer;
- 2) Cultures that are resistant to change (status-quo);
- 3) Mindless work environments, old business practices, functional silos;
- 4) Change efforts that over time, erode and fall back to the old methods, and;
- 5) Cultures that hold onto tradition with a desire to return to the “good old days”.

This author’s research led to a Google Scholar search for an exact definition. To this author’s surprise, very little literature was found, except the following concepts:

- 1) “Zombie-Masters” – Individuals who through some self-interest keep bringing up discussions from the “dead” several years after they have been discussed and dismissed (Evans, Barer, Stoddart, & Bhatla, 1993), and;
- 2) “Zombie-like” behaviours of firms that follow others in some business trend for little apparent reason or return (Beattie & Sohal, 1999).

It is reasoned that a “zombie system archetype,” might involve multiple system traps discussed earlier in Table 13. However, a “zombie culture” and its group behaviour within system dynamics might be better described as a *stagnant cultural paradigm*.

A cultural paradigm, according to Dr. Meadows, is the hardest leverage point from which to make changes within a system (Meadows D. H., 2008). If the quality leader maintains flexibility in the conceptualization of the current business model and maintaining that no paradigm is “true” or “right,” it permits them to remain unattached and transcend the current cultural paradigm. In a way, the quality assurance professional can help facilitate discussions and critical thinking by acting as the “Devil’s advocate” by pointing out weaknesses, obstacles, and opportunities with an operational or strategic plan. This approach in quality assurance is important in that it mitigates the operational and strategic risks associated with *Groupthink* decision making in organizations (Park, 1990). Quality planners can facilitate learning through analysis of the problem from multiple vantage points using different quality tools (ASQ, 2015). The use of different quality tools permits the quality leader and its team to leverage changes within the current cultural paradigm responsible for the “zombie” problem within their organization. Therefore, if quality leaders can influence project team members by continually “thinking outside the box” and re-evaluating the business model, this helps mitigate the risk of the “zombie apocalypse”; a stagnant cultural paradigm within a complex system, which can lead to business or healthcare service crisis and possible failure if the market or operational constraints suddenly change.

Making major changes within such zombie systems may require significant resources, effort, risk, and a major cultural paradigm shift. Quality improvement efforts will naturally be challenged and resisted by the status-quo. However, Donella Meadows offered words of wisdom for those making a change:

Aid and encourage the forces and structures that help the system run itself. Notice how many of those forces and structures are at the bottom of the hierarchy. Don't be an unthinking intervener and destroy the system's own self-maintenance capacities. Before you charge in to make things better, pay attention to the value of what's already there. (Meadows D. H., 2008, p. 178)

It is thought by this author that what Dr. Meadows was inferring, was the nature of *social-functional holarchies* at the bottom of the hierarchy and how they relate to quality. There is a phrase “from silos to systems” frequently used in Canadian healthcare that implies silos are outdated models, with cultural patterns of thinking that are perhaps “zombie-like.” This form of rhetoric is often used by advocates for regional service models (Simpson, 2011). This opinion is incorrect, in that it depends on the nature of the business, the dimensions of quality wanted by the customer, and the mode of knowledge transfer. Silos have the advantage of fast local feedback loops and can operate as stand-alone systems (Epple, Argote, & Murphy, 1996). Silos permit actors to resolve a product or service issue quickly, rather than go through a complex and possibly rigid, structural *hierarchy* or *heterarchy*, which can result in time delays (Dominici, 2008).

Silos are, in fact, small systems and can exist as cultural, functional, geographical, or as business units. Therefore, it needs to be clarified what *type* of silo is causing the problem with knowledge transfer, product or service delivery in relation with the needs of the customer. Specifically, the greater system problem is that for *functional silos* the actors do not as easily benefit from the *knowledge transfer* gained from other functional centres within hierarchies or heterarchies, which may span large distances (Dominici, 2008). Therefore, functional silos and their problems with knowledge transfer can be responsible for sub-optimization of processes within a program offered in a regional health services model, when it is viewed as a supplier-service chain.

Based on the evidence presented in the literature review, it is questioned by this author if mirror neuron systems within the local work community may be responsible for a silo's strength, if the TALiS and Orch-OR models are considered. This very important and most fundamental aspect of human biology easily explains why it can be a challenge to overcome silos during organizational change. Mirror neuron systems have permitted Man to *evolve* and *survive* through the millennia as a species into complex and dynamic cultural silos, better called "tribes." It is in this light, the quality assurance professional as an intervener should be mindful of mirror neuron systems and their dynamics within cultural silos, recognizing their importance and effective self-maintenance capacities within biological systems as social-functional holarchies.

An idiom that may best describe this challenge and social dilemma within change management is called “squaring the circle” (Farlex, Inc., 2015).²⁵ Silos and *redundancies* may be important if the site is very remote and difficult to access, for instance:

- 1) *Weeneebayko Area Health Authority* in Northern Ontario (WAHA, 2015);
- 2) Healthcare facilities operating in the Northwest Territories (GNWT, 2015);
- 3) The Yukon (Yukon Hospitals, 2015), and;
- 4) Nunavut (Nunavut Department of Health, 2015).

However, it is the problem of *knowledge transfer* that makes remote sites vulnerable to quality erosion. Therefore, it is very important to distinguish between the different types of silos and to carefully consider their positive and negative attributes when making changes within a system, and to carefully consider the knowledge requirements of users by keeping an eye on the customer’s vantage point and needs.

No business model is perfect, and its design can impact other organizations who are servicing the same community. A regional health services model by its sheer size and design can create undesirable system archetypes. System traps such as “drift to low” *service erosion* can impact the services of other organizations operating within the same community, creating inefficiencies and leading to new archetypes within their systems, such as *escalation*. Healthcare authorities and their services may be needed to be designed in a way that distributes wealth fairly through jobs, which in turn, addresses the social and economic needs of smaller communities. If the healthcare service is the largest industry in the community, then the secondary economies benefit from the primary industry as concentric rings of nested social-functional holarchies. An excellent

example of a governance model that understands this social ethic is the *Government of the Northwest Territories* (GNWT, 2015). Poverty in communities brings to surface multiple social and health related problems, which can come back and lead to an *escalation* archetype impacting health and social services. *Integral Permaculture* is *mindful* of the interrelationships between the multiple systems that exist within communities.

In addition to social responsibilities, health authorities need to consider the migratory patterns of patients, such as the Baby Boomers (Canadian Home Builders Association, 2006). Evidence supports that the migratory patterns of baby boomers are going in the opposite direction of a health service centralized model. The evidence shows that baby boomers are migrating from large cities to small rural towns (Dowd, 2011). A business model that is mixed-service or decentralized may in fact, deliver better care, depending on the services offered and quality requirements of the customer. It is thought that the business case should present all three models (centralized, mixed, decentralized) before the approval of a quality project management plan. It is in this light that quality leaders must be mindful of the system trap called the “success to the successful” archetype (Meadows D. H., 2008). Stakeholders, who have positions of power and consultants who have privileged access to knowledge within the social hierarchy, may have personal motives with system changes. Therefore, it is reasoned that by presenting *all three models in the business case*, transparency and objective thinking can be maintained during organizational change.

A method to improve quality and overcome the cultural archetypes during organizational change can be accomplished by adopting the Deming PDSA Cycle within the QPMP. The Deming Cycle model is discussed in detail by the CLSI in their guidance document *QMS06-A3: Quality Management System: Continual Improvement; Approved Guideline*. The Deming PDSA Cycle is a type of dynamic control feedback loop,²⁶ which permits learning and neuroplasticity within an organization. Deming said that with organizational learning:

Joy in learning comes not so much from what is learned, but from learning. It's fun to learn if you learn knowledge. Not fun to learn information. The joy in the job comes not so much from the result, not from the product, but from contributing to optimization of the system where everyone wins. (Deming, 2013, p. 200).

To paraphrase Deming's quote in a different light, the "joy of learning" is the excitement experienced by employees through their discovery of a novel idea. It is human nature to share knowledge within the tribe. However, a novel idea discovered within one group may also benefit other locations within a regional health authority. Therefore, the adoption of a QMS and a structured quality improvement approach using the Deming PDSA Cycle permits the organization to "break out of its mold" and to evolve through revelation with the knowledge and turn into a new cultural paradigm.

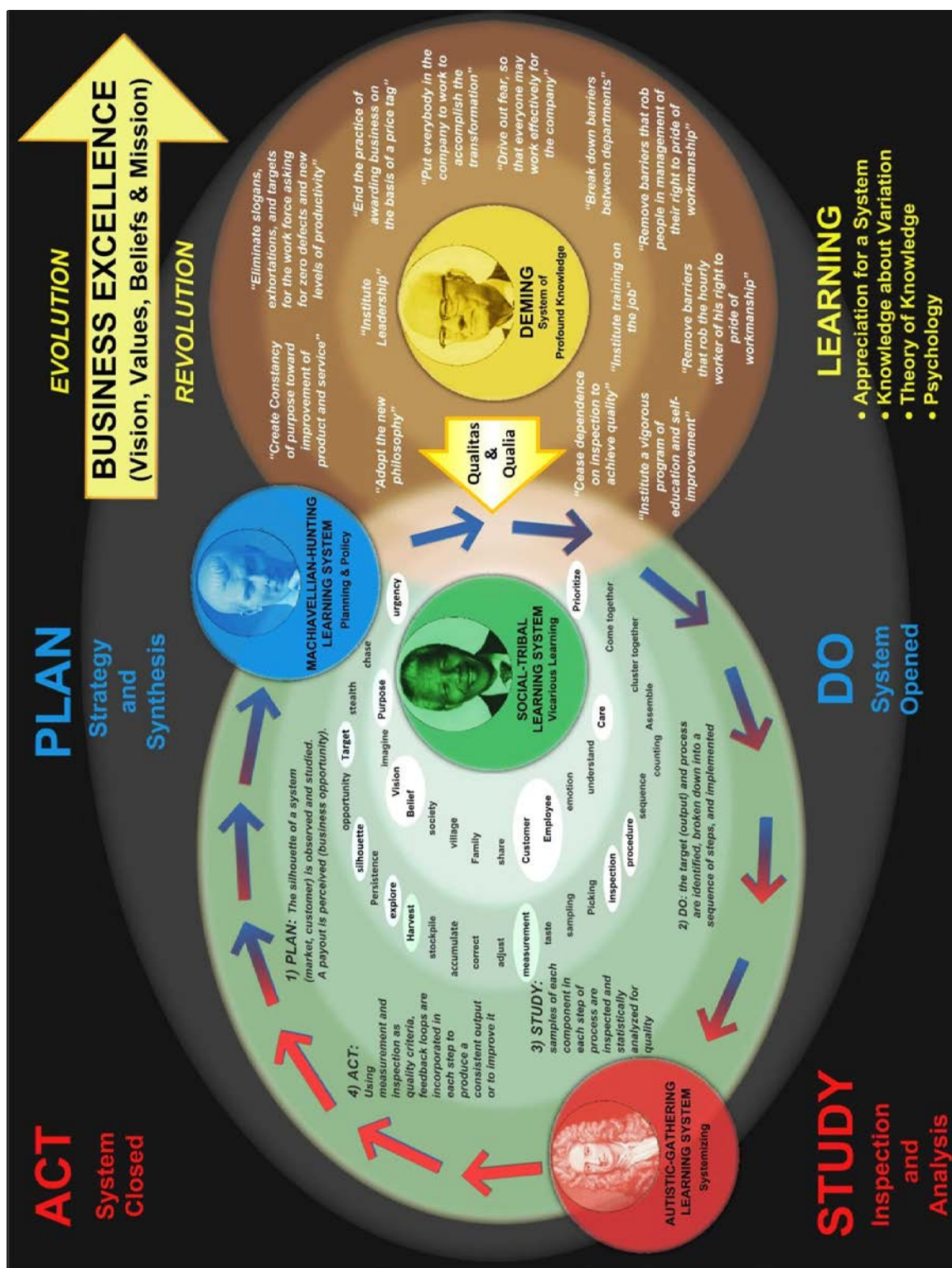


Figure 15. TALiS, the PDSA Cycle and Deming's System of Profound Knowledge.

The Deming PDSA Cycle and the dynamical forces interacting within the TALiS model are presented in Figure 15. Through Deming's *System of Profound knowledge*, it is shown that transformation begins with the individual (Deming, 1982). Transformation is accomplished by the construction of a cognitive lens that looks at the system from the *outside* in the attempt to overcome a systematic pattern of thought occurring *within* the current cultural paradigm. Supporting Deming's model, Dr. Meadows stated that with systems thinking an organization must defy the disciplines to see the whole system (Meadows D. H., 2008). This effort requires an interdisciplinary approach and *Variation of Mind*. All disciplines, by their nature, have particular lenses which have distortions, narrowness, and incompleteness of information (Meadows D. H., 2008). Therefore, by taking an *interdisciplinary* approach to problem solving, this forces everyone to teach each other, from their area of expertise, how to solve a quality problem.

Organizational learning has a long history with many published sources by researchers who have developed models in various industries (Yelle, 1979). One of the goals of these models is parameter estimation, with improved quality project planning and budgeting. These models involve the use of a *learning curve*, which is a mathematical description of an employee's knowledge and performance over time. These curves can be linear-log, S-curve, exponential, hyperbolic and others, with many variations (Anzanello & Fogliatto, 2011). *Quality Learning Curve* models have also been proposed (Lapre, Mukherjee, & Wassenhove, 2000). One important study in 1991 used a learning curve model for investigating intra-plant *carry-forward* and *transfer* of knowledge through "learning by doing" between employees in different shifts and sites

(Epple, Argote, & Devadas, 1991). Epple, Argote, and Devadas discovered that knowledge as a stock does not embody itself in the technology or tools, but rather, it *flows between employees* (Epple, Argote, & Devadas, 1991). The researchers discovered through several experiments that there was a greater knowledge transfer across shifts within a plant than across production facilities that are geographically separated.²⁷

Knowledge transfer barriers between employees, their teams, and inter-organization knowledge transfer have also been studied in detail (Yih-Tong Sun & Scott, 2005). This evidence suggests the importance of mirror neuron systems in the learning dynamics within organizations and industrial work environments. Therefore, the evidence suggests if the knowledge being transferred is *tacit* or *implicit* knowledge, the best mode of transfer are through effective training programs that lean heavily on action based learning and careful planning of schedules.

Explicit knowledge transfer has been studied within organizations that have implemented both TQM and ISO 9000 quality programs. In a 2004 study, firms that had implemented TQM and ISO 9000 were compared against organizations that did not have active quality programs (Molina, Javier, Montes, & Fuentes, 2004). The effects of *knowledge transferability* and *knowledge transfers* (internal, supplier and customer) were studied. Firms with TQM and ISO 9000 programs were found overall to have greater knowledge transferability in comparison to other industries that did not have active programs. Firms with TQM programs were found to have improved knowledge over non-TQM firms. However, it was found that ISO firms had a *lower supplier and customer*

knowledge than non-ISO firms. An important characteristic of the ISO environments is the high degree of codification that is involved translating knowledge to information.

In system dynamics, knowledge as a *stock* can be categorized into *explicit*, *implicit* and *tacit* knowledge (Johnson, Lorenz, & Lundvall, 2002). Explicit knowledge can be demonstrated, captured, codified, stored and transmitted as an inventory. A diagram in Appendix C has been provided for the reader as a visual aid that shows the capture, codification and flow of knowledge as “qubits” within an ISO 9001:2008 quality management system. The terms “implicit” and “tacit” have been used interchangeably; however, they are not the same. With quality, both terms (implicit and tacit) relate to *qualia*, whereas explicit knowledge is related to *qualitas*. Implicit knowledge can be inferred through empathy, language and socialization. However, tacit knowledge is the skills and expertise of the individual and cannot be communicated; rather, it must be directly seen or experienced in the first person to be clearly understood. This author was unsuccessful in finding literature evidence that clearly explained these differences, in particular where it related to quality assurance. Tacit knowledge relates to mirror neuron systems and action learning. Tacit knowledge is also a *perishable stock* (Epple, Argote, & Murphy, 1996). Tacit knowledge within the individual has a rate of knowledge decay, called the “Power Law of Forgetting” (Wixted & Ebbesen, 1997). The acquisition of knowledge called the “learning curve” within individuals has also been investigated (Ritter & Schooler, 2002).

This author was also unsuccessful in finding evidence of studies in laboratory medicine that investigated in detail, the rate of tacit knowledge decay and acquisition in

learning, that is: 1) low motor; 2) high motor; 3) low cognitive; and, 4) high cognitive laboratory skills. However, a thesis was discovered which explored in detail the effects of knowledge acquisition (and decay) within individuals versus groups (MacKinnon, 2007). Dr. MacKinnon found that for participants who are learning a complex skill, it may be best to train them formally, then allow them to use what they have learned and continue to learn by doing. Also, Dr. MacKinnon found that if mentoring is performed by peers and not an expert, a performance deficit might arise. Therefore, *designated expert trainers* help ward off tacit knowledge decay within laboratory environments.

Explicit, implicit and tacit knowledge have been found to decay at different rates (Tunney, 2003). Also, depending on the nature and complexity of the task (motor, high-motor, cognitive, and high cognitive), tacit knowledge itself will decay at different rates (MacKinnon, 2007). Dr. MacKinnon's thesis is valuable to quality assurance and laboratory medicine. His study found that knowledge decays more rapidly in *individuals* than *groups*. MacKinnon also found that when team members *changed roles*, that the decay of knowledge was *slowed*. These findings are very important when considering *cross-training* and the *total knowledge capital* of medical laboratories within a regional health authority. The *types* of knowledge decay and their *rates* of decay within *rural laboratories* versus *regional medical laboratories*, does not appear to have been investigated. However, there is some indirect evidence that quality assurance countermeasures to reduce knowledge decay and where they are related to analytic error rates, within Point of Care Testing (POCT), has been recently investigated within a regional health services model (Khoury, 2014).

This study has revealed that the Systemizing Quotient may be important and may be related to knowledge transfer and decay. However, the AQ, EQ, and Mach-IV may be very important as well and where they relate to cognition. Depending on the discipline and knowledge required for analytic quality, it is quite reasonable that skills which require a high level of cognitive interpretation (e.g. cytology, microbiology and hematology morphology) would deteriorate more quickly than simpler repetitive tasks (e.g. automated biochemistry or automated hematology). Also, depending on the frequency of the test ordered, technical knowledge may deteriorate as well. It is in this light that the high degree of codification of explicit knowledge is very important within an ISO regulated laboratory environment. However, due to the nature of implicit and tacit knowledge and their vulnerability to decay over time, it appears that a rigorous training program is required as a complement to an ISO quality management system to keep the knowledge stock relatively stable. Therefore, *total knowledge* (explicit, implicit and tacit) as a pool or stock is maintained by a robust *quality management system* and *rigorous training program*.

The Deming PDSA cycle supports the TALiS and Orch-OR models through its method of knowledge capture, translation, codification, and transfer within a complex system. Knowledge flows begin with an understanding of the needs of the customer where teams are organized through vertical hierarchies. The knowledge of the customer quality requirements are captured using quality tools. Once captured, this knowledge is translated, codified and transferred within a quality system (Epple, Argote, & Murphy, 1996). However, this knowledge transfer (explicit, implicit and tacit) within a quality

system is reasoned to follow a defined sequence within distinct information pathways. The dynamics of learning and knowledge transfer within the TALiS and Deming PDSA cycle are presented in Figure 16.

Using concepts from Kurt Lewin's *Field Theory* and *Change Theory* (Lewin, 1947), a quality project management plan can be visualized and modeled as a *learning space* (See Appendix A). The learning space (a gestalt field) can be mathematically modeled and plotted graphically by using a sigmoid function curve. In project management, the project S-curve is frequently used as a visual plot of the cumulative totals of the resources that are used versus time, and it is used to depict value against the costs of the project work (Project Management Institute, Inc., 2008).

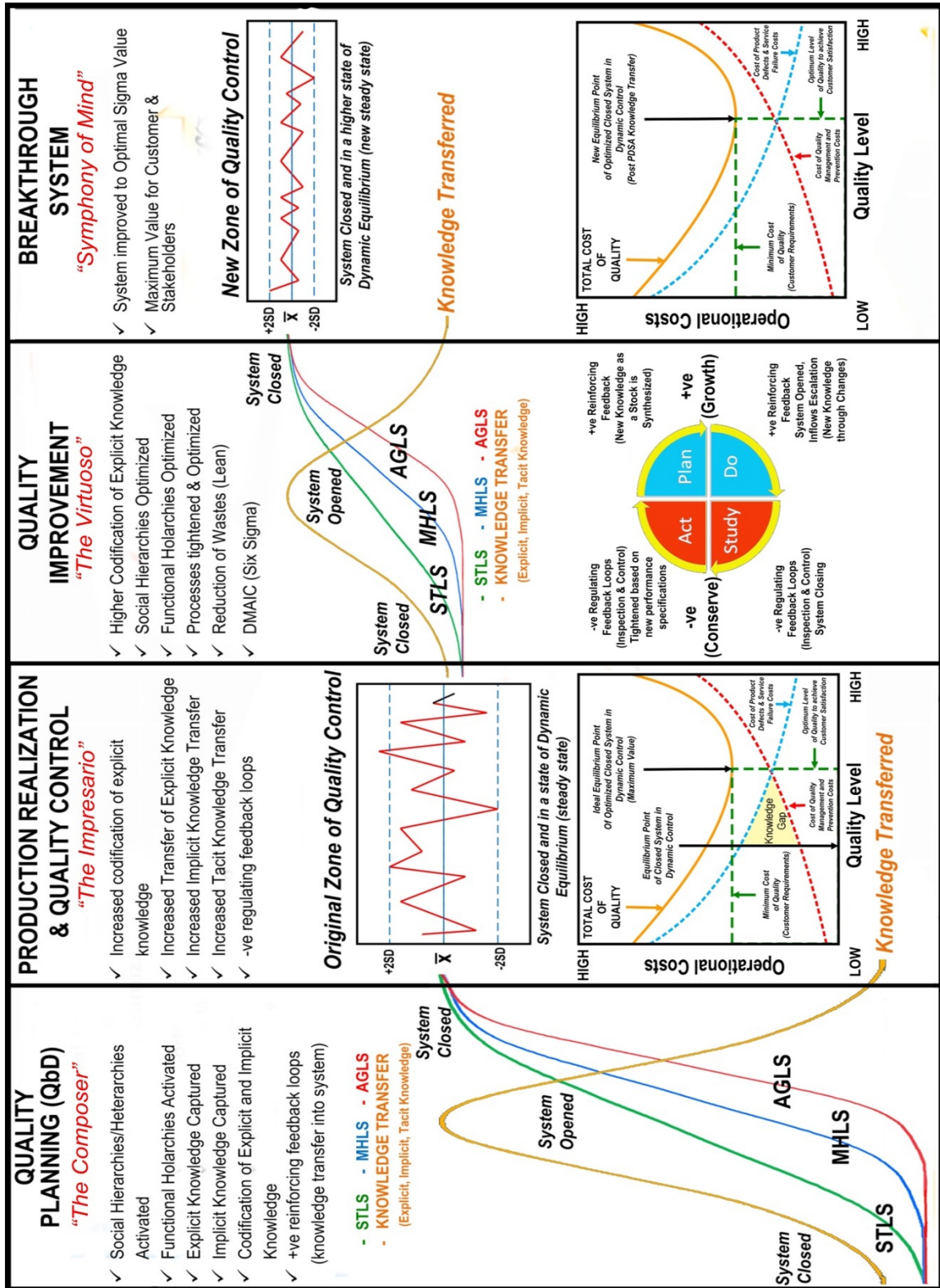


Figure 16. TALiS, knowledge transfer and the QPMP sigmoid function curve.

Within a QPMP, the project S-curve starts off slowly, escalates, and then levels off as the project approaches completion. However, within the project S-curve, a *learning curve* also exists, which can be modeled the same way (Anzanello & Fogliatto, 2011). This learning S-curve plots the knowledge transfer as a stock within the project learning space. Due to the design of the system and the actors employed, there are *limiting factors* that constrain the QPMP (Meadows D. H., 2008). This sigmoid function curve can be described using a simple heuristic formula:

$$P_{LS}\% = f(t, T_{SF})$$

Where:

$P_{LS}\%$ = percentage of the project completed (Knowledge transfer as a stock)

t = time frame within the project implementation

T_{SF} = total time frame of the project (total learning space)

The variable T_{SF} that describes the Lewin learning field is bound by the “shape factor” or dimensions of learning and knowledge transfer between actors employed within a system.

The infographic in Appendix A is a projection of dimensions which makes up the Lewin learning field in a QPMP based on the TALiS model. Four dimensions of learning and knowledge transfer (explicit, implicit and tacit knowledge) are reasoned to be occurring within this gestalt sphere (Lewin learning field) over time. These dimensions of learning making up the overall field surrounding the actors are required to understand the knowledge and complete the project. Human beings make decisions and act upon them through “bounded rationality”; that is, the actors make the best decisions based on the information and knowledge they have at the time, through their relative vantage points (Meadows D. H., 2008). All actors do not have access to *perfect information*, as

“omniscient rational optimizers.” This time delay with information flows is problematic for more actors employed in *distant parts of the system* and also their *perception of time*. To complete the project, all actors require feedback information to keep the project in control (Meadows D. H., 2008). Due to imperfect information and time delays with feedback, the shape factors that describe the total learning space (T_{SF}) are constraints which put a *minimum time limit* on the project S-curve knowledge transfer cycle (change cycle). This constraint within the learning field of the group means that the four time dimensions of knowledge transfer (and feedback control) must be considered within the three-dimensional learning space. Therefore, within a large-scale system, this time limit is a constraint that impacts the organization’s ability to *maneuver* quickly, due to sudden changes in the *market*, if customers’ needs change or if there is a threat of *competition*.

The learning space is also a product of the four phases making up the PDSA cycle. QIPs that are of similar nature, such as periodic equipment installations, can be reasoned to have learning spaces with similar *shape factors*. If the *same projects* are managed at *defined phases* in the *same sequence*, the learning space along these dimensions collapses. Using defined phases in the same sequence collapses the shape factors making up the learning space for each PDSA cycle. As the process of change within the QPMP is better understood by the actors (implicit and tacit knowledge) for each change cycle, there is less time delay since this knowledge *has already been transferred* to the actors. Therefore, the importance of the Deming PDSA Cycle and its variants that are used in Six Sigma QPMPs, is their ability to both collapse and smooth the learning process for each step in the cycle, thus reducing total project cycle time

within the learning space through improved knowledge transfer for each change, product-service or business lifecycle.

Discussed earlier in this thesis, knowledge flows through the actors (Epple, Argote, & Devadas, 1991). Quality tools are “neurocognitive prosthetic devices,” which help capture, translate, codify and facilitate the flow of knowledge between the actors. The flow of knowledge within learning space for the actors involved in the change plan can be expounded upon using TALiS model. The three learning system archetypes (See Figure 16, “STLS,” “MHLS” and “AGLS”) within the TALiS are visualized as three distinct sigmoid learning curves within the overall project learning space sigmoid curve. If the project learning space spans more than one workspace (multiple functional centres) and translated into a stock and flow model for each TALiS learning system archetype, the information flows, and knowledge transfer are reasoned by this author, not to be instantaneous and occur at different rates through functional holarchies and social hierarchies. Knowledge does not transfer to all actors at the same time due to feedback time delays between each actor in the system. For clarity to the reader, if the project is of minor complexity within one workspace as a simple functional holarchy and involves a small group of employees, mirror neuron systems and their effectiveness at transferring both tacit and implicit knowledge through reciprocal feedback compensate for any shortcomings of the change plan.

The *phase lag* of the new flows of knowledge for large-scale change projects, however, would be problematic if the area for improvement spans multiple functional holarchies, multiple layers of social hierarchies or heterarchies. This implicit and tacit

knowledge transfer obstacle is reasoned to be due to the limitations of mirror neuron systems. Also, the phase lag is due to time delays with the capture, codification, and transfer of explicit knowledge. It is in this light that the Deming PDSA cycle and variants of this dynamic control feedback loop, used in Six Sigma QMPs, become very important in quality assurance. It is questioned by this author if the quality tools that are used in the QMPs act as neurocognitive supports, triggering the appropriate mirror neuron activation at the correct sequence to different parts of the TALiS (see Appendix B). As the backbone of a change management project, the Deming PDSA cycle helps project leaders reduce operational risks through effective change sequence and knowledge transfer. Therefore, if the rules, tools and procedures used in the QMP are understood and followed by all team members in the correct sequence, the Deming cycle permits the systems to be safely opened, knowledge to be transferred and closed within large scale QMPs.

Expounding upon Lewin's Field and Change Theories, the TALiS knowledge transfer model in Figure 16, predicts that there will be time lags with specific types of *knowledge* transfer within the triad:

- 1) The STLS is first used to understand the *voice of the customer* and begin the capture and translation of customer requirements (qualia and qualitas) as qubits of explicit, implicit and tacit knowledge in the PLAN phase. Reciprocal feedback occurs between team members within the social hierarchies or heterarchies;
- 2) The qubits of knowledge are then characterized and prioritized, using various quality tools in a defined sequence. The project team and their leaders, then figure out which functional centres and their departments (functional holarchies) that are affected by the improvement (QFD). A reciprocal flow of knowledge occurs between the STLS and MHLS;

- 3) The MHLS then figures out the exact entry point into the system using tools such as the House of Quality and constructs the roadmap of changes in a defined sequence, using tools such as Gantt charts. The MHLS begins to *action the plan* and open the social-functional holarchies at the bottom of the hierarchy/heterarchy (DO phase);
- 4) The MHLS then begins to work with the AGLS, to introduce feedback loops into the new process flows within the new functional-holarchies. Explicit knowledge is further codified into tools, such as flow charts, checklists, procedures and validated by users. Implicit and Tacit knowledge is transferred through training. Product output quality is measured and compared (inspection and control), against the quality requirements of the customer using tools such as statistical process control charts in the STUDY phase, and;
- 5) The AGLS then makes the appropriate adjustments to the steps in the process flows within each functional holarchy and improves codification of the knowledge. This codification in higher detail is accomplished through inspection and control, effectively closes the system (ACT phase). Repetition facilitates the transfer of implicit and tacit knowledge. Through a process of continual improvement as a dynamic learning loop, the AGLS is heavily leaned on, ever tightening the process steps through inspection and control to meet the product or service requirements of the customer (STLS). Explicit, implicit and tacit knowledge has been transferred in the new system.

Therefore, when the knowledge flows are visualized as a sigmoid function curve and compared against the action based learning *bell curve*, it is predicted that implicit and tacit knowledge transfer within the TALiS will occur as a distinct sequence of steps, at different rates of flow, where action learning escalates and peaks between the DO and STUDY phase within the PDSA Cycle.

The type of the change made within a regional laboratory service and the size of the improvement project may be problematic for quality leaders. The positive correlation between the systemizing quotient versus the laboratory size (see Table 9, SQ-R, $r_s=0.34$, $p<0.10$) suggests that there might be challenges in rural laboratories. As discussed earlier, the lack of correlation between the SQ-R and Mach-IV (see Table 7), along with the

higher Mach-IV group mean within the workforce (see Table 11), suggests that there are two distinct forms of perception at play (the AGLS versus MHLS archetype). Both learning system archetypes within the TALiS model have different requirements, which points to different learning supports and reciprocal feedback control to capture and transfer knowledge. Therefore, it is questioned by this author, if more time is needed, along with specific learning supports, information access, training and feedback are needed to bring rural laboratories in alignment with the larger regional laboratories during QPMPs.

Large regional laboratories face challenges as well. It was originally thought by this author, based on the literature review and evidence presented, that individuals with ASDs might have a preference for work environments with smaller social circles and may be motivated to work in rural laboratories, thus avoiding the high social traffic and hierarchies in the larger laboratories. This author's hypothesis may not be correct, based on the evidence in this workforce study. The inverse relationship between the AQ and EQ scales is clearly understood by the psychology researchers and has been validated by prior studies. This relationship was verified in this medical laboratory workforce study and was found to be statistically significant (Table 7, Column 1, row 2, EQ versus AQ, $r_s = -0.59$, $p < 0.001$). However, minor correlations were detected for both the AQ and EQ scales versus "Size of community employed" and "Laboratory size," which seem to hint that the AQ scores *rise*, and EQ scores *drop*, with *increasing size* of the community or laboratory (see Table 8). The reader is cautioned that this evidence is far from conclusive, and these relationships need to be verified in larger and more robust studies.

As mentioned earlier in this thesis, empathy is associated with social dominance and Authoritarian behaviour (Backstrom & Bjorklund, 2007). It appears, based on the evidence in this study, that within a regional healthcare services model laboratory leaders think objectively and see the “bigger picture” with common quality goals in mind. If the AQ and EQ scales and the evidence in this study have any predictive utility in change management, it is thought that greater success with QMPs might be realized if the team sizes are kept relatively small, perhaps groups of two to five person teams. It is thought by this author that using a small team approach could help reduce staff confusion, information overload, stress, and anxiety.²⁸ Too much time may be wasted keeping large teams together. However, the issue of implicit and tacit knowledge transfer, and also decay, within different team models and their relationship with Dunbar’s Number needs to be studied in future experiments relating to change management. These experiments should also be studied within ISO regulated and non-ISO regulated environments. Therefore, more research is needed to better understand the relationships between the workforce population characteristics and knowledge transfer within change management.

A final discussion should be made with Six Sigma methodologies. The CLSI document *QMS06-A3: Quality Management System: Continual Improvement* briefly discusses of Six Sigma and the merits of this methodology. However, the guidance document only discusses the DMAIC methodology. The committee did not mention *Design for Six Sigma* and its variants.²⁹ There has been a concern expressed by researchers about the lack of evidence in published journal papers which have investigated six sigma methodologies using a rigorous research approach.

Nonthaleerak and Hendry found that there was a *notable bias* where the authors focus only on the positive attributes, with a lack of conclusive empirical evidence showing both the strengths and weaknesses of this approach (Nonthaleerak & Hendry, 2008). Also, Nonthaleerak and Hendry discussed the complexity of six sigma tools, employee literacy, and fear levels, leading to avoidance of undertaking six sigma projects.³⁰ These learning obstacles, combined with fear, could lead to failure. Several issues were identified by Nonthaleerak and Hendry that influence the success of six sigma implementation (Nonthaleerak & Hendry, 2008):

- 1) Black Belt involvement (part-time vs. full-time);
- 2) Reporting structure of belts to the Project Champion;
- 3) Inclusion of a technical support team;
- 4) The effectiveness of training programs in six sigma, and;
- 5) Involvement of management.

Despite the numerous benefits of Six Sigma methodologies, such initiatives should not be taken lightly. Six Sigma projects are heavy, data-driven methodologies that require both executive engagement and staff buy-in. As with any change, there is political resistance to six sigma methodology and it is not isolated to the healthcare industry (Feng & Manuel, 2008).

It is thought by this author that if there is time and leadership is aware that a six-sigma culture is the direction where their organization is headed, that *Design for Six Sigma* might be a better starting point. This approach allows the foundation to be laid down first, permitting staff to learn, and appreciate the many merits of six sigma

methodology. There is also a great amount of flexibility and creativity, depending on the industry. As an example, a medical laboratory is a hybrid of the manufacturing and service business model. Depending on the nature of the service, some quality tools may be more appropriate than others. It is possible that new tools can be developed that are entirely novel and unique to the industry. Also, through practice and evaluation (“lessons learned”), it may be possible to both ease and streamline Six Sigma Quality Project Management Plans (QPMPs).

The incorporation of *Heuristics* into change plan methodologies might benefit organizations when the project team is facing uncertainty, lack of time and incomplete information (Gigerenzer & Gaissmaier, 2011). Heuristic methodologies, as strategies to speed up decision making are beyond the scope of this thesis. However, it is felt that heuristics is an important area for study in Quality Assurance, valuable in conceptualisation, trial-and-error experimentation, and deserves mention.³¹ Therefore, QPMPs can combine the best aspects of Heuristics with Six Sigma, leading to novel approaches to change management, giving organizations a competitive edge, and product-service distinctiveness.

Cultural obstacles to organizational change and QIPs using Six Sigma methodologies may be easily explained using the TALiS model. The AGLS archetype, and its association with systemizing, has an inverse relationship with the STLS, which is associated with empathy, care, and community, although *both* involve “close seeing,” based on the TALiS model. Evidence in the literature review, along with the laboratory workforce study (see Table 7); has verified the inverse relationship of the SQ and EQ,

supporting Dr. Baron-Cohen's *E-S Theory of Mind* model (ToM) (Baron-Cohen, 2009). However, the two learning system archetypes are reasoned to be distinct in their vantage points to the MHLS. Using Figure 9, the AGLS and STLS are reasoned to interact *within* the Lewin social space as dynamical opposites; whereas the MHLS interacts with *both* from a distant vantage point *outside* the Lewin social space. Dr. Deming has stated, "Suppose that (1) everybody knew what to do. (2) Everybody did his best. Result: dissipation of knowledge and effort; results, far from optimum. There is no substitute for teamwork and good leaders of teams to bring consistency of effort, along with knowledge" (Deming, 1982, p. 19). This dynamic relationship between the three learning systems within the TALiS means that the leadership approach is to reach *within* the group's social space and cognitively *shift* the project team's vantage point *outside* the social space, so they can see the "bigger picture" from a *distance*. This effort can easily be accomplished, by construction of flowcharts, cross-functional maps, value stream mapping (see Figure 13) and other quality tools (ASQ, 2015). By doing so, the employees can better see how their roles and actions as teams can be optimized by doing things the *same way* to achieve a greater *Transfer Value*, thus supporting the wisdom of Dr. Deming's consistency of effort during organizational change (Deming, 1982).

Raising the bar and aligning higher quality goals with the mission and vision statements can be a great challenge for leaders, especially when the markets change. This reality may come to a point where the organization may need to make changes to the vision and mission statements. It is well known in the corporate world that within many companies, the vision and mission statements have become "watered down" where they

have become meaningless. Vision, mission, and value statements, are powerful transformation tools in quality assurance and are the critical link to product and service *distinctiveness* and more importantly, long-term sustainability. These tools help the organization, and its people understand who they are as a community, their purpose and their relationship with their customer. Therefore, these changes to the vision, mission, and values statement may require careful use of new *persuasive* language, which is not frequently used within the “common tongue” of the group.³²

Although it is out of the scope of this thesis, it is questioned if the study of *semiotics* and where it relates to knowledge transfer could support the advancement of quality assurance.³³ However, Dr. Meadows and Dr. Deming both cautioned quality leaders about the use of business slogans (Deming, 1982) and language pollution (Meadows D. H., 2008). In the act of trying to achieve organizational distinctiveness, the careless use of new language may lead to employee confusion within the organization. In healthcare, this author proposes that the use of words, to shape the new vision statement should capture the *aura* or *spirit of goodness*. In this light, quality leaders might want to seek moral reasons for a change, with dimensions of spirituality through the *art of rhetoric*. Therefore, in healthcare, the philosophies, science, and ethics of *Integral Permaculture* may be a better approach, with the persuasive language to overcome the cultural barriers to QMPs, thus leading to new cultural paradigms.

Dr. Donella Meadows’s research in systems science and environmentalism may be a great source of inspiration for quality leaders. Dr. Donella Meadows discussed her own “sins” and related them to Thomas Jefferson, stating that both “Tom” and she were

“slave-owners” in her article “Thomas Jefferson and Donella Meadows, Slave-Owners” (Meadows D. , 1998). She stated that if she were an average American, she would “consume in fossil fuel the energy equivalent of 80 full-time slaves” (Meadows D. , 1998). Knowing this, she discusses her sins and efforts to mitigate them. Meadows stated, “Like Jefferson, I do my best to mitigate my sins, to use my energy slaves kindly and efficiently, to reduce my load on the groaning earth. But to do that entirely would be to lose my livelihood, my farm, my society, my whole culture” (Meadows D. , 1998). It is believed by this author, that Donella Meadows’s philosophy and wisdom could have a big impact in business and healthcare. In the act of pursuing *a livelihood* and “doing business,” an organization, with its stakeholders and employees commit “acts of sin” that impact people, society, and the environment. Dr. Meadows presents an ethical dilemma that no organization can truly transcend as a goal, but must continually work towards it as a community.

Wastes, energy consumption, and environmental harm can be reasoned to be “sins.” Dr. Meadows stated to “never erode the goal of goodness” (Meadows D. H., 2008, p. 184). This form of ethical reasoning suggests that Lean Six Sigma and other quality improvement methodologies should be encouraged and worded in the spirit, ethics and language of integral permaculture so that the organization *sins as little as possible* in the process of doing business. Integral Permaculture applies to healthcare organizations. Being conscientious of wastes and using more environmentally friendly and socially responsible approaches, should lead to service stability and long-term sustainability in

healthcare. Therefore, there are both *practical* and *moral* reasons for adopting integral permaculture in healthcare and business.

Organizational Learning and Profound Knowledge

A new employee represents a golden opportunity for an organization to evaluate the effectiveness of its quality system and training program, especially employers who have a “zest for experiment” and wish to study learning curves within their organization. A better understanding of employee learning curves is important for planning and budgeting. No man-made system is perfect. Donella Meadows said, “stay humble - stay a learner” (Meadows D. H., 2008, p. 180). A new employee serves as an opportunity for an organization to detect the systems problems with “fresh quality eyes,” much like an auditing tool. It is quite possible that due to status-quo, long-term employees may develop “blind eyes” in some circumstances. Explicit, implicit and tacit knowledge acquisition (and decay) can be measured and monitored. Keeping both current and competitive is a daily challenge for all laboratories.

There is also an opportunity for cross-pollination of ideas and knowledge transfer. Organizations and their employees can learn from one another. Also, this should be seen as the golden opportunity to evaluate the new employee’s character and perception. Quality awareness should be discussed right from the start and encouraged using one of Donella Meadow’s quality rules. Meadows stated, “be a quality detector. Be a walking, noisy Geiger counter that registers the presence or absence of quality”. (Meadows D. H., 2008, p. 176)

In addition to training checklists, new employees could be provided with non-conformance forms and audit checklists as the “newly appointed interim quality detector.” The learning goal is to bring the new employee into the quality culture as fast as possible. The trainer should find out what impressed the new employee the most about the work environment. The quality goal would be to capture dimensions of the laboratory environment and its distinctiveness, in relation to other experiences the new employee had with other organizations. Therefore, auditing tools can help establishing feedback loops quickly in a training program by tearing down barriers to learning.

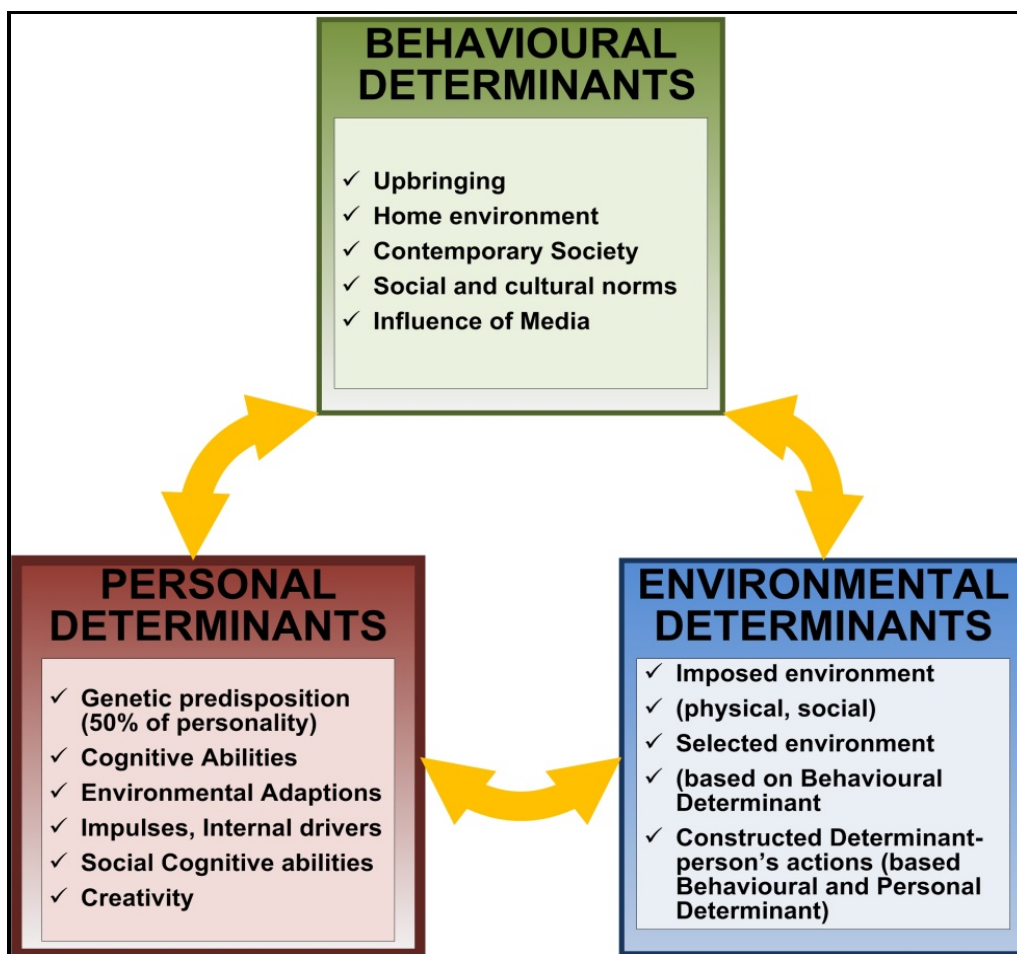


Figure 17. Dr. Albert Bandura's Reciprocal Determinism Model of social learning.

Auditing tools can be learning tools as well. The auditing tools permits the trainer and organization to figure out what the learner might think is important and their perceptiveness. Bandura's reciprocal determinism model is presented in Figure 17. To support the reciprocal determinism model, a training program should have within its design learning supports that recognize the employee's cognitive style, their prior work history and have the capacity to align the new skills to meet the quality goals of the organization. Therefore, there are sets of feedback loops required, which recognizes that there is both a process of *unlearning* and *learning* involved. New employees may have unique learning needs and may potentially have *poor quality habits* that can be carried from a previous employer. Mirror Neuron Systems may relate to bad habits creeping into the tacit knowledge stock of the group.

The research study on the laboratory workforce is thought-provoking because the evidence suggests that a significant number of technologists may have an autistic personality type. However, this thesis is merely a starting point for future research opportunities. If there are, in fact, laboratories which employ technologists with AS:

- 1) It could be reasoned, based on the evidence in this study, that medical laboratories have enjoyed an overall success with this workforce population;
- 2) Asperger's Syndrome personality traits may be viewed as "desirable qualities", such as high attention to detail, rigid adherence to processes, procedures, and;
- 3) Medical laboratory environments, in comparison to other industries, might even be called "autistic friendly" work environments, with many supports.

It is well known that individuals with ASDs can have difficulties with employment (Hurelbutt & Chalmers, 2004). Other industries may want to these individuals who have Autism Spectrum conditions for their differences in perceptiveness, but may lack the

knowledge that medical laboratories have to employ these individuals successfully. Therefore, if other industries can learn from leaders in laboratory medicine, this could mean a competitive business edge for many businesses.

The CLSI document *QMS03-A3: Training and Competence Assessment* is rich with ideas, words of wisdom, templates, and examples. This body of knowledge provides the structural supports and guidance to promote effective learning for the new employee. To expound upon the body of knowledge within the CLSI document, this author targeted the following areas discussion and improvement: 1) mirror neuron systems and their differences between employees; 2) perceptions of care by patients; and, 3) social learning and Dunbar's Number. The CLSI document *QMS03-AS* discusses in detail the desirable qualities of a good trainer:

Trainers should be qualified to impart the necessary knowledge and skills to others and regularly work in the processes and perform the procedures in which they instruct others. The service needs to decide how it will determine which person(s) is (are) qualified to train others. (CLSI, 2009, p. 11)

The CLSI also listed the necessary personality traits of a qualified trainer: 1) enthusiasm for working with people; 2) good verbal, observational and listening skills; and, 3) patience and respect for colleagues (CLSI, 2009, p. 11). Therefore, good trainer qualities require a balance of technical and "soft skills" to nurture and develop effective learning.

The CLSI also recommends that the training environment should be conducive to learning, where the learners have a "safe" learning environment and are not punished for their mistakes. Deming stated that management must "drive out fear, so that everyone

may work effectively for the company” (Deming, 2013, p. 132). The CLSI committee endorses the EDIC model of learning (CLSI, 2009):

- 1) *Explain* – The trainer explains why a task is performed within a process;
- 2) *Demonstrate* – Trainer explains steps in procedure (visual, auditory learning);
- 3) *Imitate* – Learner imitates the trainer’s actions (tactile, auditory learning), and;
- 4) *Correct* – The trainer corrects the learner’s errors in a safe manner.

This learning process involves a cyclical feedback loop that benefits both parties.

Therefore, the EDIC process supports the TALiS model, which helps ensure the appropriate mirror neuron activation within each learning system archetype, permitting implicit and tacit knowledge transfer from person to person.

The goal of the literature review and this medical laboratory workforce study is to provide readers with evidence which could lead to new ideas for improved training programs. The first step would be to identify the obstacles that are associated with *social learning*.³⁴ It is reasoned by this author, that better understanding of the dynamics, which relate to social bonding can be realized. Evidence was gathered from studies where researchers investigated social transactions and their dynamics within the ASD population (Table 14). This author has also suggested possible situations where learning obstacles might occur during social learning. Therefore, the aim of Table 14 is to provide the reader the most current information on ASD socialization challenges, where improvements can be made in the employer’s training program.³⁵

Table 14:

ASD Research Evidence and Opportunities for Training Supports

| LITERATURE SOURCE | ASD RESEARCH EVIDENCE | COMMENTS |
|--|--|---|
| (Baron-Cohen, 2013) | <ul style="list-style-type: none"> ✓ ASD show high morality & care ✓ Mirror opposites of Psychopaths | <ul style="list-style-type: none"> ●^u Contradicts findings of (Kukoyi, 2007) related to <i>moral reasoning</i> |
| (Rogers, Dziobek, Hassenstab, Wolf, & Convit, 2007) (Dziobek, et al., 2008) | <ul style="list-style-type: none"> ✓ individuals with ASDs appear to have no issues with <i>affective empathy</i>, but rather impairments with <i>cognitive empathy</i> | <ul style="list-style-type: none"> ✓ ASD group may struggle with politics and/or bullying ✓ agrees with University of Cambridge (Baron-Cohen, 2013) |
| (Whyte, Nelson, & Scherf, 2014) (Uchiyama, et al., 2006) | <ul style="list-style-type: none"> ✓ Individuals with ASDs have issues with figurative speech such as <i>metaphors, idioms, and sarcasm</i> ✓ Related to <i>Theory of Mind</i> | <ul style="list-style-type: none"> ✓ Sarcasm relates to humor and cultural differences ✓ ASD individual may take figurative speech literally |
| (Samson, Huber, & Ruch, 2013) | <ul style="list-style-type: none"> ✓ ASD scored significantly lower on cheerfulness than controls ✓ ASD scored significantly higher on seriousness than controls ✓ ASD scored significantly lower on mean-spirited humour than controls | <ul style="list-style-type: none"> ✓ cultural differences might exist between laboratories ✓ ASD employee may misinterpret a joke as a personal attack ✓ May relate to dynamics of bullying in workplaces. |
| (Fecteau, Agosta, Oberman, & Pascual-Leone, 2011) | <ul style="list-style-type: none"> ✓ Abnormal language neural network dynamics exist in ASD ✓ Aphasias mentioned | <ul style="list-style-type: none"> Q Is there an overlap of traits between ASD, faces and names? Q What about the ability to remember the names of people? |
| (Ashwin, Wheelwright, & Baron-Cohen, 2006) (LoBue, 2009) | <ul style="list-style-type: none"> ✓ People with HFA/AS had a superior ability compared to normal controls in detecting angry or threatening faces in crowds | <ul style="list-style-type: none"> Q Is this related to traits found in Machiavellianism? ✓ Doesn't imply that ASD individuals have superior ability to <i>recognize faces</i> in crowds |
| (Ashwin, Baron-Cohen, Wheelwright, O'Riordan, & Bullmore, 2006) | <ul style="list-style-type: none"> ✓ Fear perception differences in HFA/AS group when compared to normal control group due to <i>face processing deficits</i>. | <ul style="list-style-type: none"> ✓ A person with ASD may not realize they are causing fear. Q Could ASD <i>anxiety</i> and/or <i>perfectionism</i> traits be perceived as <i>bullying</i> by others? Q What about <i>tone of voice</i> to detect fear? |
| (Pierce, Sedaghat, & Courchesne, 2004) | <ul style="list-style-type: none"> ✓ ASD group showed a limited network response to familiar faces in comparison to control group | <ul style="list-style-type: none"> ✓ ASD employees may take longer to get familiar with new culture Q Is there a relationship between ASD and <i>prosopagnosia</i>? |
| (O'Connor, 2012) | <ul style="list-style-type: none"> ✓ Auditory Processing Disorders with languages are commonly found with ASD individuals | <ul style="list-style-type: none"> ✓ Individuals with ASDs may have greater challenges following social dialogue in groups |

The reader should be aware that some of the evidence presented in Table 14 involved smaller scale studies. Also discovered by this author during the literature review were two published sources that discussed *moral reasoning*, which appear on the surface to contradict one another. Moral reasoning is a product of *social learning*. Dr. Simon Baron-Cohen at the University of Cambridge stated that individuals with ASDs were best described as: 1) “mirror opposites” of psychopaths; 2) often showing high levels of care; 3) are often the most loyal of employees; 4) recognize the immorality of betrayal; and, 5) the importance of “group loyalty” (Baron-Cohen, 2013). In this light, individuals with ASDs appear to have no issues with *affective empathy* and care.

Dr. Baron-Cohen’s opinion, however, appears to contradict the findings of Dr. Benedictus Kukoyi, who used the *Defining Issues Test* (DIT-2) to investigate moral reasoning among medical laboratory employees in 2007 (see Table 1, n=47). Dr. Kukoyi stated that medical laboratory professionals had “lower levels of morality” when compared to other healthcare professionals (Kukoyi, 2007). Dr. Kukoyi stated in the abstract of his doctoral dissertation:

Moral reasoning forms the basis of ethical behavior and good decision making; this is limited in people with poor moral reasoning score, which could result in incorrect laboratory results being reported to patients and physicians. (Kukoyi, 2007, p. 5)

It is this author’s concern that Dr. Kukoyi’s conclusions are misleading. The shortcomings of his study can be explained by an understanding of the limitations of the DIT-2 Test.

The *Defining Issues Test* (DIT-2) is a multiple-choice, Likert-scale questionnaire that contains six hypothetical dilemmas, which are used to determine an individual's moral reasoning skills. There are two very important limitations of this test: 1) none of the dilemmas in the DIT-2 involves a *business scenario*; and, 2) the DIT-2 also involves the use of a *protagonist* (Elm & Weber, 1994). The use of a protagonist requires the participant to *imagine* the dilemma from the protagonist's *viewpoint*, which requires *cognitive empathy*. It is in this light, that the earlier discussion by Dr. Baron-Cohen becomes very clear with Dr. Kukoyi's study and conclusions. Dr. Kukoyi's evidence may have provided greater utility if the DIT-2 and EQ tests were used together in the design of his study. It is also important to note that the EQ test used in this author's thesis study is also very limited and cannot distinguish between *cognitive empathy* and *affective empathy* (Rogers, Dziobek, Hassenstab, Wolf, & Convit, 2007). However, it is possible that his study may provide a clue when the limitations of the DIT-2 test are considered with the evidence presented in this study. Therefore, individuals who may have ASDs and are employed in the laboratory, appear to have no issues with affective empathy and care, but may have possible challenges in busy laboratories that demand *high social attention, rapid attention shifting* and cognitive empathy.

These social learning difficulties which might arise in a laboratory environment are scenarios where an employee is required to quickly cognitively shift to another person's vantage point. This issue will easily surface in any busy medical laboratory or workplace environment, where employee's attention must quickly shift their attention between the bench, other workers, clinicians and their customers. The discussion of

morality, being a form of social learning and where it applies to the medical laboratory workforce is very complex and beyond the scope of this thesis. With limited published research data, including this study, it is very difficult to draw any conclusion. In the spirit of continual improvement, Table 14 is presented to the reader as a reference source and starting point, for better understanding, that could lead to new ideas and learning supports. It is thought that the gaps in knowledge in Table 14 may be sufficient evidence for laboratory leaders and researchers to argue for research funding through the CIHR. However, this evidence is also thought to benefit *all employees* through an understanding of social dynamics in the workplace. Therefore, the orientation-learning program should consider the dimensions of social learning, Dr. Bandura's reciprocal determinism model, along with the evidence presented in Table 14, to better accommodate all learning styles and needs.

The EDIC training model endorsed by the CLSI is reasoned to be a method of "neurocognitive lens training for quality." In Table 14, the social quality dimensions are related to empathy, bonding and the perception of care. Even with effective training programs, the learner may have difficulty adjusting to the new culture. Therefore, Table 14 can be used as briefing material for the trainer's awareness on Autism Spectrum Disorders. It is recommended that there should be clear *anti-bullying policies* because anxiety and fear are barriers to learning. One item not discussed by the CLSI is the importance of *cultural sensitivity training*. This service quality dimension is important with respect to clinical programs specialized to the needs of the Francophone populations, First Nations and Inuit cultures in Canada. Therefore, it is reasoned that

cultural sensitivity training should be a mandatory part of employee education, promoting empathy and community within organizations that service the needs of minority groups and marginalized populations.

Training does not just apply to the new employee. Training also applies to situations where learning needs identified through:

- 1) Organizational and technological changes;
- 2) Quality issues in the laboratory (IQC and EQA), and;
- 3) Post-peer review visits by accrediting or regulatory bodies.

The laboratory workforce study has produced some evidence suggesting that there is a relationship between facility/community size and the systemizing quotient. Individuals employed in smaller laboratory sites scored lower than individuals in larger sites (see Table 9). The predictive validity of the SQ-R questionnaire may be valuable to quality assurance. It is thought by this author that the bigger picture should be considered, which includes all healthcare employees. It is quite possible that a similar relationship may be found in all health disciplines within a regional health services model. However, this author's suspicion needs be verified in a future study. Therefore, the evidence is not just important to learning requirements of medical laboratories; it may apply to learning needs of all users across the whole healthcare organization and could very well apply to non-healthcare industries.

Due to lack of learning supports, other departments may unknowingly be undermining quality goals and efficiencies of medical laboratories. Even with the best spirit of quality service in mind, healthcare clinicians or other users of laboratory services

may be unaware how their actions lead to problems elsewhere within the system. Also, services that support laboratory operations may require training as well. That can include facility services, housekeeping, and materials management. Learning supports may be required for smaller, peripheral health care sites and departments, such as nursing, where training is needed to blood collection procedures, point-of-care testing (POCT) and computer technologies (HIS, LIS and EMR). The systemizing quotient differences between the medical laboratory group and nursing is thought-provoking. The SQ-R questionnaire serves as an excellent opportunity for employers, who need insight on the learning needs of a workgroup that is undergoing change and also with budget preparations. Therefore, undesirable system archetypes may surface with every laboratory change if countermeasures are not made to accommodate the different learning needs of all users.

Although any medical laboratory is potentially vulnerable to system traps, a robust quality system, with a well-trained workforce, should be able to detect the risk of undesirable system archetypes very early if they are understood by everyone. As mentioned earlier by this author, was the relationship between mirror neuron systems that are associated with hand movements. This evidence may be related to quality issues with internal process control (IQC) and external proficiency (EQA). Laboratories by their nature require very stable environments to maintain quality. They can be easily impacted by changing economic constraints, staffing, workloads and time pressures. Since mirror neuron systems are related to implicit and tacit knowledge transfer, it is recommended that all laboratory personnel should regularly check each other's hand techniques to ward

off this form of knowledge decay. This collective effort may help improve and maintain analytic precision in disciplines such as biochemistry.

The question of “bias creep” however, may be another issue altogether. Two or more laboratories may have excellent analytic precision, but they could have bias issues compared to peer-group values for a given analytic method. Bias problems with analytic quality *may* point to problems with feedback loops and time delays between the laboratories and higher level quality analysts. Specialists may include biochemists, haematologists, microbiologists or pathologists. If this flow of information is well mapped out, the quality specialist, senior technologist (or a technical services department) can better see the overall performance of the laboratories in the region and advise all staff and expert trainers on opportunities for improvement.

It is not entirely clear how the psychometric questionnaires used in this study may relate to mirror neuron systems, cognition, and implicit-tacit knowledge acquisition. Laboratory techniques can be classified as low-motor, high-motor, low-cognitive and high-cognitive tasks. Examples are provided for clarity, but can be expanded upon:

- 1) Low Motor – inventory loading, waste disposal, workflow organization;
- 2) High Motor – pipetting technique, Instrument maintenance, phlebotomy;
- 3) Low Cognitive – reading ESRs, reading instrument computer screens, and;
- 4) High Cognitive – Hematology, Cytology, Microbiology (microscopy).

This author was unsuccessful in finding evidence of prior investigations that studied in detail the rate of knowledge acquisition, retention, and decay in laboratory medicine where participants were also required to take standardized cognitive tests in parallel with

clinical psychology researchers. Also, this type of research could be linked with fMRI studies. It is thought that the knowledge gained would be valuable for laboratory medicine, psychology, and quality assurance.

Patients are learning systems as well. Perceptions of care as qualia, through the patient's eyes, are influenced by the patient-phlebotomist transaction. Mirror neuron systems of both parties are reasoned to activate during phlebotomy procedures (pre-analytic phase). Following the phlebotomy procedure, the patient will perceive care through fast turn-around-times (TATs) in laboratory results in the post-analytic phase. Also, the patient will note the speed of the laboratory service in relation to the other services they require as a service chain. If the patients are routine patients (e.g. INR testing), they will compare these service transactions with their prior experiences. Therefore, there are several forms of qualia that the patient will detect from their vantage point in the service transaction.

Earlier in this thesis, qualia have been reasoned by this author, to be an important dimension in quality assurance. Qualia can be seen as quantum waves, which collectively make up the "aura of distinctiveness" within a service transaction, thus shaping the customer's perception and behaviour within their learning field. The customer as a patient will experience different types of qualia based on the TALiS model:

- 1) Empathy, perceptions of care and importance ("Green Rules", STLS);
- 2) Workflow efficiencies, i.e. waiting lines, TATs ("Blue Rules", MHLS), and;
- 3) Phlebotomy technique and sample quality for testing ("Red Rules", AGLS).

The training and performance measurement techniques should incorporate all dimensions of the TALiS model experienced by the patient. All medical laboratories struggle with quality goals due to economic, human resources and time constraints. These pressures are slowly, but surely eroding the transaction times, between providers and their patients.

As a consequence of these pressures, environments over time are placing increasingly higher demands on the employee, which includes high social attention and attention shifting. The erosion of transaction time may lead to *perceived apathy* and perceptions of poor quality in care by the patient. Also, the erosion of transaction time affects implicit and tacit knowledge transfer between employees and their patients. The literature review and this laboratory workforce study may lead to improvements in training that can be used as countermeasures. Therefore, a better understanding of the nature of mirror neuron systems can help employees ward off “drift to low performance” system archetypes, which can lead to *knowledge transfer failure* and the perception of *apathy* in the service transaction by the patient.

Another problem that can lead to possible system archetypes might arise from a cultural mindset that relies too heavily on certain measurement types, their limitations and numbers. With systems thinking and quality, Donella Meadows said “pay attention to what is important, not just what is quantifiable” (Meadows D. H., 2008, p. 175). Also important, she stated that the quality leader and project teams should take caution and keep in mind of *what is not known* when making system changes within a QPMP (Meadows D. H., 2008).

Dr. Meadows then clarified the differences between *quantity* and *quality*, from the perspective of the customer and society as a whole:

Our culture, obsessed with numbers, has given us the idea that what we can measure is more important than what we can't measure. Think about that for a minute. It means that quantity is more important than quality. If quantity forms the goals of our feedback loops, if quantity is at the centre of our attention and language and institutions, if we motivate ourselves, rate ourselves and reward ourselves on our ability to produce quantity, then quantity will be the result. You can look around and make up your own mind about whether quantity or quality is the outstanding characteristic of the world in which you live. (Meadows D. H., 2008, p. 176)

Patients and employees are both impacted by service erosion. Mirror neurons impact both employees and the patients they provide service to. The transaction which occurs between the provider and patient *benefits both parties*. These lead to bonds of care and community. Therefore, mirror neuron systems and their importance in human biology and quality may be the key to improving both patient and employee mental health.

Happy and Healthy Workplace Environments

This workforce study suggests that healthcare employers in Canada are not only doing something right, they also appear to be doing it well with laboratory employees who might be on the autistic spectrum. This could be due to the fact that medical laboratories are highly regulated workplaces. Individuals with AS thrive in structured, environments with predictable routines (Attwood, 2008). This evidence leads to this author's discussion and critique of the CLSI standard *QMS04-A2: Laboratory Design; Approved Guideline – Second Edition*. The CLSI states that the document is merely a guideline. They state that many important and specific issues which need consideration in a well-designed laboratory are beyond the scope of the document (CLSI, 2007). The CLSI also states that it is unreasonable to expect laboratory managers, to be familiar with “thousands of pages of changing and seemingly contradictory regulations, or to master architecture and engineering in their spare time” (CLSI, 2007, p. 1). Therefore, the CLSI recommends that laboratory managers should have a general awareness of these elements in laboratory design.

For this discussion and critique of the CLSI document *QMS04-A2*, the focus of this author's investigation is on Autism Spectrum Disorders. The approach taken was to investigate learning environments, which serviced students who had ASDs. It was found that design specifications for Autistic children were remarkably similar to the guidelines recommended by the CLSI document *QMS04-A2*. What the reader might find fascinating is that that *Lean Systems Design* appears to have been used. This information is presented in Table 15.

Table 15

CLSI Laboratory Design, Ergonomics and Human Factor Engineering Countermeasures

| CLSI QMS04-A2 | AUTISM RESEARCH STUDIES | REFERENCES |
|---|---|---|
| <p><u>DESIGN PROCESS</u></p> <ul style="list-style-type: none"> ➤ Lean Design ➤ Value added , remove wasteful practices ➤ one-piece flow processes ➤ 5S, VSM, Control Plan, Data focus, Workstations ➤ Motion Reduction & Visual management | <ul style="list-style-type: none"> ✓ routine predictable areas , “spatial sequencing” of workstations ✓ Motion reduction improved attention spans by 3x ✓ Spaces - “high stimulus” to “low stimulus” ✓ Reduce fields of peripheral vision ✓ Executive Dysfunction common, but overcome by structured rules in processes ✓ retrospective/prospective memory issues with “stairwell structured rules” | <p>(Mostafa, 2008)</p> <p>(Rajendran, et al., 2011)</p> <p>(Hill, 2004)</p> |
| <p><u>HEALTH & SAFETY</u></p> <ul style="list-style-type: none"> ➤ Acoustics – white noise, sound masking ➤ Sound proofing | <ul style="list-style-type: none"> ✓ background noise reduced to 52.5 dB ✓ Echo ratio reduced from 96% to 57% ✓ Noise gradients should be reduced | <p>(Sanchez, Vazquez, & Serrano, 2011)</p> <p>(McAllister & Maguire, 2012)</p> |
| <p><u>SPACE DETERMINATION</u></p> <ul style="list-style-type: none"> ➤ minimum clearance and space requirements ➤ open concepts trend in labs (cross-training) | <ul style="list-style-type: none"> ✓ Proxemics should be in discussions ✓ Autistics need double the space of normal population ✓ “Snoezelen rooms”, quiet rooms ✓ Extra space for high social traffic areas | <p>(Gessaroli, 2013)</p> <p>(Scott, 2009)</p> <p>(Mostafa, 2008)</p> |
| <p><u>VENTILATION</u></p> <ul style="list-style-type: none"> ➤ Air exchange req. ➤ Temp. & humidity | <ul style="list-style-type: none"> ✓ Recommends reducing gradients of temperature (hot, cold) ✓ Recommends Universal Design | <p>(Sanchez, Vazquez, & Serrano, 2011)</p> |
| <p><u>LIGHTING</u></p> <ul style="list-style-type: none"> ➤ recommended lighting requirements for tasks ➤ No mention of full spectrum lighting | <ul style="list-style-type: none"> ✓ Avoid dazzle, shadow-light sequences ✓ Full Spectrum lighting improves cognitive performance by 33.6% ✓ Avoid flickering and buzzing lights ✓ Avoid glares and bold patterns ✓ Blue light is highly recommended to counter seasonal mood disorders | <p>(Colau, 2013)</p> <p>(Sanchez, Vazquez, & Serrano, 2011)</p> <p>(McAllister & Maguire, 2012)</p> <p>(Gooley, et al., 2010)</p> |

The studies in Table 15 suggest that architects and investigators have been very conscientious about spacing, reduction of motion and removal of stimuli. These facility design countermeasures are remarkably similar to 5S methodology in *Lean Systems Design*. Also noted by this author, was the emphasis the researchers and designers placed on organizing work into processes, with carefully designed workstations.³⁶ These human factors engineering countermeasures were found to improve attention spans by a *factor of three* in Autistic children. It was also found by researchers, that “stairwell structured rules” in workflows, helped Autistic children overcome problems with executive dysfunction and set-shifting between tasks.³⁷ This evidence is reasoned to have close parallels with current medical laboratory practice. It may explain the ability of laboratory professionals to work effectively within fast-paced environments such as “core laboratories” which requires a high degree of multi-tasking.³⁸ This evidence leads this author to question what lean systems thinking could do for school systems, from primary schools up to post-secondary institutions. Such quality improvement initiatives could help reduce costs with the potential to boost student academic performance. Therefore, it is reasoned by this author that lean systems thinking, clears the clutter of complexity, promotes effective “seeing”, thus facilitating learning and knowledge transfer.

In addition to improvement of workflows and organization, adequate facility space is important as well. Proxemics language should be entered into the vocabulary of laboratory design planners and quality leaders when considering the needs of technologists who may be on the Autistic spectrum. Researchers found that autistic children required double the physical space for social interaction than that of normal

controls. This author appreciates that space requirements will be a highly contentious issue when planning and budgeting for new laboratories or renovations. However, Dunbar's number and the workforce characteristics may be an important consideration, when building large regional laboratories. Also, high traffic areas that involve social interaction should be expanded. Therefore, recognizing the reality of fiscal constraints, it is reasoned by this author that lean systems design methodologies can be an effective HFE countermeasure to help offset the workspace challenges.

Another thought-provoking idea concerns the use of "Snoezelen rooms" or "quiet rooms" to help employees who are having anxiety issues to decompress or relax. Snoezelen rooms are multi-sensory environments used for autistic children and are also used for patients who may have neurodegenerative conditions, such as Alzheimer's disease. Socialization during coffee or lunch break may not help the Autistic personality type since these transactions require *high social attention*. Therefore, employees with ASDs during a break may not be relaxing. Quiet rooms give personnel who are on the Autistic spectrum a place to retreat from excessive stimuli. Early in this thesis, the introductory evidence suggested that nearly a third of medical laboratory technologists reported psychiatric morbidities in Taiwan (Lee, Lee, Liao, & Chiang, 2009). The goal of these dedicated quiet-relaxation rooms is to permit the employee the opportunity to decompress. There should be no talking, food consumption, or drinks permitted in these rooms since these should be seen as *low stimulus rooms*. Supports like these may be valuable for long-term employee mental health. Therefore, these countermeasures would

improve laboratory personnel performance during patient care transactions, which demand high social attention.

Lighting appears to be a very important issue within laboratory design. The CLSI provides recommendations for lighting. However, document QMS04-A2 does not mention full spectrum lighting. Two published sources in Table 15 mention the importance of *blue wavelength* lights to ward off depression and to improve cognitive performance. Full spectrum with blue wavelength lighting was found to improve cognitive performance in Autistic children by approximately 33% (Colau, 2013). It appears as though the blue wavelength is the most important wavelength because of its effect on the circadian rhythm (Gooley, et al., 2010). Also, laboratory leaders should consider the effect of blue wavelength full spectrum lighting for employees who work *evening* or *midnight* shifts. This author questions if full spectrum lighting could lead to significant improvements in the medical laboratory workforce in operational performance, analytic quality and group morale. This HFE countermeasure may greatly benefit more northerly regions of Canada, such as the Yukon, Northwest Territories, and Nunavut.³⁹ There appears to be an opportunity for research and possible funding with CIHR. This author was unsuccessful in finding published evidence where researchers investigated the benefits of full spectrum lighting in the healthcare workforce environments in Canada. This human factors engineering countermeasure, based on the evidence to date, appears to be an easy fix with an impact on laboratory quality. Therefore, full spectrum lighting would benefit both healthcare workers and patients.

There is an additional item that should be discussed as an intervention and stress reduction method, which may benefit all employees. This discussion concerns *Mindfulness* meditation. Mindfulness is a form of meditation that is based on Buddhist and Yoga practices, which has grown in popularity in western culture (Hofmann, Sawyer, Witt, & Oh, 2010). Mindfulness-based therapy (MBT) has become a very popular form of treatment in psychotherapy. It has been used as a therapy in clinical psychology to help address: 1) Fear and anxiety; 2) Depression, anger, and aggression; 3) Concentration, awareness; and, 4) Stress and Insomnia. Many studies support that mindfulness behavioural therapy shows much promise as an intervention method in clinical populations (Hofmann, Sawyer, Witt, & Oh, 2010). This therapy has been demonstrated to be an effective countermeasure with adults who have autism spectrum disorders (Spek, Ham, & Nyklicek, 2013). Also, mindfulness therapy has been found to work as a countermeasure to reduce hostilities among workers and reduce counterproductive behaviours associated with Machiavellianism (Krishnakumar & Robinson, 2015). However, the use of MBT therapy has not been studied in the medical laboratory workforce, but is thought to be an excellent opportunity for research and may qualify for CIHR funding. Mindfulness therapy shows great potential as both an intervention method to improve laboratory personnel morale and productivity. Therefore, as a learning support, MBT as a countermeasure may be effective at reducing undesirable system archetypes, their costs, and wastes, within healthcare organizations.

Ethical Leadership and Integral Permaculture

There have been brief discussions of integral permaculture in this thesis, the literary work and research of Dr. Donella Meadows, who is viewed by many environmentalists to be the “Mother of Integral Permaculture” (Permaculture Science, 2015). The greatest challenge within healthcare is the long-term sustainability and quality of services. There are all-encompassing economic and political forces at play, which will have an impact on Canadian healthcare and its aging population in the long term. Most notable is the issue of energy; in particular, the use of fossil fuels. The high standard of living that Canadians enjoy will be challenged by the global demand for oil and the global supply limit. All of the easily accessible oil deposits have been extracted and the current reserve is dwindling (Miller & Sorrell, 2013). Unconventional fossil fuel resources and the extraction methods are increasingly causing environmental damage from water table contamination, wildlife habitat, and global warming.

At some point in the near future, the rising cost of fossil fuels, along with the limited resources available, will force a change in culture and impact carbon-sensitive industries globally, if another abundant and cheap energy supply is not found. It is predicted that the transport costs due to oil prices will alter world trade affecting businesses that rely on global supply chain networks (Lynch, 2008). A shift in the current business model is predicted to occur that will force industries to become unlinked from the global market and become re-localised. Businesses are predicted to shift away from global supplier chains, with industries operating locally (Heinberg, 2005).

Lastly, the world is facing a “perfect storm” of food shortages, water scarcity and costly oil predicted by researchers leading to the “ultimate recession” somewhere between 2020 and 2030 (Earth Policy Institute, 2011). Darker predictions for humanity and the state of the planet and its biosphere have been made for the year 2052 (The Club of Rome, 2011). These models with historical evidence, all predict that the *global limit is unsustainable* if the current patterns of consumption and business practices are maintained (PBL, 2009). Healthcare organizations, personnel and their patients will all be impacted by this reality in Canada. Global pressures will force decision-making among leaders when attempting to balance the immediate needs of clinicians and their patients, with the long-term goals of sustainability. Healthcare leaders may be forced to consider *degrowth*. Therefore, there is a possibility that organizations will have to make a formal “degrowth declaration” in the future (Schneider, Kallis, & Martinez-Alier, 2010).

As an example, the reader should consider the costs of a chemistry analyzer, both in the short-term time frame and long-term time horizon. Integral Permaculture’s long-term thinking reasons that medical laboratories will need to be more conscientious about the *energy requirements* and *environmental footprint* of an analyzer if they are to deliver the same level of service to their patients in the long term. The purchase, maintenance and operating costs of an analyzer can be reasoned to be short-term thinking. However, the energy requirement of an analyzer is reasoned to be long-term thinking. All of the components that are used to make a chemistry analyzer required various forms of energy to manufacture and transport. All of the inventories that are consumed by a chemistry analyzer required energy to manufacture and transport. All wastes, which are generated

by an analyzer, require energy to transport and dispose of in an environmentally friendly and safe manner. The focus for long-term sustainability should be on the energy requirements of a laboratory service, its environmental and carbon footprint. Even if energy is relatively cheap now, in twenty years it will be more costly and impacting supplier chain networks, which operate globally if a new and abundant energy alternative is not found. Therefore, it is reasoned that for long-term planning, medical laboratories should be doing business with companies in the US and Canada, who are aware of the growing energy problem and are taking measures proactively to reduce the energy used, carbon and their environmental footprint in their products and services.

Energy, carbon, and environmental problems, will force organizations to rethink their business models and make changes, which will impact employees and the patients they serve. The growing problem will affect all healthcare services. A new mindset and value system is needed to adjust to this resource challenge while maintaining a high level of quality services. Using Integral Permaculture, a new “universal” conceptual model for quality assurance, called “The Quality System of Goodness” is proposed by this author (see Figure 18). Integral Permaculture is a holistic and ethical approach to system design with the goal of a healthy, sustainable and eco-friendly environment. The philosophy and ethics of integral permaculture requires a fundamental change of thought about value systems, habits of consumption and what is truly important with regards to sustainability.

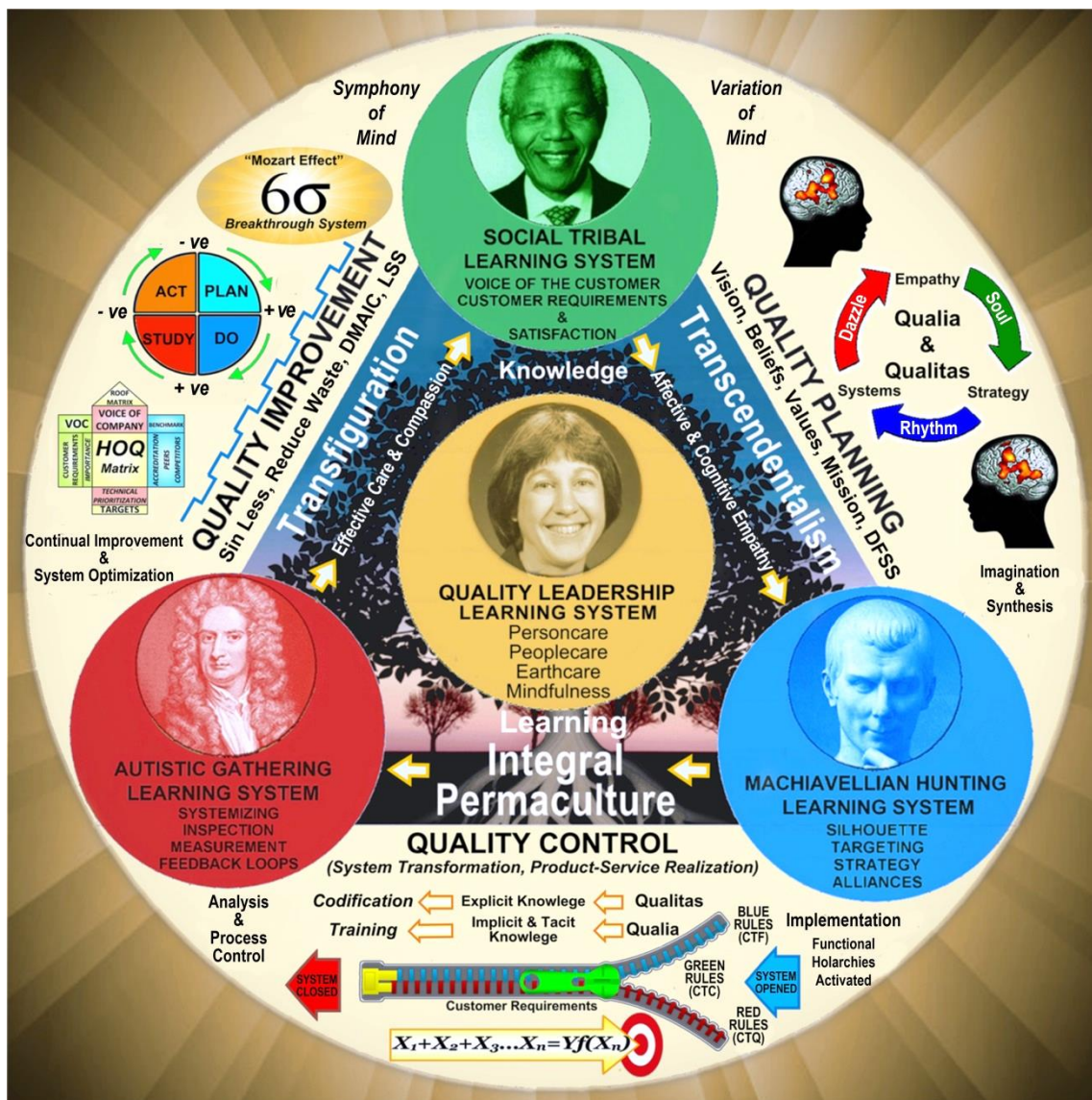


Figure 18. TALiS and the Quality System of Goodness: the Pharos of quality assurance. A conceptual model for organizational learning and knowledge acquisition.

Integral Permaculture is based on three frameworks; *Person Care*, *People Care* and *Earth Care* (Integral PermaCulture Academy, 2015). All three frameworks are compatible within the TALiS model and the Juran Trilogy. During the act of doing business and pursuing a livelihood, all organizations, including healthcare, commit acts

of “sin” when delivering quality services. A profound shift in attitudes on the patients’ part will be required to understand the importance of conservation. This change in attitudes is likely to be the hardest challenge for healthcare leaders and their employees to face when providing services for their patients. These change efforts will require organizational commitment to learning and a total quality effort. The goal of goodness within quality leadership is to seek a pathway for the organization, which balances environmentalism, sustainability, with quality excellence and customer care. Therefore, new persuasive language is needed to educate, inspire and shape mindsets of the employees through Integral Permaculture.

Where do leaders find guidance from sources that support integral permaculture and reach the goal of goodness? The *International Standards Organization* (ISO) has several published guidelines that support the philosophy of integral permaculture design:

- 1) *ISO/FDIS 14001 Environmental management systems* (ISO, 2015);
- 2) *ISO 26000 Social responsibility* (ISO, 2010);
- 3) *ISO 50001 Energy management* (ISO, 2011), and;
- 4) *ISO 113611 Community interpreting* (ISO, 2014).

The published ISO standards that support integral permaculture are not limited to the guideline documents listed above. It is important to recognize that integral permaculture is not just a morally “right” approach to system design. Integral Permaculture has many practical reasons as well, with regards to waste reduction and costs. Therefore, ISO standards can support the goal of goodness through Integral Permaculture design.

For organizations and governments to adopt the new philosophy and ethics of integral permaculture, there is a human need for a role model whose work, research, and beliefs that will inspire them. Considering the bigger picture, the current state of the planet, its biosphere and the warnings from the Club of Rome, it is felt that a woman's perspective is overdue. To begin a new age of global consciousness and enlightenment within quality assurance, there is a need for a visionary leader. Dr. Donella Meadows and her wisdom represent the "soul" of the TALiS model as a spiritual "shaman." It is wondered if the "hunter-gatherer-tribe" triadic framework of the TALiS and the Juran Trilogy, combined with integral permaculture, could have an appeal to the Francophone populations, First Nations and Inuit cultures within Canada. However, the TALiS model is thought to be a *universal design* for organizational learning and knowledge acquisition, which could apply to any culture globally, since it represents the potential of humanity.

Health and social services, which are specialized in the needs of the Francophone populations, First Nations and Inuit cultures in Canada, may benefit from the TALiS and integral permaculture model for quality. The Quality System of Goodness could have greater reach. The quality assurance professional, based on the TALiS model, is reasoned to be closely associated with that of a shaman, who through a new vision leads the culture to a spiritual transfiguration. Therefore, Dr. Donella Meadows is reasoned to be a true visionary; a spiritual, quality leader and environmental medicine woman whose philosophies best supports the culture of goodness in healthcare across Canada and abroad.

Speak the Truth

“Speak the truth.

Speak it loud and often, calmly but insistently,

And speak it, as the Quakers say, to power.

Material accumulation is not the purpose of human existence.

All growth is not good.

The environment is a necessity, not a luxury.

There is such a thing as enough.”

(Meadows D. , *Wise Words from Dana*, 2015)

CHAPTER 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary of Research and Areas for Future Investigation

There is a paucity of literature evidence where researchers have investigated the relationship between Autism and Machiavellianism within workforce populations employed in healthcare. Much of the literature focuses on: 1) the relationships between Autism and social cognition; and, 2) Machiavellianism and its relationship to social cognition. This relative lack of published evidence may be due to a lack of a clear insight by researchers of the dynamical relationship between Autism and Machiavellianism and more importantly, how they relate to quality assurance. It is this author's aim that the models and evidence presented in this thesis may provide insight and will encourage dialogue, debate and ideas for future research. Empathy is an important learning system archetype, which binds the medical laboratory workforce together as a community to meet the needs of their customers through care.

This medical laboratory workforce study is merely a starting point and perhaps a compass for further discovery and learning. There is some statistical evidence, which suggests that there is a pattern in the medical laboratory workforce population personality characteristics. This evidence may be important to regulators and quality leaders within laboratory medicine. The most important finding is that there is evidence to support that

there is a relationship between systemizing quotient scores of employees and the size of laboratory and community size, where the highest scores are in the largest sites and the lowest scores are in the smallest sites. Also, it was found that individuals who scored the highest on systemizing were males and those employed in non-unionized positions. This discovery is important for quality assurance since highly regulated, rule-bound ISO environments, in theory, should lead to relative consistency within the workforce performance characteristics. It appears that ISO regulated environments may mitigate operational load imbalances across large-scale healthcare systems, thus leading to relative consistency in quality levels.

What is not known is how the psychometric scores for the workforce relate to the accumulation of knowledge capital within regulated regional health systems. These psychometric scores may be related to knowledge acquisition, transfer, and decay in laboratory medicine. One area of interest and possible future research are the relationships between the psychometric scores and: 1) internal process control; and, 2) external proficiency testing. Explicit, implicit and tacit knowledge within laboratory medicine should be studied in parallel with standardized cognitive tests and perhaps fMRI studies. A better understanding of mirror neuron systems and how they impact quality assurance in laboratory medicine is needed. This study found a relationship with the SQ-R scores for rural labs versus regional laboratories and may be important for quality assurance. For the larger sites, the relatively low empathy scores of the workforce population bring into question Dunbar's number, project team sizes, and knowledge transfer. The EQ score has limitations where it cannot differentiate between affective and

cognitive empathy. It is not known if there is a correlation between the empathy quotient scores and the Dunbar's number, therefore it is an experiment in itself. Since both areas of knowledge deal with social cognition, it is reasoned by this author that there must be some relationship. Therefore, future research studies of this nature would benefit quality leaders, who face challenges balancing the needs of so many employees and the customers they serve across large geographical distances.

Symphony of Mind and the Mozart Effect

What is true genius within Quality Assurance? Quality begins with qualia and is at the heart of what it means to be human. Genius is linked to the inner conscious potential within all employees and their uniqueness in minds, to wonder and imagine great things of value for the customer as a community. *Variation of Mind* is the key to profound knowledge, which leads to a cultural paradigm shift, thus resulting in breakthrough systems. Neurodiversity in the workforce supports organizational neuroplasticity. Understanding the requirements of the customer is accomplished both through empathy and Variation of Mind. A quality system is an extension of the TALiS and Orch-OR models: a human-based knowledge system that supports the collective genius and voice of all employees. Quality Assurance orchestrates intellectual synergy within all minds across complex health care systems, called the *Symphony of Mind*. It is through neuro-optimization within the workforce that the Symphony of Mind achieves the *Mozart Effect* in quality excellence.

The Mozart Effect is the customer's perception of a product's or service's "aura of distinctiveness" which sets it apart from other competitors. Therefore, a true genius system meets the following requirements:

- 1) Product or service quality features that are *distinctive*;
- 2) The product-service quality features cannot be replicated by *competition*;
- 3) A quality system that is unique due to its *internal information design*;
- 4) A cultural paradigm that is unique due to its employees' *talents and cunning*;
- 5) Closes the gap between the provider and the customer through *customer care*;
- 6) Profound knowledge is nurtured by cultural commitment to *continual learning*;
- 7) Brand loyalty through value, satisfaction and the *aura of moral goodness*.

The Quality System of Goodness is offered as a new vision for organizational excellence. It is reasoned that the greater gift that an organization can give back to civilization goes beyond the distinctiveness of a product or service and its quality features. The organization must impress upon the public, that the world is a much better place through its actions as a role model, holding fast to the goal of goodness.

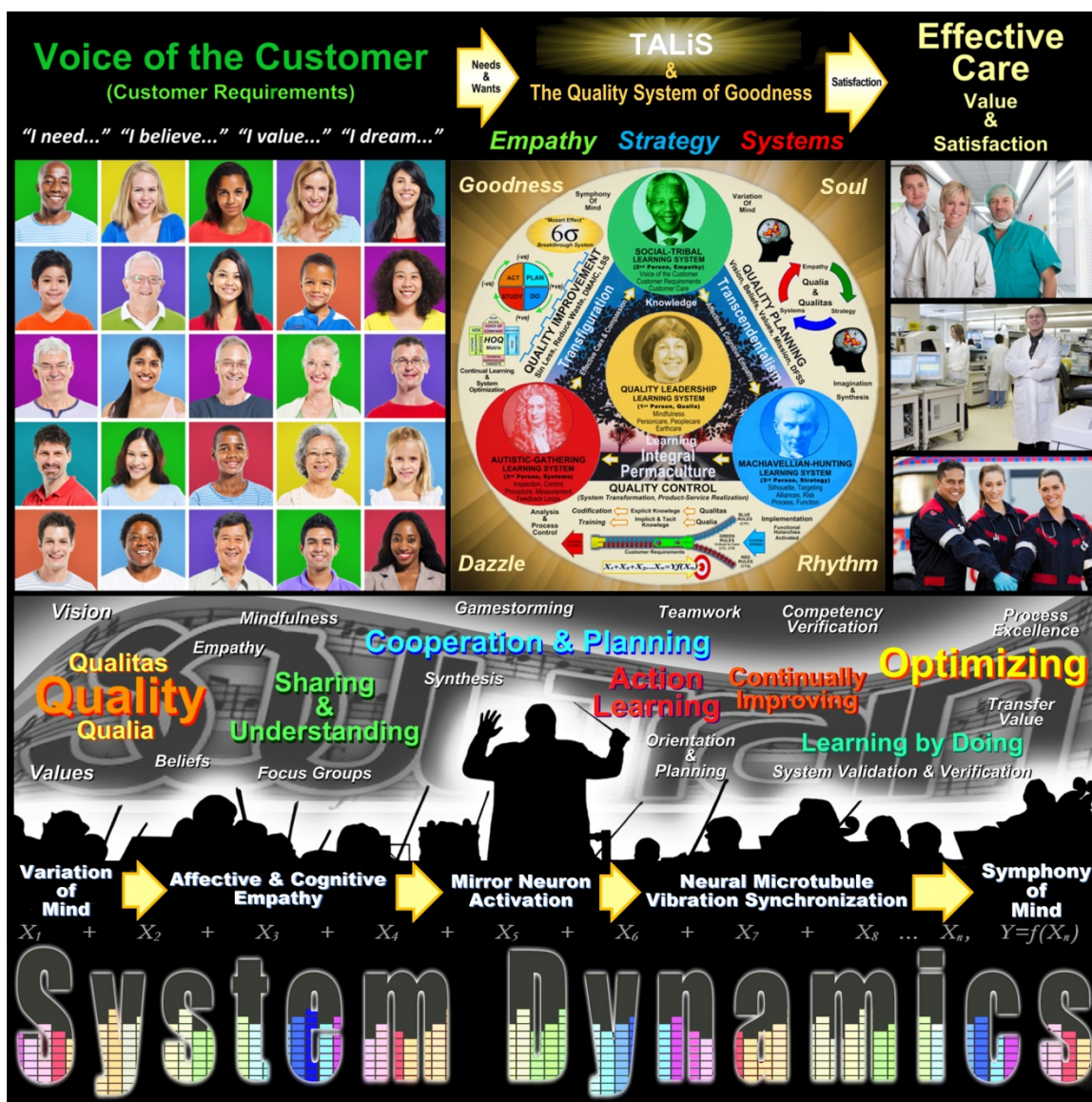


Figure 19. The goal of goodness: customer care, community care, and environmentalism.

The propensity of people to do good things of value for one another is at the heart of what it means to be human. Empathy is instinctive and found in every culture. It is part of Man’s evolution. Goals are achieved through cooperation, mutual understanding, and care. It is central to Quality Assurance. Empathy binds people together as a community within healthcare, society and abroad. Quality Assurance, through its methodologies,

tools and standards, facilitates organizational Symphony of Mind. Collective genius across large scale systems is orchestrated and synchronized by quality systems. Quality Assurance celebrates system complexity, promotes seeing and understanding through learning. Through quality assurance, Man as a species has conquered complexity, uniting people separated by vast distances as a global learning village. Quality through care and learning nurtures the culture of goodness, leading to greatness in Mankind.

The Dance

1. Get the beat.
2. Listen to the wisdom of the system.
3. Expose your mental models to the open air.
 4. Stay humble. Stay a learner.
 5. Honor and protect information.
 6. Locate responsibility in the system.
7. Make feedback policies for feedback systems.
8. Pay attention to what is important, not just what is quantifiable.
 9. Go for the good of the whole.
 10. Expand time horizons.
 11. Expand thought horizons.
 12. Expand the boundary of caring.
 13. Celebrate complexity.
14. Hold fast to the goal of goodness.

(Meadows D. , *Dancing with Systems*, 2015)

ENDNOTES

ENDNOTES

¹ “Baby boomers” are a population group that was born after world war two. This group includes people born between 1946 and 1964.

² The “Generation X” group are the population generation born after the baby boom post-World War II. Demographers propose that this group was born between the early 1960s and early 1980s.

³ Dunbar’s number may be very important in quality assurance and customer service. This number is predicted to vary depending on the occupational group. It is thought by this author that: 1) EQ scores will correlate with Dunbar’s number; 2) Mach-IV scores will show no relationship with the Dunbar’s number; 3) AQ scores will show an inverse relationship with Dunbar’s Number, and; 4) SQ will show an inverse relationship with Dunbar’s number.

⁴ People in social groups as “tribes” can be visualized as social holarchies “nested” within greater mixed hierarchies. An example would be multiple occupational groups on a floor in a hospital who share a common space that their different departments are nested within, but all report to a higher reporting structure. Holarchies arise from the ability of biological systems to self-organize into groups. It is questioned by this author if mirror neuron systems are responsible.

⁵ The Orch-OR model implies that the experience of qualia within a person, arises where the theory of relativity and quantum theory meet within a biological system, leading to consciousness.

⁶ Functional Magnetic Resonance Imaging is an MRI technology that images subtle changes in brain activity associated with blood flow (oxygen rich, oxygen poor) linked with neuron activity.

⁷ The phrase “Left-Brained” should not be interpreted literally. The Machiavellian fMRI study suggests that the brain is “leaning” on the left hemisphere when figuring the solution to a problem.

⁸ It is questioned by this author, if the Orch-OR model, along with the mounting evidence of mirror neuron systems, could be a possible mechanism to explain the *McClintock Effect*, or menstrual synchrony among women in close social groups (*Weller, Weller, Koresh-Kamin, & Shoshan, 1999*). It is also questioned by this author if there is a relationship between the EQ, Dunbar’s number, and the McClintock Effect. Also, if future research evidence supports this author’s notion, researchers should investigate if this synchrony is related to, or affected by operational rhythms within large scale organizations. It is thought that these investigations would benefit nursing, other healthcare disciplines, industrial and other business environments. It is thought that future researchers should also investigate the *Whitten Effect*.

⁹ The position of the *learner*, relative to the *trainer* may also be very important. As an example, it is questioned if the action observed from *across a bench*, rather than *standing next* to the trainer and observing the action *to one side* of the learner's body may produce different mirror neuron synaptic activity. If the learner observes the action across the bench from the trainer, they are forced to "mentally rotate" what they have observed.

¹⁰ The word "Talis" comes from Latin, meaning "of such a kind", "such"; "so great"; "so excellent"; "of such kind".

¹¹ This Author obtained permission through written consent by Christopher Marley, the Artist behind the "beautiful beetles" background in the TALiS model (See Appendix F). Christopher Marley's work is available online. <http://www.pheromonedesign.com/>

¹² The term "neurocognitive social astigmatism" might be a better politically correct term to describe the condition, but this idea is to be put forth for the reader's consideration by this author. Also, the term "deficit" may be inappropriate as well, in that the word "deficit" can mean different things to many people. The phrase "neurocognitive astigmatism" may be a better term to use in workplace discussions relating to different learning needs of employees, *Variation of Mind* and the importance of *neurodiversity*.

¹³ It is believed that a technology could be developed based on the "Rules of Herds". It would be based on motion silhouette. Once validated, the technology when used in conjunction with experiments in system dynamics could reveal hidden feedback patterns within organizations, pointing to undesirable system archetypes not previously known. The technology would first need to establish a baseline set of metrics based on common motions to determine the underlying "heartbeat" within the organization. It would become progressively more intelligent in detecting motion cues through *direct observation*, which points to trends, oscillations, or escalation scenarios. This technology could operate globally, becoming an "invisible hand". It is questioned if this technology can produce evidence to support the TALiS and the Orch-OR models. If this technology, through evidence, supports the models, it is then questioned by this author if another technology, based on *sound cadence*, *sound harmonics* which also detects *emotional valence states* of social groups indicating close systems. This sound technology would not focus on language, merely sounds. The two technologies can then be linked to underlying rhythms within the greater system. With the data gathered, the rhythms, sounds and motions can be used as statistical "musical notation" to model the transfer value $[Y=f(X_n)]$ at the *program* or *organizational level* using system dynamics software such as *Anylogic Multi-Method Modelling software* (<http://www.anylogic.com>).

¹⁴ It is believed that the silhouette technology could be developed to improve supplier chain inventory flows. For every customer that purchases a product in a store, there may be several or many people that

come close enough to the product to inspect it for quality, with the possibility of purchasing. The purchases captured by the financial electronic transaction system within the store have some predictive value for trends, but the silhouette motion system has far greater reach, with respect to customer intentions to buy in the future. This information is captured through motion cues. By going one step further, less waste in holding time for inventories is reduced. Therefore, waste is reduced through energy consumption, inventory movement, and labour. The greater goal of goodness is to reduce environmental footprint and long-term sustainability.

¹⁵ The same silhouette technology could be developed to improve patient workflows by monitoring only silhouette movements, thus *protecting patient confidentiality*. The technology would look for periodic motions in common areas such as hallways and advise on areas for improvement. This would provide valuable insight on *implicit* and *tacit knowledge flows* and also provide greater predictive power to quality leaders. This technology would complement a pre-existing Health Information System. Within a healthcare organization spanning large geographical distances, the metrics captured can lead to improvements with workflows using the “Rules of Herds” through *direct observation*.

¹⁶ For the reader, it should be noted that the *Born-Einstein Letters* is an important and significant body of literature, which spanned a time frame of 39 years. The correspondence between Einstein and Born occurred from 1916 to 1955 (*Einstein, Born, & Born, 1971*).

¹⁷ The reader should note that Low-Mach’s use different strategies of manipulation within interpersonal relationships and within groups. This includes a tactic called “sandbagging”, where they can display a low ability or weakness to undermine group goals. However this form of strategy can backfire, causing a “sand trap” for the sandbagger (*Shepperd & Socherman, 1997*).

¹⁸ It is this author’s opinion that the Mach-IV test does not detect true Machiavellianism, but rather can be better described using a very simple analogy. This author proposes that the Mach-IV test merely detects “poker playing cowboys and cowgirls, who can line-dance effectively”, based on the work of Christie and Geiss.

¹⁹ To be clear to the reader, “social cognitive deficits with empathy” does not mean lack of empathy or care. This phrase relates to the speed of the social transactions within group settings and the ability to a person to understand the point of view of another person during these social transactions. This understanding comes from the brain’s ability to process facial expressions, motion cues, and language, during high-speed social transactions in busy workplace scenarios.

²⁰ This notion can be explained further by an example in healthcare. The laboratory department is composed of several smaller departments such as chemistry, microbiology, hematology, transfusion medicine,

cytology, and histology, which are “nested” as functional holarchies. The laboratory may work with the ECG department and the diagnostic imaging departments that are also nests (x-ray, ultrasound, CT, MRI, etc.). These departments can be seen from two vantage points: 1) their function, the flow of work and patient in-out flows, or 2) by reporting structure. All of the departments can then be seen as nested holarchies that have a mixed hierarchy (heterarchy) under a functional centre called “Diagnostic Services” within the hospital or health authority.

²¹ It is thought that the four psychometric questionnaires could be consolidated into one short form instrument, which can then called, the *TALiS psychometric questionnaire*. If future researchers can verify the: 1) the relationship between the AQ and Mach-IV test, and; 2) the relationship between the SQ-R and Mach-IV tests; then it may be possible to construct a psychometric questionnaire for quality assurance in the future.

²² The choice of colours is credited to the literature source *Delivering Knock Your Socks off Service* by Performance Research Associates, Inc. The authors discussed the concept of “Red” and “Blue” rules in Healthcare. “Red Rules” are “rules that cannot be broken” and are based on clinical, regulatory, scientific and engineering reasoning. Blue Rules are designed to make the “hospital experiences run more smoothly for patient and staff alike” (*Performance Research Associates, Inc., 2012*). The “hospital experience” can be expanded upon where Blue Rules are only concerned with the efficiency of workflows, functional holarchies and supplier-service chains (Lean System Design), and “Green Rules” are concerned with the perceptions of care during the patient-clinician transaction and “social holarchies”. Green Rules mesh with “Personcare” and “Peoplecare” language of Integral Permaculture Design. Greater clarity can then be achieved by using “Critical to Quality” (CTQ) as “red rules”, “Critical to Flow” (CTF) as “blue rules” and “Critical to Empathy” (CTE) or “Critical to Care (CTC) as a “green rules”.

²³ A Quality Management System can easily be automated within a business or healthcare model using software packages such as the *Lean Machine* (<http://www.theleanmachine.com/>). Such packages reduce the administrative weight of maintaining ISO compliancy.

²⁴ The concept of zombies and qualia in philosophy are thought to be valuable in quality assurance, with respect to constructing new heuristic models and solving quality problems. This type of lens forces planners to look at the *design of the system* rather than the *people within the system*, since it sees the system through 3rd person thinking. However, it can be used to explain the problems of cultural change. The usage of zombies to explain quality issues can then be used to: 1) make work processes better; or 2) to explain cultural stagnancy and learning needs of the organization.

²⁵ The “Squaring the Circle” idiom can be expanded upon where the quality leader as an intervener is attempting to place the organization and its functional centres within an “ISO Box”. This idiom may be useful for Quality Assurance, where: 1) a triangle represents the TALiS and the learning needs of the individual; 2) The circle represents the social group or “tribe” within a functional holon, and; 3) the Square is the ISO box, which permits the groups to work in a value chain towards a higher goal.

²⁶ It should be clarified that the Deming Cycle is the best known dynamic control feedback loop, but there are other types of dynamic control feedback loops within systems dynamics such as the OODA Loop (*Owen, Burstein, & Mitchell, 2004*).

²⁷ This author proposes that the same study can be replicated in medical laboratories which operate under a health authority. It is predicted that the same results will be found and conclusions will be drawn.

²⁸ Auditory Processing Disorders are commonly found with individuals who have Autism Spectrum Disorders (*O'Connor, 2012*). Individuals on the Autistic spectrum, with this condition, have greater challenges following social transactions groups and keeping up with dialogue; therefore long meetings may be exhausting.

²⁹ Design for Six Sigma (DFSS) as a QPMP can take on various forms, depending on the organization, whether or not it manufactures a product or offers a service. Some versions may include DMADV, IDOV, DCCDI, and DMEDI (*I-Six Sigma, 2015*). See Appendix G.

³⁰ It is an opinion by this author that the use of coloured belts may be counterproductive and may, in fact, project Authoritarian behaviour, since the idea of belts comes from the martial arts such as Karate, Kobudo, Judo, Jujitsu and other variations. Martial arts are directly related to warfare. Such a ranking system may be inappropriate and counterproductive within an industry that is predominantly female, healthcare, or services specialized in the needs of the Francophone, First Nations, and Inuit populations in Canada.

³¹ A Heuristic is a strategy that ignores part of the information (or reasons with incomplete information) with the goal of making decisions more quickly, frugally, and accurately than more complex methods (*Gigerenzer & Gaissmaier, 2011*).

³² Words form mental pictures, which can have different meanings to different people. Words strung together in sentences form larger pictures and with mind maps, can help construct conceptual models. By carefully studying the words and their associations with other words using online tools such as *Visuwords* (<http://www.visuwords.com/>), new cognitive lenses can be created. This approach can lead to new vision

statements or improvements with the current vision statement. Therefore, the study of semiotics may be useful in Quality Assurance.

³³ Semiotics is the study of analogies, metaphors, and symbolism in language. This discipline may be very important with respect to First Nations and Inuit cultures in Canada or other cultures globally. It is thought that these studies should be investigated in parallel with fMRI studies. These efforts would benefit many disciplines outside of neuropsychology.

³⁴ It is believed that there is a great opportunity for future experiments, which relates to social learning, and *social space sizes* within large organizations based on the evidence presented in table 14. This relates to ASDs, Prosopagnosia, and Aphasias. These conditions point to the social cognitive ability of employees to remember other people within in groups of varying sizes and complexities. This is thought to be important in quality assurance. Specifically, it relates to employees ability to 1) *recognize people* within the organization; 2) remember their *names*; 3) their *function* and *area worked*. It is thought that there is a relationship between the EQ, AQ, Dunbar's number, and the mental ability to remember people's names quickly, and the ability to know other employees social dimensions (personal, work connections) within the organization. This notion relates to people discussing workplace issues related to "people not immediately present", which is another form of social cognition. This form of social learning can be measured for new employees and longer term employees. Social learning curves can be modeled. With this data, Kurt Lewin's models can be used to predict the flow of implicit and tacit knowledge, and group dynamics within the organization. It is predicted that individuals with ASDs or traits of Prosopagnosia and Aphasias will have better memory of individual's *roles* and *functions*; in relation to their *names*. This research idea may relate to Mach-IV scores. Also, it is questioned if ASD individuals may be using *objects* in the work environment as cues to remember other people. Also questioned by this author, is the relationship between ASDs, Prosopagnosia and the experience of seeing "doppelgangers". Specifically, if the person is sees *too many* doppelgangers, does this point to a symptom? These questions are put forth for psychology researchers who are investigating *intra-group empathy*, *inter-group empathy*, and social cognition.

³⁵ This author was unsuccessful in finding research evidence supporting the notion that sudden motions of hand movements could *trigger panic responses* in Autistic personality type, and where this relates to the AGLS within the TALiS. It is thought that individuals on the Autistic spectrum may have excellent visual memories of hand movements. This prediction, based on the TALiS model, may explain the ability of medical laboratory technologists to remember the specific requirements of patients who require routine bloodwork, even if the routine patients come in bi-weekly, once per month, etc. (e.g. INR patients). This is thought to be easily testable in future experiments.

³⁶ Based on the literature review and evidence found in the workforce study, it is questioned by this author if modifications within laboratory environments could be made where there is silhouette reduction. This human factors engineering countermeasure would involve removal of sharp corners on walls, and benches and using *curved surfaces*. The goal is to reduce the sharpness of contrast or the contrast gradient. A current laboratory can be studied by taking high contrast black and white images and studying silhouette and dazzle effects within process flows. It is thought that this effort would be particularly important in Core-laboratories. However, all laboratories would benefit. Also, hospitals should consider Autistic friendly colours, which do not overpower or overstimulate visual systems.

³⁷ This Author questions the term “multi-tasking” and where it might relate to executive dysfunction, ASDs, and work environments. Could Autistic personality types be better described as “Fast Serial Sequencers”, rather than “Multi-Taskers”? No direct evidence was found to support this idea.

³⁸ Core Laboratories have a carefully designed portfolio of tests in different disciplines such as biochemistry, immunochemistry, haematology, transfusion medicine and urinalysis. They may include some microbiology testing as well. Core Laboratories are engineered for fast TATs.

³⁹ There is also a relationship between Vitamin-D Levels and mental health. A 2010 Study in Sweden found a relationship between geographic latitude, Vitamin-D levels, and psychiatric morbidities. It was found that *individuals with Autism had the lowest Serum 25-OH-vitamin D levels*. The psychiatric out-patient department was located in Gustavsberg, Sweden, at geographic latitude of 59.3° North (*Humble, Gustafsson, & Bejerot, 2010*). Therefore, at this latitude, this infers that Medical Laboratory Technologists employed in the Yukon, Northwest Territories, and Nunavut would be most impacted.

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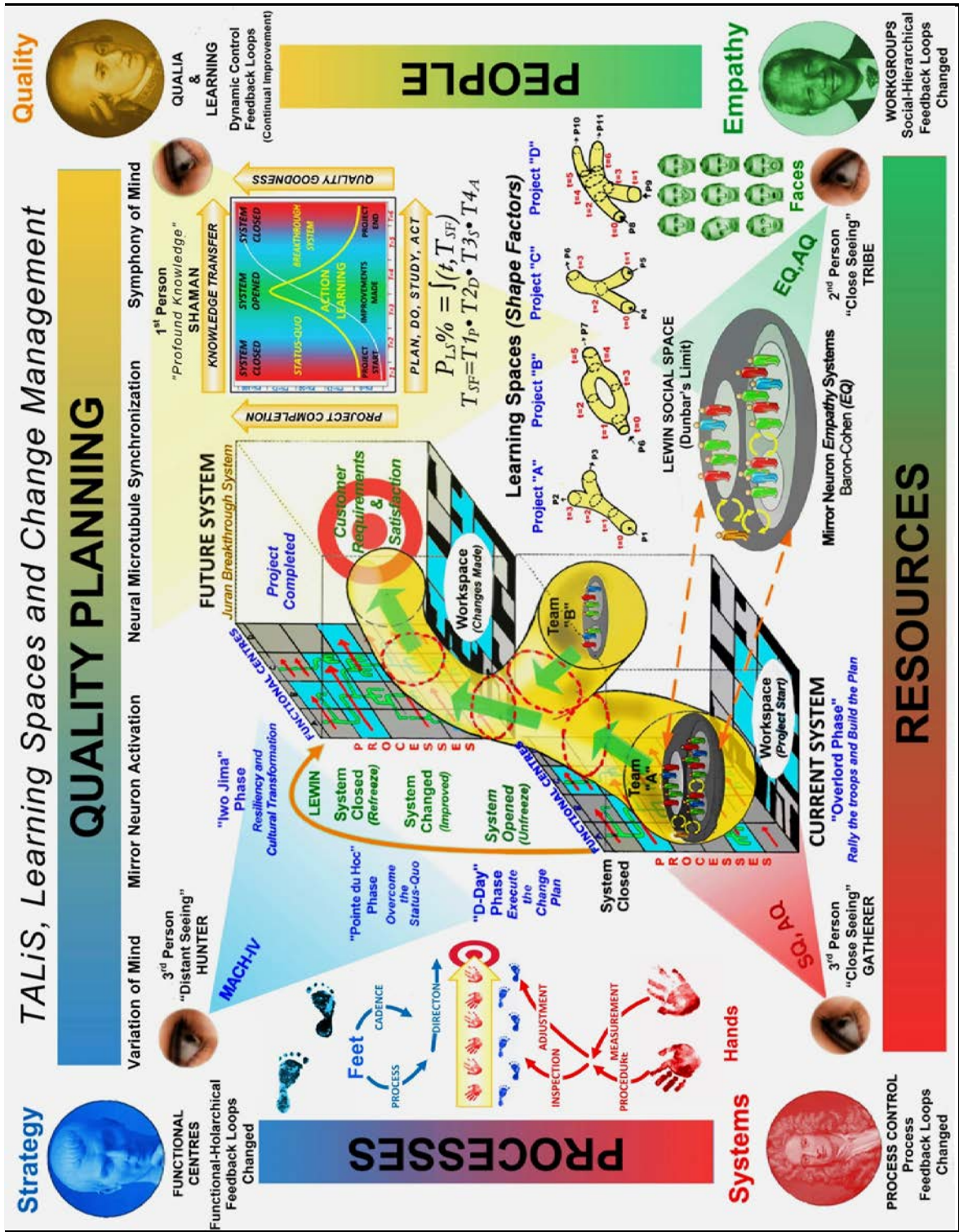
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APPENDICES

APPENDIX A

TALIS, LEARNING SPACES
AND CHANGE MANAGEMENT



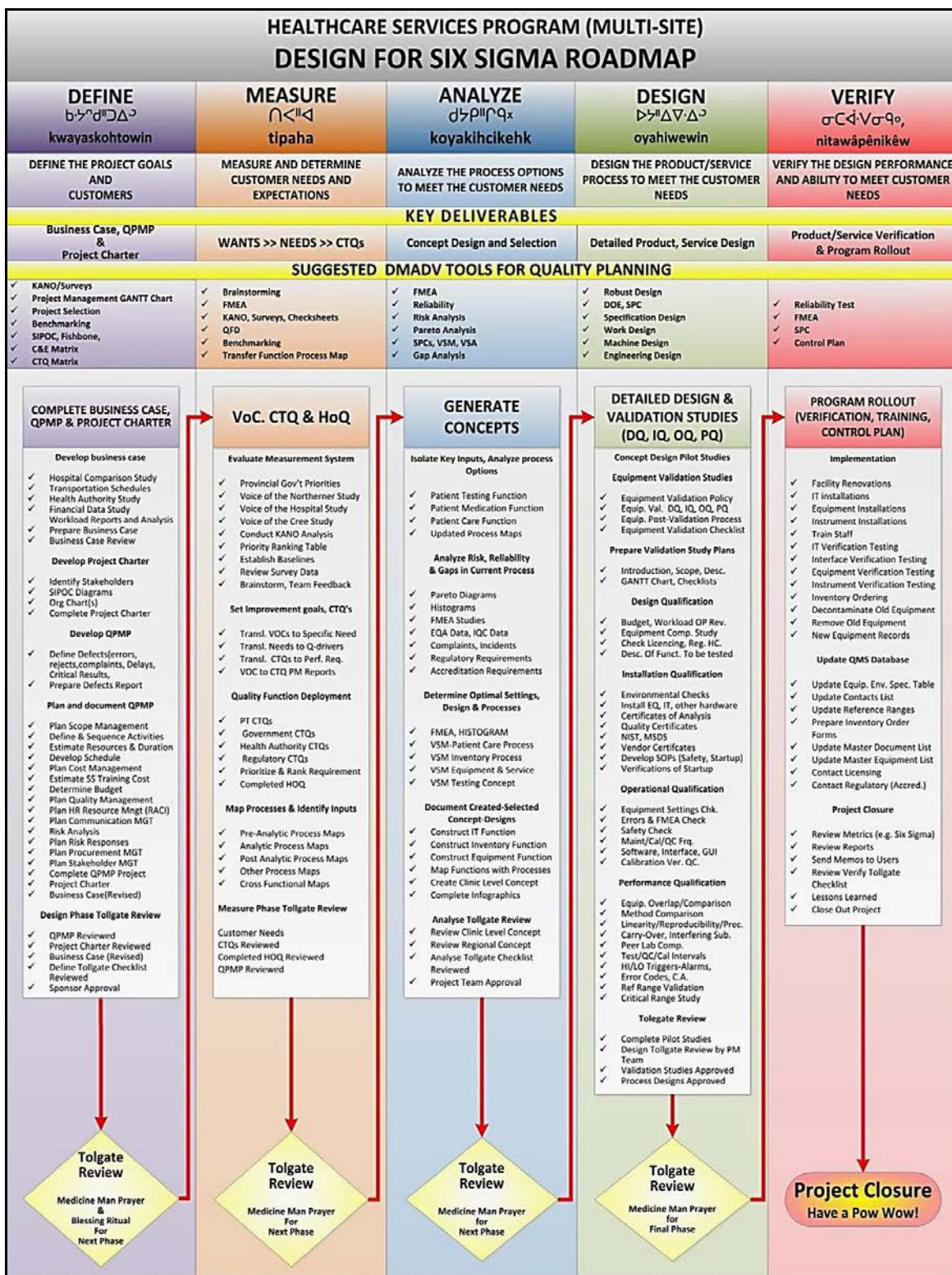
APPENDIX B
ASQ QUALITY TOOLS AND TALIS

ASQ Quality Tools and TALiS

| ASQ QUALITY TOOLS* | TALiS | | | COMMENTS |
|---------------------------------|-------|------|------|--|
| | STLS | MHLS | AGLS | |
| 1. A3 Report | √ | √ | √ | proposals, problem solving ,story boards |
| 2. Affinity diagram | √ | √ | √ | Brainstorming tool |
| 3. Arrow Diagram | | √ | √ | used with CPM |
| 4. Balanced Scorecard | | √ | | Strategic management tool |
| 5. Benchmarking | | √ | | Measurement against competition |
| 6. Box and Whisker Plot | | | √ | |
| 7. Brainstorming | | √ | | |
| 8. Cause-and-effect | | √ | | Ishikawa, Fishbone Diagram |
| 9. Check Sheet | | | √ | "Gathering Tool" (AGLS) |
| 10. Control Chart | | √ | √ | Process Variation vs. Time |
| 11. Decision Matrix | √ | √ | | Evaluation Prioritization Tool |
| 12. Design of Experiments | | | √ | |
| 13. Eight Disciplines (8D) | √ | √ | √ | Powerful QI methodology |
| 14. FMEA | | √ | √ | Process problem solving tool |
| 15. Five S (5S) | | √ | | Work environment improvement |
| 16. Five Whys, Five Hows (5W5S) | | √ | √ | Process improvement tool |
| 17. Flowchart | | √ | | "Silhouette" of process seen |
| 18. Force Field Analysis | | √ | | Strategic Decision Making tool |
| 19. Gage repeatability | | | √ | |
| 20. Gantt chart | √ | √ | | Monitoring Chart, Tasks, Timelines |
| 21. Histogram | | | √ | |
| 22. House of Quality (HOQ) | √ | √ | √ | Powerful "Lens" for SS projects |
| 23. Impact Effort Matrix | | √ | | Prioritization Tool for Implementation |
| 24. Kano Model | √ | | | Customer Needs Tool |
| 25. Matrix Diagram | | | √ | |
| 26. Mistake-Proofing | √ | √ | | Also called Poka-yoke |
| 27. Nine Windows | √ | √ | | Powerful tool for Social Change |
| 28. Nominal Group Technique | √ | | | Brainstorming tool |
| 29. Pareto Chart | | | √ | |
| 30. PDSA | √ | √ | √ | Model for Continuous Improvement |
| 31. Problem Conc. Diagram | √ | √ | | Supports "Rules of Herds" model |
| 32. Decision Program Chart | | √ | | Tree Diagram showing relationships |
| 33. Quality Function Deployment | √ | √ | √ | |
| 34. Relations Diagram | √ | √ | | Cause-and-effects relationships |
| 35. Scatter Diagram | | | √ | |
| 36. SIPOC+CM Diagram | | √ | | |
| 37. SMART Matrix | | √ | | Planning and Communication Tool |
| 38. Spaghetti Diagram | √ | √ | | Lean tool- helps improve workflows |
| 39. Success and Effect Diagram | | √ | | Similar to Fishbone Diagrams |
| 40. Survey | √ | | | Used for Voice of the Customer |
| 41. Tree Diagram | | √ | | |
| 42. Value Stream Mapping | | √ | | Lean tool |

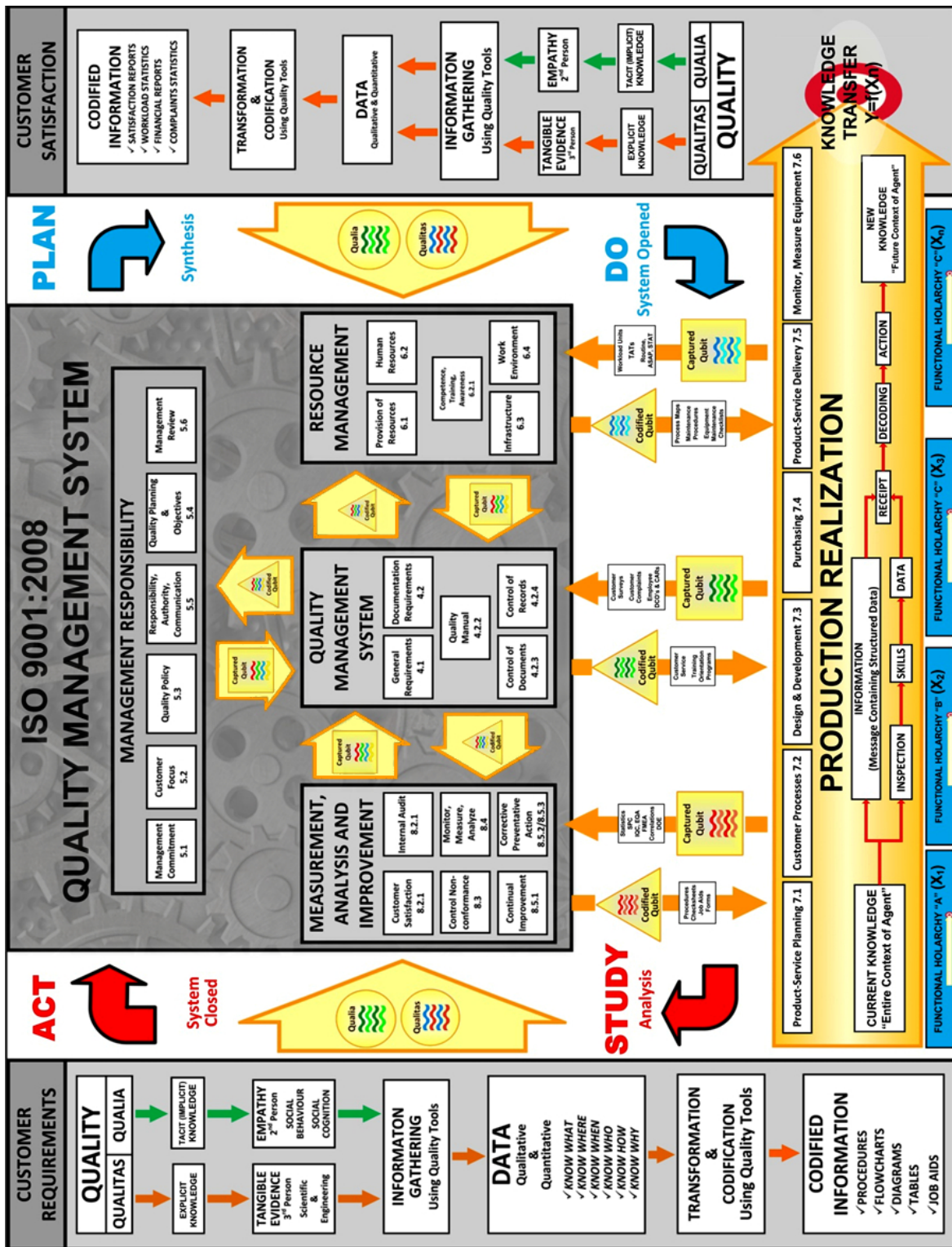
APPENDIX C
DESIGN FOR SIX SIGMA (DMADV)

Design for Six Sigma (DMADV)



APPENDIX D:
ISO 9001:2008
QUALITY MANAGEMENT SYSTEM
AND KNOWLEDGE TRANSFER

Quality Management System and Knowledge Transfer



APPENDIX E

CSUDH IRB STUDY APPROVAL, APRIL 2014

CSUDH IRB Study Approval April, 2014

CSUDH Institutional Review Board

for the Protection of Human Subjects in Research


Date: April 10, 2014

To: Robert Spencer, PhD
Dept.: Quality Assurance

Robert Sean Davies
Dept.: Quality Assurance

Janine Montgomery, PhD
University of Manitoba, Canada

CC: File

From: Judith Weber, IRB Compliance Coordinator 
CSUDH Institutional Review Board (IRB)

Subject: 14-135: Change Management in the Medical Laboratory Industry
Approved: April 10, 2014

The IRB is pleased to inform you that it has approved your proposal. We have determined that your research qualifies for exemption from the requirements of 45 CFR 46 according to **Exempt Category 2** concerning “research involving the use of educational tests (cognitive, diagnostic, aptitude achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects’ responses outside the research could reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects’ financial standing, employability or reputation.” (CITE: 45CFR46.101.b.2).

The stamped Informed Consent document is enclosed and should be used as a template for distribution to your subjects.

Procedural changes or amendments must be reported to the IRB and no changes may be made without IRB approval except to eliminate apparent immediate hazards. Please notify the Office of Research and Funded Projects (a) if there are any adverse events that result from your study, and (b) when your study is completed.

If you have any questions, you may contact the Office of Research and Funded Projects at (310) 243-3756.

Thank you.

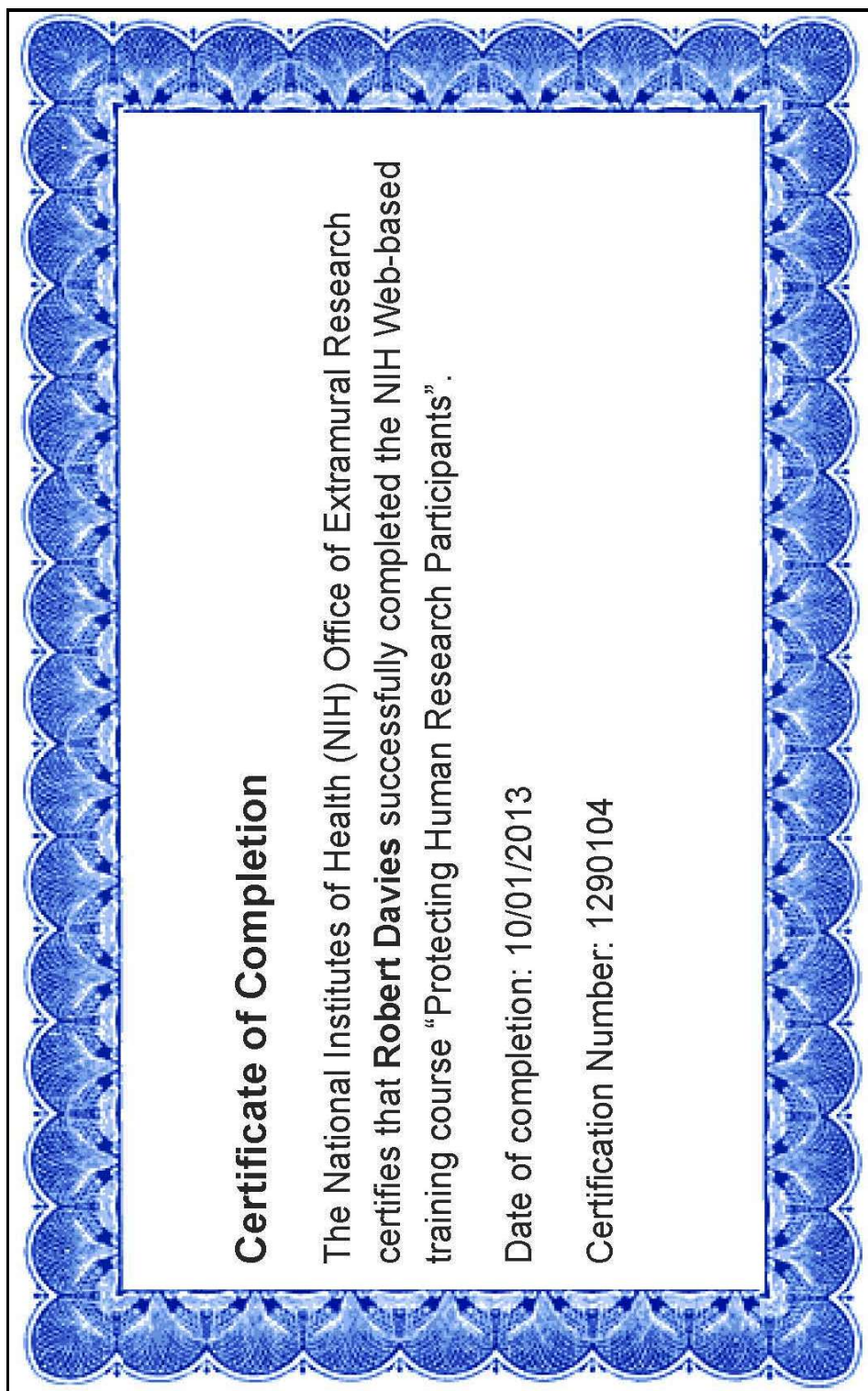
**Approval expires one
year from above date**

*Subject recruitment and data collection may not be initiated prior to formal written approval from the
IRB Human Subjects Committee*

APPENDIX F

NIH RESEARCH ETHICS CERTIFICATE

NIH Research Ethics Certificate



APPENDIX G
CHANGE MANAGEMENT SURVEY

Change Management Survey

Introduction and Disclaimer

California State University, Dominguez Hills

Consent to Act as a Research Subject

Change Management in the Medical Laboratory Industry

You are being asked to participate in a research study. Before you give your consent to volunteer, it is important that you read the following information and ask as many questions as necessary.

Principal Investigator:

Robert Spencer, MA, MS

Adjunct Professor, Quality Assurance Dept., CSUDH

email: rspencer@csudh.edu

Co-Investigators:

Robert Sean Davies, BA, MLT (CMLTM) Graduate Student, MSQA Program, CSUDH email: rdavies1@csudh.edu

phone: (204) 372-6560

Janine Montgomery, PhD (Advisor)

Associate Professor, Psychology Department

University of Manitoba

email: Janine.Montgomery@umantioba.ca phone: (204) 474-8306

Purpose of the Study:

The purpose of this study is to determine the personality characteristics of the medical laboratory workforce. A new change management model will be developed that will help organizations and their employees overcome interpersonal conflict, resistance, and anxiety to operational change.

This study will involve recruiting approximately 5000 potential participants. All employed laboratory professionals are eligible to participate in this study.

Description of the Study:

You, the participant will be asked to complete an online survey through Qualtrics, involving a series of questions related to different topics in laboratory quality management:

- 1) Social Systems and Teamwork
- 2) Systems Thinking
- 3) Emotional Intelligence
- 4) Leadership

In addition to the above tests, you will be asked about your age, gender, and questions related to employment.

Risks or Discomforts:

No known or potential risks are anticipated with this study. Subject identifying information will not be collected for this research. All potential risks are considered to be minimal at worst, and most likely nonexistent. Your personal data will not be made available to your peers, employer, or regulatory college.

In the event that you feel uncomfortable with the survey questions, you may discontinue participation at any time, and it will not affect your relationship with the principal investigator, CSUDH, the University of Manitoba, your employer, or your regulatory college.

Benefits of the Study:

The results of the research are of immediate value to the disciplines of laboratory medicine, industrial psychology, human factors engineering, and organizational behavior.

The goal of this research is to propose a new model in change management that will reduce anxiety, resistance, and interpersonal conflict in the medical laboratory.

Confidentiality:

Data collected will be stored using an online survey website called Qualtrics (www.qualtrics.com). All subject information is password and encryption protected. Confidentiality will be maintained to the extent permitted by law and the policies outlined by California State University, Dominguez Hills. Anonymity is protected since the individual's identity is not known to the researchers, and is never recorded or associated with the data collected.

Incentives to Participate: None

Voluntary Nature of Participation:

Your participation in this study is voluntary. Your choice of whether or not to participate will not influence your future relations with California State University, Dominguez Hills, the CMLTM, SSMLT, or your employer. If you decide to participate, you are free to withdraw your consent and to stop your participation at any time.

Questions about the Study:

If you have any questions about this study or your rights as a participant, you may call the co-investigator (Sean Davies, 204-372-6560), Professor Robert Spencer (rspencer@csudh.edu), or the Institutional Review Board for the Protection of Human Subjects at CSUDH, 310-243-3756.

CMLTM, SSMLT and U of M Disclaimer:

When you link to this survey, you are no longer using the CMLTM and SSMLT websites and this linked website (www.qualtrics.com) is not under the control of the CMLTM, the SSMLT and the U of M. This link is provided for information and convenience only. The CMLTM, SSMLT, and the U of M are not responsible for the content of this linked website and do not endorse the contents of this linked website. As such, the CMLTM, SSMLT, and the U of M cannot be held liable for any damages caused as a result of the use of this linked website.

By entering the CAPTCHA code below, this indicates that you have read the information in this document and have had a chance to ask any questions you may have about the study. Your CAPTCHA code also indicates that you agree to be in the study and have been told that you can change your mind and withdraw your consent at any time. You have been given a copy of this consent form. You have been told that by entering the CAPTCHA code into this electronic consent form you are not giving up any of your legal rights.



CHANGE MANAGEMENT SURVEY

Demographic Information

DEM1. What is your sex?

- Male
- Female

DEM2. What is your age?

DEM4. What is the population size of the community you live in?

DEM5. What is the population size of the community you are employed?

DEM9. What is your highest educational level achieved?

- Community College Certificate (1 Yr)
- Community College Diploma (2-3 Yr Diploma)
- Bachelor's Degree
- Master's Degree
- Doctorate Degree

Q280. Which Country do you live in?

- Canada
- United States
- Other

Employment Statistics Questions

Q1. What is your current title?

- Laboratory Assistant/Technician
- Laboratory Technologist
- Senior Technologist, Section Head (one department)
- Laboratory Supervisor/Manager/Chief Technologist (Multiple departments)
- Regional Manager/Laboratory Director
- Other

Q2. What role best describes your scope of responsibilities?

- General Duty Technologist/Core Lab
- Specialized in Hematology
- Specialized in Chemistry
- Specialized in Transfusion Medicine
- Specialized in Microbiology/Virology/Parasitology
- Specialized in Histology
- Specialized in Cytology
- Specialized in Genetics/Molecular Biology
- Laboratory Information Systems
- Administration/Management

- Quality Management
- POCT Coordinator
- Instructor
- Other

Q5. Is your primary employer a

- Private Medical Laboratory
- Urban Hospital or Regional Teaching Hospital
- Rural Hospital
- Biomedical Equipment/Reagent/Supply/LIS firm
- Academic institution
- Regulatory Body/Agency
- Nursing Station/Physician's Clinic
- Pharmaceutical Firm
- Other

DEM9. What is the size of your laboratory? If your employer is not a hospital or private medical laboratory, please state the number of employees at your immediate worksite.

DEM10. What is your employment status?

- I work full time
- I work part time (permanent)
- I work part time (casual)
- Other

DEM11. Are you a unionized employee?

- Yes
- No

Q280. How many years have you been employed in your profession?

Q281. How many years have you been employed with your current employer?

Q282. How many employers have you been employed with over your career?

Social Systems and Teamwork

AQ1. I prefer to do things with others rather than on my own.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ2. I prefer to do things the same way over and over again.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ3. If I try to imagine something, I find it very easy to create a picture in my mind.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ4. I frequently get so strongly absorbed in one thing that I lose sight of other things

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ5. I often notice small sounds when others do not.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ6. I usually notice car number plates or similar strings of information.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ7. Other people frequently tell me that what I've said is impolite, even though I think it is polite.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ8. When I'm reading a story, I can easily imagine what the characters might look like.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ9. I am fascinated by dates.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ10. In a social group, I can easily keep track of several different people's conversations.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ11. I find social situations easy.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ12. I tend to notice details that others do not.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ13. I would rather go to a library than a party.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ14. I find making up stories easy.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ15. I find myself drawn more strongly to people than to things.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ16. I tend to have very strong interests which I get upset about if I can't pursue.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ17. I enjoy social chit-chat

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ18. When I talk, it isn't always easy for others to get a word in edgeways.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ19. I am fascinated by numbers

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ20. When I'm reading a story, I find it difficult to work out the characters' intentions.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ21. I don't particularly enjoy reading fiction.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ22. I find it hard to make new friends.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ23. I notice patterns in things all the time.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ24. I would rather go to the theatre than a museum

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ25. It does not upset me if my daily routine is disturbed.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ26. I frequently find that I don't know how to keep a conversation going.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ27. I find it easy to "read between the lines" when someone is talking to me.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ28. I usually concentrate more on the whole picture, rather than the small details.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ29. I am not very good at remembering phone numbers.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ30. I don't usually notice small changes in a situation, or a person's appearance.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ31. I know how to tell if someone listening to me is getting bored.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ32. I find it easy to do more than one thing at once.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ33. When I talk on the phone, I'm not sure when it's my turn to speak.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ34. I enjoy doing things spontaneously.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ35. I am often the last to understand the point of a joke.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ36. I find it easy to work out what someone is thinking or feeling just by looking at their face.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ37. If there is an interruption, I can switch back to what I was doing very quickly.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ38. I am good at social chit-chat.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ39. People often tell me that I keep going on and on about the same thing.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ40. When I was young, I used to enjoy playing games involving pretending with other children.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ41. I like to collect information about categories of things (e.g. types of cars, types of birds, types of trains, types of plants, etc.)

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ42. I find it difficult to imagine what it would be like to be someone else.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ43. I like to plan any activities I participate in carefully.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ44. I enjoy social occasions

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ45. I find it difficult to work out people's intentions.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ46. New situations make me anxious.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ47. I enjoy meeting new people.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ48. I am a good diplomat.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ49. I am not very good at remembering people's date of birth

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

AQ50. I find it very easy to play games with children that involve pretending.

Definitely Agree Slightly Agree Slightly Disagree Definitely Disagree

Emotional Intelligence

EQ1. I can easily tell if someone else wants to enter a conversation.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ2. I prefer animals to humans.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ3. I try to keep up with the current trends and fashions.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ4. I find it difficult to explain to other things that I understand easily, when they don't understand it the first time.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ5. I dream most nights.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ6. I really enjoy caring for other people.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ7. I try to solve my own problems rather than discussing them with others.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ8. I find it hard to know what to do in a social situation.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ9. I am at my best first thing in the morning.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ10. People often tell me that I went too far in driving my point home in a discussion.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ11. It doesn't bother me too much if I am late meeting a friend.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ12. Friendships and relationships are just too difficult, so I tend to not to bother with them.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ13. I would never break a law, no matter how minor.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ14. I often find it difficult to judge if something is rude or polite.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ15. In a conversation, I tend to focus on my own thoughts rather than on what my listener might be thinking.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ16. I prefer practical jokes to verbal humor.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ17. I live life for today rather than the future.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ18. When I was a child, I enjoyed cutting up worms to see what would happen.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ19. I can pick up quickly if someone says one thing but means another.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ20. I tend to have very strong opinions about morality.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ21. It is hard for me to see why some things upset people so much.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ22. I find it easy to put myself in somebody else's shoes

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ23. I think that good manners are the most important thing a parent can teach their child.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ24. I like to do things on the spur of the moment.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ25. I am good at predicting how someone will feel.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ26. I am quick to spot when someone in a group is feeling awkward or uncomfortable

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ27. If I say something that someone else is offended by, I think that that's their problem, not mine.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ28. If anyone asked me if I liked their haircut, I would reply truthfully, even if I didn't like it.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ29. I can't always see why someone should have felt offended by a remark.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ30. People often tell me that I am very unpredictable.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ31. I enjoy being the centre of attention at any social gathering.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ32. Seeing people cry doesn't really upset me.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ33. I enjoy having discussions about politics.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ34. I am very blunt, which some people take to be rudeness, even though this is unintentional.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ35. I don't tend to find social situations confusing.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ36. Other people tell me I am good at understanding how they are feeling and what they are thinking.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ37. When I talk to people, I tend to talk about their experiences rather than my own.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ38. It upsets me to see an animal in pain.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ39. I am able to make decisions without being influenced by people's feelings.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ40. I can't relax until I have done everything I had planned to do that day.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ41. I can get upset if I see people suffering on news programs.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ42. Friends usually talk to me about their problems as they say that I am very understanding.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ43. Friends usually talk to me about their problems as they say that I am very understanding.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ44. I can sense if I am intruding, even if the other person doesn't tell me.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ45. I often start new hobbies but quickly become bored with them and move on to something else.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ46. People sometimes tell me that I have gone too far with teasing.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ47. I would be too nervous to go on a big rollercoaster.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ48. Other people often say that I am insensitive, though I don't always see why.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ49. If I see a stranger in a group, I think that it is up to them to make an effort to join in.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ50. I usually stay emotionally detached when watching a film.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ51. I like to be very organized in day to day life and often make lists of the chores I have to do.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ52. I can tune into how someone else feels rapidly and intuitively.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ53. I don't like to take risks.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ54. I can easily work out what another person might want to talk about.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ55. I can tell if someone is masking their true emotion.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ56. Before making a decision I always weigh up the pros and cons

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ57. I don't consciously work out the rules of social situations

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ58. I am good at predicting what someone will do.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ59. I tend to get emotionally involved with a friend's problems.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

EQ60. I can usually appreciate the other person's viewpoint, even if I don't agree with it.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

Systems Thinking

SQ1. I find it very easy to use train timetables, even if this involves several connections.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ2. I like music or book shops because they are clearly organized.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ3. I would not enjoy organizing events e.g. fundraising evenings, fetes, conferences.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ4. When I read something, I always notice whether it is grammatically correct.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ5. I find myself categorizing people into types (in my own mind)

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ6. I find it difficult to read and understand maps.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ7. When I look at a mountain, I think about how precisely it was formed.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ8. I am not interested in the details of exchange rates, interest rates, stocks and shares.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ9. If I were buying a car, I would want to obtain specific information about its engine capacity.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ10. I find it difficult to learn how to programme video recorders.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ11. When I like something I like to collect a lot of different examples of that type of object, so I can see how they differ from each other.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ12. When I learn a language, I become intrigued by its grammatical rules.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ13. I like to know how committees are structured in terms of who the different committee members represent or what their functions are.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ14. If I had a collection (e.g. CDs, coins, stamps), it would be highly organized.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ15. I find it difficult to understand instruction manuals for putting appliances together.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ16. When I look at a building, I am curious about the precise way it was constructed.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ17. I am not interested in understanding how wireless communication works (e.g. mobile phones)

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ18. When travelling by train, I often wonder exactly how the rail networks are coordinated.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ19. I enjoy looking through catalogues of products to see the details of each product and how it compares to others.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ20. Whenever I run out of something at home, I always add it to a shopping list.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ21. I know, with reasonable accuracy, how much money has come in and gone out of my bank account this month.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ22. When I was young, I did not enjoy collecting sets of things e.g. stickers, football cards, etc.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ23. I am interested in my family tree and in understanding how everyone is related to each other in the family.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ24. When I learn about historical events, I do not focus on exact dates.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ25. I find it easy to grasp exactly how odds work in betting.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ26. I do not enjoy games that involve a high degree of strategy (e.g. chess, Risk, Games Workshop)

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ27. When I learn about a new category I like to go into detail to understand the small differences between different members of that category.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ28. I do not find it distressing if people who live with me upset my routines.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ29. When I look at an animal, I like to know the precise species it belongs to.

- Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ30. I can remember large amounts of information about a topic that interests me e.g. flags of the world, airline logos.

- Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ31. At home, I do not carefully file all important documents e.g. guarantee insurance policies.

- Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ32. I am fascinated by how machines work.

- Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ33. When I look at a piece of furniture, I do not notice the details of how it was constructed.

- Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ34. I know very little about the different stages of the legislation process in my country.

- Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ35. I do not tend to watch science documentaries on television or read articles about science and nature.

- Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ36. If someone stops to ask me the way, I'd be able to give directions to any part of my home town.

- Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ37. When I look at a painting, I do not usually think about the technique involved in making it.

- Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ38. I prefer social interactions that are structured around a clear activity, e.g. a hobby.

- Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ39. I do not always check off receipts etc. against my bank statement.

- Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ40. I am not interested in how the government is organized into different ministries and departments.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ41. I am interested in knowing the path a river takes from its source to the sea.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ42. I have a large collection e.g. of books, CDs, videos etc.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ43. If there was a problem with the electrical wiring in my home, I'd be able to fix it myself.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ44. My clothes are not carefully organized into different types in my wardrobe.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ45. I rarely read articles or webpages about new technology.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ46. I can easily visualize how the motorways in my region link up.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ47. When an election is being held, I am not interested in the results for each constituency.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ48. I do not particularly enjoy learning about facts and figures in history.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ49. I do not tend to remember people's birthdays (in terms of which day and month this falls).

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ50. When I am walking in the country, I am curious about how the various kinds of trees differ.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ51. I find it difficult to understand information the bank sends me on different investment and saving systems.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ52. If I were buying a camera, I would not look carefully into the quality of the lens.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ53. If I were buying a computer, I would want to know exact details about its hard drive capacity and processor speed.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ54. I do not read legal documents very carefully

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ55. When I get to the checkout at a supermarket, I pack different categories of goods into separate bags.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ56. I do not follow any particular system when I'm cleaning at home.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ57. I do not enjoy in-depth political discussions.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ58. I am not very meticulous when I carry out D.I.Y. or home improvements.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ59. I would not enjoy planning a business from scratch to completion.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ60. If I were buying a stereo, I would want to know about its precise technical features.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ61. I tend to keep things that other people might throw away, in case they might be useful for something in the future.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ62. I avoid situations which I cannot control.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ63. I do not care to know the names of plants I see.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ64. When I hear the weather forecast, I am not very interested in the meteorological patterns.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ65. It does not bother me if things in the house are not in their proper place.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ66. In mathematics, I am intrigued by rules and patterns governing numbers.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ67. I find it difficult to learn my way around a new city.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ68. I could list my favourite 10 books, recalling titles and authors' names from memory.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ69. When I read the newspaper, I am drawn to tables of information, such as football league scores or stock market indices.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ70. When I'm in a plane, I do not think about the aerodynamics.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ71. I do not keep careful records of my household bills.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ72. When I have a lot of shopping to do, I like to plan which shops I am going to visit and in what order.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ73. When I cook, I do not think about exactly how different methods and ingredients contribute to the final product

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ74. When I listen to a piece of music, I always notice the way it's structured.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

SQ75. I could generate a list of my favourite 10 songs from memory, including the title and the artist's name who performed each song.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

Leadership

MACH1. Never tell anyone the real reason you did something unless it is useful to do so.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

MACH2. The best way to handle people is to tell them what they want to hear.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

MACH3. One should take action only when sure it is morally right.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

MACH4. Most people are basically good and kind.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

MACH5. It is safest to assume that all people have a vicious streak and it will come out when they are given a chance.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

MACH6. Honesty is the best policy in all cases.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

MACH7. There is no excuse for lying to someone else.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

MACH8. Generally speaking, people won't work hard unless they're forced to do so.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

MACH9. All in all, it is better to be humble and honest than to be important and dishonest.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

MACH10. When you ask someone to do something for you, it is best to give the real reasons for wanting it rather than giving reasons which carry more weight.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

MACH11. Most people who get ahead in the world lead clean, moral lives.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

MACH12. Anyone who completely trusts anyone else is asking for trouble.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

MACH13. The biggest difference between most criminals and other people is that the criminals are stupid enough to get caught.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

MACH14. Most people are brave.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

MACH15. It is wise to flatter important people.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

MACH16. It is possible to be good in all respects.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

MACH17. P.T. Barnum was wrong when he said that there's a sucker born every minute.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

MACH18. It is hard to get ahead without cutting corners here and there.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

MACH19. People suffering from incurable diseases should have the choice of being put painlessly to death.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

MACH20. Most people forget more easily the death of their parents than the loss of their property.

Strongly Agree Slightly Agree Slightly Disagree Strongly Disagree

APPENDIX H

PHEROMONE IMAGE APPROVAL

Pheromone Image Approval

PHEROMONE

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