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An action design research on development and deployment of a computer-based group discussion support tool for achieving consensus and culture change at a tertiary educational institution

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An Action Design Research on Development and Deployment
of a Computer-Based Group Discussion Support Tool
for Achieving Consensus and Culture Change
at a Tertiary Educational Institution

by
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Submitted to Lee Kong Chian School of Business in partial fulfilment of the
requirements for the Degree of Master in Business (General Management)

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(ABSTRACT)

Organisational culture change is a long and complex process that typically takes years to complete and has a very low success rate. This Action Design Research Study in an educational setting, addresses the problem by the proposed use of an Action Design Research Methodology to build and deploy an IT artifact named Organisational Culture Assessment Instrument-Spilter (OCAI-Spilter) to speed up cultural change while reducing failure rate. OCAI-Spilter should be able to fast-track culture change by addressing the problem of scalability and process losses encountered in most change projects involving large numbers of people. We deploy an iterative prototyping process using Component Based Software Development to continuously refine the tool in use. We also reviewed the design principles in Action Design Research to improve the usability of the tool. New design principles and learning were derived from this process. Finally, we showed the effectiveness of the artifact by measuring the results of the tool in use through culture surveys and alignment, as well as idea generation that was administered through the tool.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1: INTRODUCTION

1.1 Problem context and Background of Study

Culture change is a long and complex process that can take years to complete. Most current manual methods for culture change are long and tedious and their success rates typically low. (Smith, 2003) reported that only 10-32% of companies in transformation attain the desired cultural shift. (Baker, 2002) stated that cultural change "is not easy to achieve; it is a difficult, complicated, demanding effort that can take several years to accomplish."

In this case study of a tertiary educational institution, we will demonstrate how through the use of an IT artifact, we were able to reduce the long process time it took to manage culture alignment and change. The educational institution in this study is the Singapore University of Technology and Design(SUTD). SUTD has a vision to introduce disruptive change and innovation to the traditional engineering education that is typically offered. As a result of this innovative vision, the institution is offering non-traditional engineering degrees with a multi-disciplinary focus. No traditional schools, faculties, or departments exist in this structure, but instead the concept of pillars of specialisation dominate the key educational foundation of the university. These pillars interact through the key themes of research and design. There is multi-disciplinary collaboration across specialisations. The pillars are managed by a "pillar head" instead of a "dean". The purpose of this management structure is to prevent territorial delineation. Administrators, faculty, students, and researchers work together to achieve the mission and vision. In such a dynamic organisation, culture becomes important as we need the right culture to foster the type of innovation that is required for it to be successful.

Despite having an innovative vision, most key stakeholders, (students, academic and administrative management, faculty and staff) may have been brought up and have been successful in a traditional university environment. They carry with them the assumptions and values, that is, the culture that helped them survive and succeed in a traditional university environment. Under work and promotion pressure it would be easy for them to revert back to a traditional university culture.

In creating a university with such a unique vision and mission, and with a fragile culture that is always in the danger of reverting back to the traditional university culture, the development and integration of a strong organisational culture that is consistent with its vision, becomes important. The development of this strong unifying culture is important because students, faculty and staff come from different disciplinary, national, cultural, and institutional origins and from diverse academic backgrounds. In Clayton Christenson's book, The Innovative University, the author noticed that in the spirit of honouring tradition, universities hang on to past practices to the point of imperilling their futures. They do not reinvent their curriculum to better prepare students for the increasing demands of the world of work. (Christensen and Eyring, 2011, pg xxii) SUTD's culture journey is in another sense, synonymous with the journey that today's universities must undertake to transform themselves in order to meet the expectations of the changing world.

1.2 Definition of Culture and its importance

Cameron & Quinn (2011) defined organisational culture as, "the taken-for-granted values, underlying assumptions, expectations, and definitions that characterize organisations and their members. It is an enduring slow-to-change core characteristic of organisations" (Kim S. Cameron & Quinn, 2011). Fralinger & Olson, (2011) state that at the university level, culture can be defined as the values and beliefs of university stakeholders, based on

tradition, and communicated either verbally or nonverbally. The beliefs and practices of the university community, including trustees, senior administrators, faculty and students, combined to fundamentally shape the effectiveness of the university. A strong and well defined culture helps to pave the way for stakeholders to align their actions towards achieving the organisation's vision and objectives.

It is therefore important to have a common understanding of shared beliefs, and through this understanding, obtain cultural alignment to achieve the mission and vision of the organisation. This common understanding is reinforced by Van den Berg & Wilderom's (2004) notion of culture as "shared" perceptions of organisational work practices within organisational units. Given that these are shared perceptions; it is important that members of the organisation participate in the process of agreeing upon their perceptions of the current culture; define their desirable cultures, and share these perceptions.

These cultures may differ across organisational units. Therefore, it is important that we identify the perceptions of the key stakeholders in various units (academic and administrative management, faculty, staff, and students) about the institution's current and desired cultures. If the current culture is found to be different from the organisational culture underlying the desired vision, we need to undertake an organisation culture change exercise. As there are a relatively large number of academic and administrative management, faculty members, staff, and students, we need an organisational culture change process and an organisational culture assessment tool that can be scaled up to measure, assess and change the culture of large groups of stakeholders.

Culture change projects are typically complex and subject to process losses that can occur in large deliberation sessions that prohibit problem solving. Process losses are aspects of group interactions that might inhibit problem solving. It is typically exemplified in factors such as failure to remember, conformance pressure, concentration blocking, dominion, slower feedback, ambiguity and evaluation apprehension, to name a few. (Nunamaker, et al 1991)

The purpose of this thesis is thus to develop a scalable digital organisational culture measurement instrument and a tool and methodology for cultural change that is both scalable and at the same time, ameliorates process losses. One of the key ingredients in the culture change process is participation from all levels of staff in the organisation. Clear participation helps to ensure that groups or individuals are able to fully subscribe to an understanding of the current culture and commit to the desired culture and the means to attain it. It is important to develop and use a discussion tool that allows various members of the stakeholder groups, and the groups themselves, to participate in and collectively influence this process of discussion. In the use of this tool, all stakeholder groups should be able to provide their input, and groups and members of the group should feel that they are being heard.

1.3 Significance of Study

This study is significant because while there are many culture-related tools available in the market, most of these tools only measure culture and do not have the ability to allow for effective and efficient group discussions and their follow up action plans to change culture. These discussions are necessary to reach a common understanding and participatory group decision making that is necessary for alignment and potential consensus building.   We also

see a lack of such an integrated tool in research. Many culture change projects still need a great deal of manual intervention after the culture survey is conducted. Marcella Bremer, in her book on "Organisational Culture Change", details the steps she takes in facilitating change conversations. Each change workshop takes 2 days and can only be facilitated in groups of 10. (Bremer, 2012) This process will take a great deal of time to cover large groups. If we are able to develop a tool and a methodology that can be used to not only measure current and desired cultures, but at the same time replace the manual sessions with an on-line discussion platform that can reach large groups of people to enable decision-making, it would speed up the process of culture change. We see the value and novelty in this approach with the integration of a culture tool and digital group discussion platform to effect culture change. Currently, while there are many culture-related tools available in the market, most of these tools only measure culture, and do not have the ability to allow for effective and efficient group discussions. These discussions are necessary to reach a common understanding and participatory group decision making that is necessary for alignment and potential consensus building.

1.3.1 Organisational Culture Framework and Participatory Discussions. To facilitate the group discussion process, we first need to establish a culture framework that is able to assist us to measure the current and desired culture. In this research, we use the Cameron and Quinn's Competing Values Framework (CVF) as the underlying theoretical framework for our research. The selection of this culture tool is explained in Chapter 2, Section 2.1.1. Cameron and Quinn used the CVF framework to develop the organizational culture assessment instrument (OCAI). Consequently this framework is used as a basis for selecting the Organisational Culture Measurement Instrument (OCAI), which is our instrument of choice for measuring organizational culture. OCAI profiles will possess face validity in our

culture assessment and change exercise. The OCAI-CVF measures and represents an organisation's cultural profile as scores along four quadrants: adhocracy; clan; hierarchy; and market. The first two quadrants, adhocracy (innovative) and clan (collaborate), emphasize flexibility, discretion and dynamism, while the other quadrant, "hierarchy" (control) and "market" (compete) emphasize stability, order and control. The continuum ranges from organisational versatility and pliability on one end to organisational steadiness and durability on the other end. (Cameron & Quinn, page 38, 2011) The two quadrants for measuring adhocracy (innovation and creativity), and clan (teamwork and collaboration), are aligned with the vision of SUTD which emphasizes innovation and creativity achieved through teamwork and collaboration. In order to promote the institution's vision, we will need to move its culture to higher scores on the adhocracy and clan quadrants, while continuing to reduce the hierarchy, control and market orientation cultures.

To realize the vision of SUTD, culture change is necessary to align key stakeholders such as senior management, faculty members, staff and students to the desired culture of innovation and collegiality, (adhocracy and clan culture types in Cameron and Quinn's competing values framework. (Cameron and Quinn, 2011) Levin & Gottlieb (2009) state that any "successful organisational cultural realignment efforts must begin with reaching agreement among senior leaders and key stakeholder groups about the preferred future culture required to successfully help achieve business goals and implement planned changes." In addition, broad based meaningful engagement and participation across business units, functions and levels is a key mechanism for mobilizing and building ownership and commitment. The research of Coch and French Jr., (1948) shows that people more readily commit to change with enthusiasm and are willing to help enact it when they have had the opportunity to understand its rationale, have their voice heard, and are provided concrete

ways to contribute to its design and implementation (Axelrod & Cohen, 2000; Kotter, 1996). Cultural realignment efforts, should not just be imposed from the top, they need to tap into the wisdom and talents of all organisational members.

Finally, Cameron and Quinn (2011, p. 102) also further reinforce that organisational culture change is a "group process," requiring buy-in from the members of the organisation"– both regarding their perception of the organisations current cultural profile; and its desired cultural profile. The difference between the common understanding of the current and preferred profiles in turn influences the steps the organisation needs to take to move from the current to the desired cultures.

1.4 <u>Objective of Study</u>

Our Research aims were thus to develop a group discussion tool and a methodology to:

a. Measure and make explicit the perceived current and desired cultures of each stakeholder group.

b. To allow a platform for all stakeholder groups such senior management, faculty, administrative staff, and students, to be able reach an inter-group agreement or a consensus understanding of the current and desired cultures

c. Based upon this inter-group consensus to identify the differences or gaps between the consensus current and desired cultures for each group.

d. To collectively discuss and come to an agreement about the possible means of reducing these gaps between current and desired cultures

The tool that we developed was used to:

a. Collect, group, summarize, graph and report culture survey data from multiple participants;

b. Support group discussion and decision-making at both intra and inter group levels for arriving at a consensus and agreed culture-change measures

The effectiveness of this tool can only be assessed and iteratively developed by the "tool-in-use." Therefore, while our research objective was the development of a computer-assisted measurement, representation, and group discussion support tool, it is also important to evaluate the usefulness of this tool, and gradually improve it in real live "use conditions". In the development of this tool we followed a prototyping process and employed the use of group decision support systems (GDSS) in the development. Research has repeatedly pointed out (Valacich, Dennis, & Connolly, 1994) that GDSS technology has tremendous potential for improving group performance. Based upon this previous research, our assertion is that GDSS technology can be used for culture change and consensus building. Moreover, the GDSS technology can support the purported culture tool by increasing its scalability and ameliorate its current shortcomings of process losses. We followed an action design research (ADR) methodology for the research project. The ADR methodology integrates the development of an artifact (Design Research), and the use of this artifact for organisational action (Action Research). It deals with two seemingly disparate challenges:

1. Addressing a problem situation encountered in a specific organizational setting by intervening and evaluating; and

2. Constructing and evaluating an IT artifact that addresses the class of problems typified by the encountered situation (Sein, Henfridsson, Sandeep, Rossi, & Lindgren, 2011).

The generic ADR Methodology is described in Chapter II (Literature Review) and the detailed (and adapted) ADR methodology used in this thesis is described in Chapter 3 "Research Methodology"

1.5 <u>Research Outcomes</u>

The research produced two key outcomes.

1. First, we produced a computer-based (software) artifact that supports the process steps a to d as previously outlined above.

2. Second, it has resulted in Design Principles and Design knowledge about using OCAI and organisational culture change in large organisational group of stake-holders.

1.6 <u>Contributions of Research to Practice and Academia</u>

This research contributes to practice as currently there are no tools in the market that can help speed up culture change. Most of the culture change currently being executed in organisations is long and tedious and takes years to complete. The advent of a culture change tool that can reduce process losses, and speed up change will capture the interest of many organisations who will find this an invaluable resource to help align employees to achieve change in a rapidly globalised world.

In academia, the design principles and ideas picked up from designing the artifact can be used as learning points to develop future tools for cultural change and organisational intervention. The ideas can also be used in research pertaining to human resource development and organisation development involving large groups of people.

CHAPTER 2: BACKGROUND OF STUDY – LITERATURE REVIEW

Our literature review will focus on four key topics, Organisation Culture and Organisational Culture Assessment Instrument (OCAI), Group Decision Support Systems, Action Design Research and Prototyping. The literature review will be used to gather the requirements for the development of the tool.

2.1 Organization Culture and OCAI

Cameron and Quinn (2011) define organisational culture as, "the taken-for-granted values, underlying assumptions, expectations, and definitions that characterize organisations and their members. It is an enduring slow-to-change core characteristic of organisations" (Cameron and Quinn, 2011). As an organisation's culture is an enduring, slow-to-change characteristic. In this research we are only focusing on the development and testing of a computer-based artifact; the process of culture change is beyond the scope of this Masters Thesis.

For the credibility and effectiveness of this process, it becomes especially important that members of the organisation fully participate in the process of measurement and discussions about the current and desired organisational cultures and the means of changing the current to desired culture. Van den Berg and Wilderom (2004) in their paper on defining, measuring, and comparing organisational cultures, define culture as "shared" perceptions of organisational work practices within organisational units. Given that these are shared perceptions; it is important that members of the organisation participate in the process of

agreeing upon their perceptions of the current culture; and their desirable cultures, and share their perceptions.

Schein on the other hand, calls organisational culture as "the pattern of basic assumptions that a given group has invented, discovered, or developed in learning to cope with its problems of external adaptation and internal integration, and that have worked well enough to be considered valid, and, therefore, to be taught to new members as the correct way to perceive, think and feel in relation to those problems." (Schein 2004) The invention and discovery process comes about through joint discussion and construction of the perceptions of culture. Thus, in our culture change process, we will be devising ways for working with stakeholders to align the group-patterns of basic assumptions to that of the desired organisational culture. To begin the process of culture change, it is important to understand the collective thought processes of the organisation by measuring the current culture of an organisation and comparing it to the desired organisational culture. From there, we assess the culture gap, and work through change programs to close the gap between current and desired culture. This requires the use of an organisational assessment cultural tool. We begin the next section by assessing the types of organisational culture measurement tools available.

2.1.1   Measuring Organisational Culture. Next, we review the current management literature for the types of tools used for measuring culture. In Table 1 below, we have included a total of eight popular instruments (Scott et al., 2003) with a short write up and description of the tool. They are subsequently reviewed with the following criteria to identify the most suitable one for our research: The criteria are:

1.   The instrument should have good face validity

2. It should measure current and desired culture

3. It must be easily administered, allows for easy automation, and is cost effective

4. Relevant to the education industry

5. Cultural Dimensions has congruence to the goals of SUTD in promoting a culture of innovation and collaboration

Table 1. Comparison of culture survey instruments:

Name and Key Reference	Culture Dimensions	Nature of Scale	Strengths, Usability, Relevance	Limitations/Reliability and Validity
Competing Values Framework (K. Cameron & Freeman, 1991; M. B. Gerowitz, 1998; M. L. Gerowitz, Lemieux-Charles, Heginbothan, & Johnson, 1996)	Key Dimensions are staff climate, leadership style, bonding systems, prioritization of goals. Assessment results in four culture types, described as: **clan, adhocracy, market and hierarchical culture types.**	Brief scenarios describe dominant characteristics of each type. Respondents divide 100 points between these scenarios depending on how similar each scenario is to own organisation	**Simple and quick to complete**, **high face validity,** strong theoretical basis, assess both congruence and strength of culture and developed **mainly for use in educational settings. Measures both current and desired culture**	Narrow definition. Tested on 10,000 executives in 1000 business. Tests by Quinn & Spreitzer, (1991) showed coefficients at .74 for clan culture, .79 for adhocracy culture, .73 for hierarchy culture and .71 for market culture
Organisational Culture Inventory (Cooke & Lafferty, 2012; Ingersoll, Kirsch, Merk, & Lightfoot, 2000; Seago, 1997; Thomas, Ward, Chorba, & Kumiega, 1990)	Shared norms and expectations that guide thinking and behaviour of group members, resulting in 12 thinking styles of individuals within a group; humanistic, helpful, affiliate, approval, conventional, dependent, avoidance, oppositional, power competitive, perfectionistic, achievement,	5 point Likert scale	**Good face validity, widely used, graphic illustration of results**	Analysis result in limited number of aspects of culture Long and complex to complete, under copyright and may be expensive to use. Tested on 6,444 members from 1090 organisational units

	self-actualization. Analysis of these 12 styles result in three factors- people/security culture, satisfaction culture and task/security culture			
Harrison's Organisational Ideology Questionnaire (Camburn et al., 2013; Harrison, 1972; Litwinenko & Cooper, 1994)	Assess ideology of organisation in terms of orientation to power, roles, tasks and individuals	Respondents rank four statements in each item in terms of how representative they are of (a) the organisation and (b) the respondents own attitudes and beliefs	**Good face validity, addresses both existing and preferred culture**	Limited number of culture types
Mackenzie's culture Questionnaire (MacKenzie, 1995)	Employee commitment, attitudes to and belief about innovation, attitudes of change, style of conflict resolution, management style, confidence in leadership openness and trust, teamwork and cooperation, action orientation, human resource orientation, consumer orientation, organisational direction	Respondents state each statement which they feel is broadly true of their organisation	**Simple to complete**	Designed to assess only specific business units within an organisation
Survey of organisational culture (Tucker, McCoy, & Evans, 1990)	Describes culture in terms of 13 dimensions, orientation to customers, orientation to employees, congruence amongst stakeholders, impact of mission,	5 point scale	Detailed qualitative work conducted as part of development, **has been used in public and private sector**	Used in range of health and non-health organisation

	managerial depth/maturity, decision making/autonomy, communication/openness, human scale, incentive/motivation cooperation versus competition, organisational congruence, performance under pressure, theory S/theory T			
Corporate culture Questionnaire (Walker, Symon, & Davies, 1996)	Four principal domains: performance, human resources, decision making, and relationships	5-point Likert scale	instruments, comprehensive	Long and difficult to complete
Hofstede's Organisational Culture Questionnaire (Hofstede, Neuijen, Ohayv, & Sanders, 1990)	Based on three values, need for security, importance of work and need for authority, Within these, there are 6 factors relating to practice issues; process vs. outcome, employee vs. task, parochial vs. professional, open vs. closed system, loose vs tight control, normative vs. pragmatic	5 point Likert scale	**Good theoretical basis and face validity of values and practical issues**	Not widely used in English speaking countries
Organisational Culture Survey (Glaser, Zamanou, & Hacker, 1987)	Addresses six empirical factors: **teamwork** and conflict, climate and morale, information flow, involvement, supervision, meetings.	5 point Likert scale	**Easy to use, comprehensive process of development**	Address only superficial issues.

Adapted from "The Quantitative Measurement of Organizational Culture in Health Care: A review of the available Instruments:

The above table summarises many of the key culture instruments and their characteristics. A quick review of the table points to OCAI as our most appropriate choice of instrument as it meets all the five criteria that are listed above. The OCAI has strong face validity, is easy to use and administer, measures both the current and desired culture, and is relevant to the education industry. In addition, the adhocracy and the clan quadrants of the culture instrument reflect and integrate well with the innovation and multi-disciplinary culture that this institution is trying to promote.

Kim S. Cameron and Quinn, (2011) also showed that the OCAI has a strong theoretical basis and accesses both congruence and strength of culture. This has been proven by the extensive testing done by Cameron and Freeman (1991) in a study that encompassed four year colleges and universities (n=334) in the US that covers 3,406 participants.

2.1.2 The Competing Values Framework (CVF). After evaluating the above table, we chose the Competing Values Framework, and its associated culture measurement tool OCAI suitable for our purpose of bringing about an innovation and collaboration-oriented culture change at SUTD. The CVF/OCAI classifies organisations into four quadrants: clan, hierarchy, market, and adhocracy. It does so, based upon allocating 100 points among these four quadrants for six-dimensions or six facets of the organisation (Cameron and Quinn, 2011).

In this study, therefore, we used the theoretical model—of culture, the CVF and its associated culture assessment instrument Organizational Culture Assessment Instrument (OCAI). The CVF framework is based on a statistical analysis of the key indicators of organisational effectiveness proposed by Campbell, Personnel Decisions, Navy Personnel Research and Development Center, & United States National Technical Information Services

(1974). It is formulated on the basis of fundamental assumptions about how organisations work and how they are managed. CVF and its associated OCAI describe and assess organisational culture at micro (individual) and meta (organizational) levels.

CVF is based upon the work by Quinn and Rohrbaugh (1983) on organisational effectiveness indicators. Quinn & Rohrbaugh (1983) analysed these organisational effectiveness indicators and organised them into four main clusters along two major dimensions. One dimension differentiates effectiveness criteria that emphasize organisational flexibility, discretion and dynamism verses criteria that emphasize stability, order and control. Thus, the first continuum ranges from organisational versatility and pliability (Flexibility and Discretion) on one end to organisational steadiness and durability (Stability and Control) on the other.

The second continuum ranges from organisational cohesion and consonance on the one end (Internal Focus and Integration) to organisational separation or differentiation and independence on the other (External Focus and Differentiation).

Cameron and Quinn (2011) name the four quadrants produced by the intersection of these two dimensions: *clan, hierarchy, market and adhocracy* (see Figure 1). It is important to recognize that Cameron & Quinn state that all organisations have some characteristics of each of these four archetypes. However different organisations can be differentiated by dominance of one or more of these archetypes.

The **clan** archetype is like an extended family where members work with each other based on internal focus, agility, and flexibility. In William Ouchi's work on markets, bureaucracies and clans (Ouchi, 1980), likened a clan culture as displaying a high degree of goal congruence, typically through relatively complete socialization brought about by high inclusion. Clan organisations also produces a strong sense of community. A **hierarchy** on the other hand, is characterized by a formalized and structured place to work and is attuned

towards stability with an internal focus. The **market** form is based on transaction costs as foundation of organisational effectiveness and it promotes an external stability-oriented focus. **Adhocracy** refers to a temporary, specialized dynamic unit, focused externally and on agility and flexibility. Adhocracy is based on the assumption that innovation and creativity leads to success. Cameron and Quinn (2011) explained that adhocracies do not have centralized power or authority relationships. Power flows from individual to individual or from task team to task team, depending on what problems are being addressed. Emphasis on individuality, risk taking, and anticipating the future is high as everyone in this type of culture becomes involved in production, testing, research and other matters. This experimentation allows for the generation of new ideas and innovation occurs.
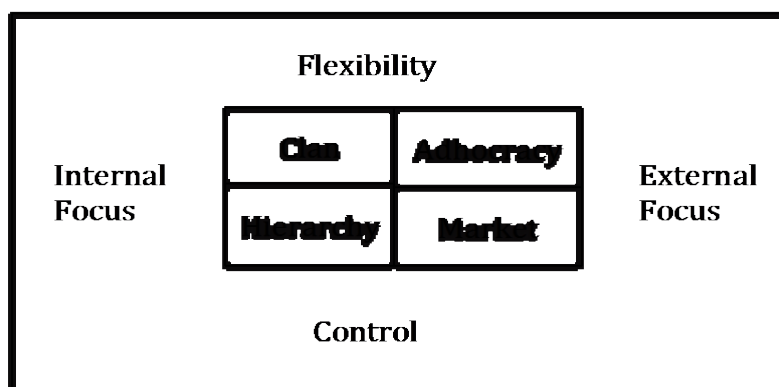
Figure 1. Competing Values Framework (CVF)

As mentioned above, one of the CVF's quadrant is adhocracy or "innovation" Another quadrant is clan (which is characterized by "collaboration"). The vision of SUTD is to promote innovation through collaboration. Therefore, the structure of CVF, and its two quadrants, "adhocracy" and "clan" are consistent with SUTD's vision and objectives (also see chapter 1). Finally the fourth quadrant "market" is compatible with SUTDs desire to be the most effective organisation of its kind. Thus the Competing Values Framework has face-validity for our exercise, and is suitable for measuring the current and desired cultures at SUTD.

2.1.3   The Organisational Culture Assessment Instrument. The Organisational Culture Assessment Instrument (OCAI), designed and validated by Cameron & Quinn (Cameron & Quinn, 2011) is based upon the above Competing Values Framework. It measures the strength of the above four organisational culture types along six content dimensions or six facets of the organisation. These six dimensions are: (1) Dominant Characteristics; (2) Organisational Leadership; (3) Management of Employees; (4) Organisational Glue; (5) Strategic Emphasis; and (6) Criteria for Success.

Each of the six dimensions can be measured along each of the four organisational characteristics (quadrants) thereby creating 24 questions (6 x 4 = 24) in the OCAI instrument. Thus, OCAI includes 24 (4 x 6) items (questions) on which respondent data is collected. An organisation may have scores on each of the four cultural types, just more or less of each. The total scores of each of the six dimensions adds up to 100 points; the 100 points being allocated between four items (A to D) corresponding to each of the four organisational archetypes. Please see a sample of the questionnaire and the scoring in Appendix A. The sum total of responses to all items marked "A" is calculated as clan culture and plotted on the diagonals in the clan quadrant, as shown in Figure 2. Similarly, we plot scores for all other three quadrants, namely hierarchy, market, and adhocracy. Joining the dots (representing total scores) on each diagonal results in a quadrilateral. This quadrilateral represents the cultural profile of an individual within the organization. Individual profiles can be aggregated and averaged to get an organisation's culture profile. An example of an organisation's culture profile is shown in Figure 2. More of the area of the cultural profile in a particular quadrant corresponds to more the dominance of that cultural archetype. The largest score in a quadrant (i.e. the largest score) indicates the dominant culture in the organisation. These cultural

profiles can be plotted separately for each of the six dimensions on the OCAI scale and can be analysed for different demographic variables.
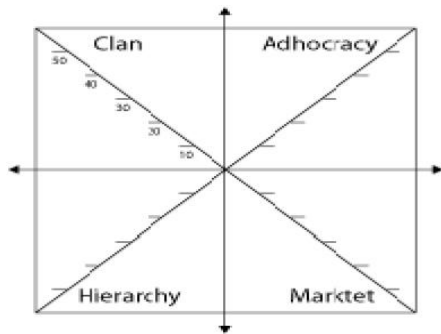
Figure 2. The Four CVF Quadrants.

2.2 <u>Group Decision Support Systems (GDSS) –</u>

(Huber, 1984) was one of the first authors who expounded the need for the use of GDSS systems. He noticed in the early days that, "the need for such group decision support systems, whether designed by the user or by a vendor, is a consequence of the clash of two important forces — the environmentally-imposed demand for more information sharing in organizations and the resistance to still more meetings. Later, (Nunamaker, et al., 1991) observed that electronic meeting systems in the early days were used to directly impact and change the behaviour of groups to improve group effectiveness, efficiency, and satisfaction. This technology results in less process losses, and speeds up group decision making.

A Group Decision Support System (GDSS) is an interactive, computer-based system that helps a group of actors or decision-makers solve problems and make choices. A GDSS is targeted to supporting groups, working together as a group, in analysing problem situations and in performing group decision-making tasks (DeSanctis & Gallupe, 1987; Huber, 1984).

A Decision Room is a type of GDSS discussed extensively in GDSS/EMS literature. A Decision Room refers to the physical arrangement for using a Group DSS. In a single room, workstations are made available to meeting participants for a same-place, same-time meeting. The objective in using a Decision Room is to enhance and improve the group's decision-making process. Technology has advanced substantially since the early papers on this topic and there now exists web technology that can make the decision room virtual without having the entire team doing this in one venue. It is the intention of this research to create a anytime, anyplace group discussion, however, this discussion would be limited to a certain pre-specified duration.

GDSS-Decision Room allows participants to sit together anonymously and have equal air time through using GDSS software. By having equal air time, individual can participate actively in the group's strategic meetings and contribute ideas productively. GDSS reduces process losses through task structure, task support, process structure and process support (Nunamaker et al., 1991). **Task Structure** assists the group to better understand and analyse task information. This is achieved through problem modelling, multi-criteria decision making and other methods. Individual and group OCAI, current and desired profiles and the gaps between them, provides us with easily understood problem models. The ensuing group discussion helps the participants consider multiple aspects of the culture change problem and thus helps in multi-criteria decision making. **Task Support** reduces process losses arising due to incomplete use of information and incomplete task analysis by providing information from previous meetings. As the EMS information is available to all participants, the problems of incomplete information, use and incomplete task analysis are reduced. **Process structure built into the GDSS/EMS** allows for a proper flow of the meeting and thus reduces process losses due to co-ordination problems. Lastly, **process support** allows for parallel

communication, group memory and anonymity. This allows everyone to communicate simultaneously.   Nunamaker et al. (1991) argue that EMS, a channel of communication, in the GDSS, strengthens process support through group memory, anonymity, parallel communication and media effects. Effective communication is achieved through support, task structure and process structure to reduce process losses. An EMS/ GDSS, by making the group discussion available to a large number of people, improves meeting scalability and reduces process losses as follows:

- Parallel communication, as compared to sequential communication, reduces the time required for people to express their opinions, promotes broader input into the meeting process, and reduces the chance that a few people dominate the meeting.

- Anonymity mitigates evaluation apprehension and conformance pressure, so that issues are discussed more candidly.

- Group digital memory (reproduced on the computer screen) enables members to pause and reflect on information and opinions of others during the meeting and serves as a permanent record of what occurred.

- Process structure helps focus the group on key issues and discourages irrelevant digressions and unproductive behaviors, while task support and structure provides information and approaches to analyse it.
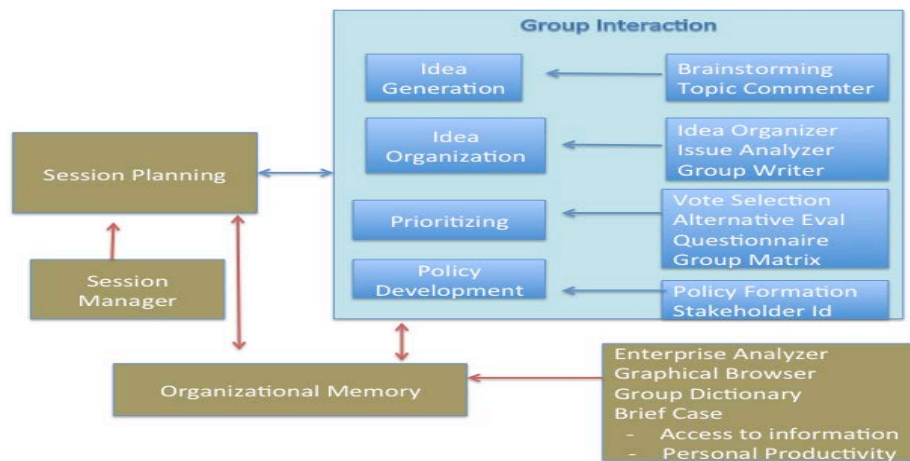
Figure 3: Typical Flow of a GSS Meeting

Since the time of Group Decision Support Systems of the 1980s and 1990s, the group systems in Arizona have evolved into that of web based system named "Think Tank". The system now has the capability of anytime; anywhere function where collaborations can be done for virtually any type of project or planning situation. As a result of new technologies, the use of Decision Rooms may no longer be applicable as many of the GDSS technologies in the present day have moved from the traditional decision rooms to modern day on-line interactive systems that can be accessed anytime and anywhere in the world on a 24 X 7 basis. The many GDSS tools include commercial systems like Think-Tank and Spilter, which are business collaboration tools that allows for professionally facilitated workshops. Others such as Meeting Sphere and Monsoon are more integrated tool kits for everyday online meetings and workshops. In this thesis, we will be using the Spilter tool. Although it has less functionality than Think-Tank, it is simpler for users, is less complex to manage, and has functionality that is sufficient for SUTD use. Our artifact will integrate the state of art internet and web-technology (Spilter) for GDSS/EMS with an organisational culture assessment tool (OCAI). As technology further evolve, (i.e. by the use of cloud-computing) the instrument was modified to employ new technology.

2.3 <u>Action Design Research (ADR) Methodology</u>

In an earlier paper by Cole et al. (2005), the authors observed that IS as a discipline has been accused of having no relevance in the practical world. Research needs to make a dual contribution to academia and practice. Two research methods with this dual orientation are design research and action research. As shown by Ivari and Venable (2007), both of these methodologies though distinct, are closely related and offer unique strengths to the research community. By examining two distinct projects with overlapping AR and DR, they found that the two methods shared important assumptions regarding ontology, epistemology, and axiology.   The authors proposed a model to integrate the two approaches together. Their integrated model involves four ADR steps:

A. **Problem Definition: -** Problem definition in DR and diagnosing the problem in AR

B. **Intervention:** - Similar to the build stage of DR and a combination of the action planning and action taking stage of AR

C. **Evaluation:-** Evaluation of the solution based on the usefulness to the practitioner

D. **Reflection and Learning:-** Abstract knowledge to make a practical and theoretical contribution to the field.

Fast forward to year 2011. In a MIS-Q article, Sein et al. (2011) developed and described a research methodology called action design research methodology (ADR). ADR is a methodology for generating prescriptive design knowledge through building and evaluating ensemble IT artifacts in an organisational setting. Prescriptive knowledge "concerns artifacts designed by humans to improve the natural world" (Gregor & Hevner, 2013). The four types of prescriptive knowledge include constructs, models, instantiations and design theory

(March & Smith, 1995). ADR is in fact, an adaptation of AR and DR and borrows many ideas from the Cole paper authored in 2005.

ADR deals with two seemingly disparate challenges:

1. Addressing a problem situation encountered in a specific organisational setting by intervening and evaluating. A problem situation in the case of this research protocol would be trying to align the organisational culture of an institution amidst the diversity of the members involved, so as to achieve a stated goal.

2. Constructing and evaluating an IT artifact that addresses the class of problems typified by the encountered situation. (Sein et al., 2011).

The class of problems associated with culture change are many and include:

a) low level of participation rate as a result of conflicting work demands and time taken to attend face to face meetings

b) Scalability

c) Process losses

d) Accuracy of information being captured

e) Getting consensus to agree on a desired culture

f) Long lead time

The proposed artifact is both a computer program and a group improvement discussion methodology. The project is an integration of OCAI, a culture assessment instrument to devise organisational change management, with a GDSS/EMS system (Spilter). This research project is an example of action design research. Multiple classes of problems addressed by the OCAI-Spilter integration software include:

a) Low participation rates of stakeholders in a culture change project

b) Process losses encountered during group meetings

c) Low speed of change

d) A lack of cultural alignment between various stakeholder groups

e) Problems with Information capture and display for the measurement and discussion processes

The OCAI-Spilter Integration project covers theory building, solution technology invention, and naturalistic evaluation. Sein et al. (2011) suggested four stages for the ADR method. Adapted from Page 40 -44 (The ADR Method)

1. **Problem Formulation –** identifies and conceptualizes the research opportunity

    a. Practice inspired research: This stage identifies and conceptualizes a research opportunity based on existing theories and technologies. It is practice-inspired research and not only provides for organisational intervention but generates new knowledge

    b. Theory ingrained artifact. This stage structures the problem, identify solution and guides design

2. **Building, Intervention and Evaluation (BIE)** – In this stage, we use the problem framing and theoretical premises adopted in Stage one to develop the initial design of the IT artifact. This artifact was subsequently shaped by organisational use and new design cycle. This phase interweaved the building of the IT artifact, and included intervention in the organisation, and evaluation. The outcome was the realized design of the artifact. There were two end points for the research design continuum in the BIE stage and they were:

    a. IT-Dominant BIE- At the Dominant BIE stage, designers work on the artifact through continuous improvements and user feedback.

      b. Organisation Dominant BIE involves. In the Organisation Dominant BIE stage. the participants' existing ideas and assumptions about the artifact's specific use are challenged to create and improve the design.

3. **Reflection and Learning.** In this stage, we move from reflection and learning to building a solution for a particular instance to them applying that learning to a broader class of problems.

4. **Formalization of learning.** Researchers at this stage outline the accomplishments realized in the IT artifact and describe the organisational outcomes to formalize the learning.
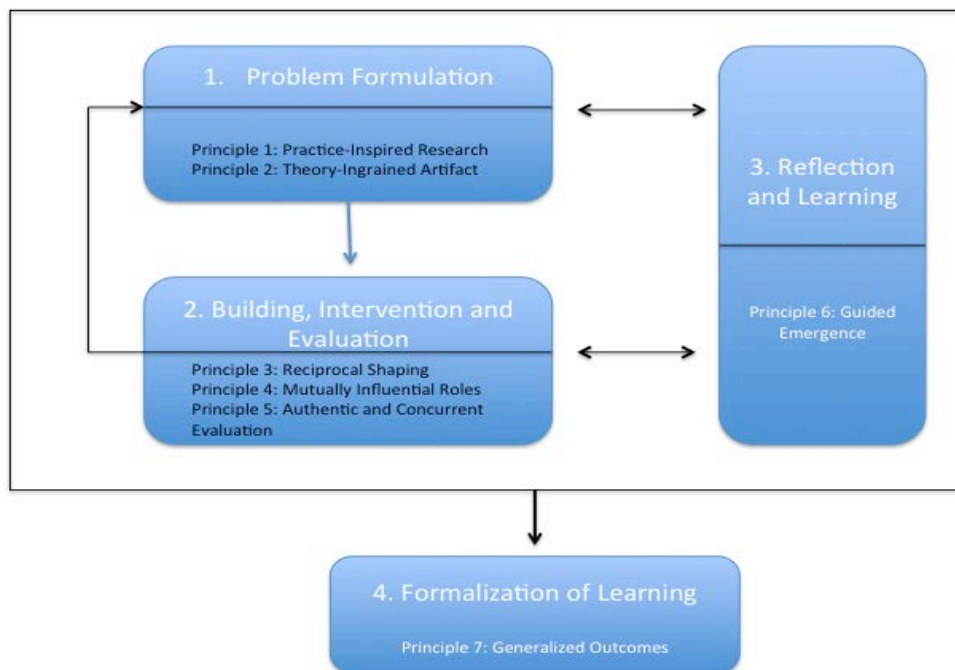
Figure 4. The ADR Method.
(Source: Sein et al. (2011)).

2.4 Prototyping using Component Based Software Development

The integration of OCAI with Spilter is done by developing software to combine the OCAI culture measurement instrument with a internet-based GDSS/EMS tool (Spilter) and testing and improving it in "real-life" use situation. Both the culture change process using this

integrated tool, and the artifact (tool) development process are iterative processes where the prototype artifact and the culture change methodology evolve with feedback from "in-use" evaluation. They are then improved with each version of the research project. In addition to these, we use some elements of component based software development to integrate modules of the OCAI culture tool into the Spilter GDSS system.
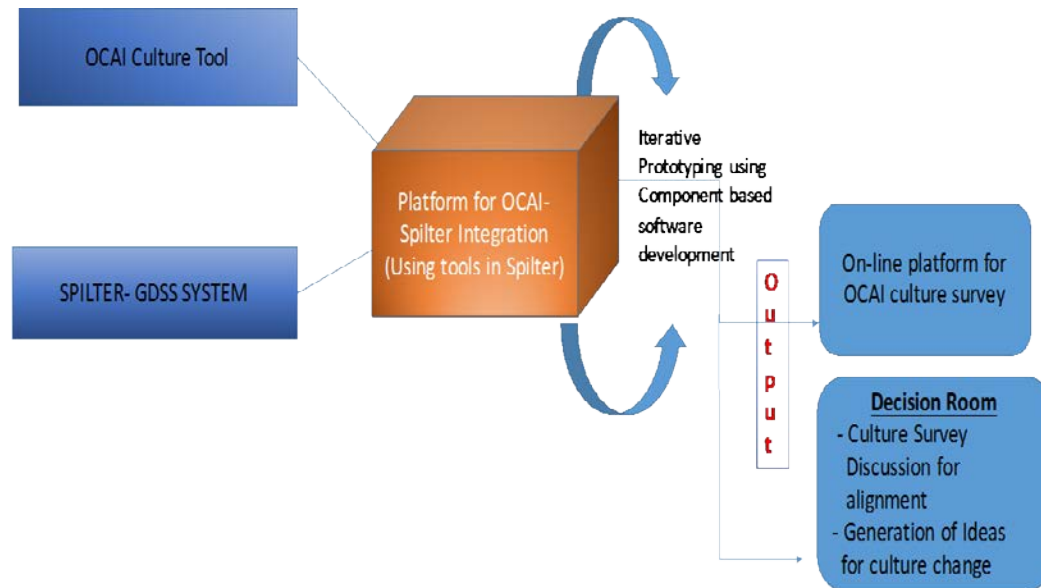
Figure 5: System Architecture of the OCAI-Spilter Artifact

In this literature review, we will examine both the concepts of prototyping and component based software engineering.. We start with prototyping. A prototype is a working model with basic specifications of the artifact or system. While it is used for preliminary demonstration purposes or as a part of the development process, it is only one type of software development- not a crucial part of systems development. In our case we also use the prototype as a continuous production tool for measuring the organisational cultures of various groups, using this measurement as a basis for culture change, and assessing the progress towards culture change.

By allowing the client to use the prototype, the client not only gets a feel for the real system but can also help himself/herself in getting a clearer picture of what exactly he/she wants as the end product. Prototyping, is an initial instantiation of a concept as part of software development process.

We defined the prototyping artifact development strategy as the set of decisions that dictate what actions will be taken to accomplish the development of the prototype. A well defined initial clear specification requirement needs to be articulated in order to determine the initial prototype. We developed these initial set of requirements for the initial prototype by reviewing literature and by using two already tested components, the successful culture measurement tool OCAI, and a successful GDSS/EMS system, Spilter. Currently, the OCAI is administered using pencil and paper. After the initial culture survey is conducted, design and management of culture change is also facilitated through a manual process. This current method of change management for culture is archaic, takes a long time, and can result in process losses. In this research protocol, we developed a prototype that could speed up the process of culture change by automating the culture measurement, display and discussion of methodology and artifact, vastly improving the participation rate of surveys, and automating the actual process of culture change by using a GDSS technology. GDSS technology has been known to reduce process losses in group participation as well as improving the willingness of group members to share freely their ideas and thoughts without inhibition because of the technology that it employs.

In this research project, we looked at the development of the integrated GDSS-OCAI system as a prototyping process. The GDSS artifact used in this project was the Spilter software, and the culture instrument was the OCAI. Spilter is a GDSS/EMS tool that can allow participation from anywhere in the world and at virtually anytime convienient to the user.

The OCAI instrument was integrated with the GDSS tool "Spilter" to facilitate culture change. In the development of the artifact, every version of the OCAI-Spilter tool was reviewed to see if it could further help to improve the participation rate of stakeholders in culture change as well as generate new ideas through its use. Peter Keen in his paper on GDSS development describes the prototyping process of GDSS. This thirteen step process can be used as a model for the GDSS development in this research study. The steps for the GDSS development specified by Meador, Guyote, & Keen (1984) include:

a) Planning – User needs assessment and problem diagnosis

b) Application Research – Identification of relevant fundamental approaches for addressing user needs and available resources

c) Analysis – Determination of best approach and specific resources required to implement it

d) Design – Detailed specifications of system components, structure and features

e) System construction – Technical implementation of the design

f) System testing – Collection of data on system performance to determine whether the system performs in accordance with design specifications

g) Evaluation – Determination of how well the implemented system satisfies users' needs and identification of technical and organisational loose ends

h) Demonstration – Demonstrating the system capabilities to the user community

i) Orientation – Instruction of top level managerial users in the capabilities of the system

j) Training – Training of direct users

k) Deployment – Operational deployment of the full system capability for all members of the user community

l) Maintenance – Ongoing support of the system and its user community

m) Adaptation – Planned periodic recycling through the above tasks to respond to changing user needs

Next we examine the literature of prototyping approaches and component based software engineering techniques used to build and fine-tune the OCAI-Spilter artifact.

2.4.1 Prototyping: Camburn et al., (2013) described these prototyping methods as strategies for conceptual phases of design framework and experimental assessment. By performing an extensive research and review of the best practices of prototype development, Camburn integrated their findings into a methodology for an enhanced prototyping process. Various independent design context variables like budget, time, and difficulty of meeting the design requirements derive this strategy. Beaudouin-Lafon & Mackay (2003) stated that a prototype as a design artifact should include certain characteristics. A perfect prototype should (a) support creativity, (b) should encourage communication within and outside the development team and also (c) should ensure early evaluation of the product with proper user feedback. They explained this further by categorizing two major types of prototypes: *offline prototypes* and *online prototypes*. **Offline prototypes** do not use a computer. They are usually implemented using paper sketches, story boards, cardboard mock-ups or videos. These are generally created at the earlier stages of the development. **Online prototypes** depend on the use of a computer to implement. Online prototypes include animations, product presentations, application mock-ups created using scripting languages and other similar methods. Sefelin, Tscheligi, and Giller (2003) in their study investigated the major differences between **paper based** and **computer based** low fidelity prototypes. Even though their study indicated that clients mostly preferred computer based prototypes to paper based prototypes, there were certain situations where clients preferred paper based prototypes.

In our research, we compared initial offline (paper-based) prototypes with online (computer-based) prototypes developed for this research. The inefficiencies inherent in the paper-based prototypes is our primary motivation for developing and testing the computer-based (online) prototype. We reviewed the inefficiencies and use them as a basis for developing the structure and flow of the computer artifact to facilitate change management at a greater and more efficient speed.

Coughlan, Suri, and Canales (2007) presented some powerful objectives enabled by a process of prototype design: Firstly, prototyping enables organisational thinking to develop concretely through action, thereby creating tangible expressions like learning faster by failing early and often, allowing low-impact failures to occur early and providing faster organisational learning; Secondly, the development of a prototype gives the developers permission to explore new behaviours thereby reliving individuals from the responsibility to consciously change what they do.

Different prototypes which differs in their life span lengths may be created, in order to suit their applications and scenarios in which they are used. Beaudouin-Lafon and Mackay (2003) in their book classified prototypes based on the length of their life span as follows:

- **Rapid prototypes** are created for some specific purposes and then thrown away. These are essentially useful in early stages of software development. For example, Guger et al. (2001) supplemented this idea of a rapid prototype by creating a new type of EEG-based brain-computer interface . This interface that uses rapid prototyping to enable a fast transition of estimation of various types of parameters and classification algorithms to real-time implementations and testing.

- **Iterative prototypes** work in iterations or steps in order to work out some details and increasing their precision. Here, each iteration should inform some aspect of the design.

- **Evolutionary prototypes** are a special case of iterative prototypes in which the prototype evolves into part or all of the final system. Evolutionary prototypes require more planning and practice than other approaches since these prototypes are representations of the final system and the final system itself, hence making it more difficult to explore alternative designs.

*2.4.2 Component Based Software Development***:** In this research we developed, evaluated, and fine-tuned iterative prototypes. The integrated OCAI-Spilter artifact was used in a real-life "use" situation, and the feedback was used to iteratively fine-tune and improve the artifact. This iterative prototyping process was employed through the use of a Component Based Software Development (CBSD) technique. This means that the prototype need not be developed from scratch, but as a sub-system within the GDSS system. As explained by Vitharana 2003, key advantages of CBSD includes reduced lead time and costs as business applications can be developed from an existing pool of components. This also leads to enhanced quality as components are retested, easily maintained and easily replaced. The life cycle of CBSD includes doing a requirements analysis, preparing the preliminary design which involves component specification, detailed design which consists of component search and identification, and finally implementation. In implementation, it is important to conduct unit testing, integration testing as well as system testing. Expertise in matching user requirements with components available in the repository before assembling them into applications will be a crucial aspect of CBSD. (Vitharana, 2003). As CBSD requires seamless communication between developers, assemblers and the customer, in the development of the OCAI-Spilter artifact, we have built a strong communication pipeline and co-operation

between the Spilter developers, the programmers developing the OCAI component within Spilter, as well as the end customer and users of the artifact.

CHAPTER 3: RESEARCH METHDOLOGY AND DESIGN PRINCIPLES

Since we are developing an "artifact-in-use" by organizational actors, we will use an *Action Design Research Methodology*. Following the suggestion by (Sein, et al, 2005) the design of the artifact will be informed by both functional and technical requirements derived from the literature review, as well as "shaped by the interests, values, and assumptions of a wide variety of communities of developers, investors, users" (Orlikowski & Iacono, 2001) without letting go of the essence of design research (DR) which is:

(1) innovation and

(2) dealing with a class of problems and systems."

3.1 ADR Methodology

We followed the four-stage ADR methodology described in (Sein, et al 2011). There are four steps to this methodology:

1. Problem formulation
2. Building, intervention and evaluation (BIE) It is either IT dominant or organisation dominant
3. Reflection and learning
4. Formalization of learning

In this research we used an *Organization Dominant BIE*. The OCAI-Spilter artifact was deployed in the design iterations and tested with members of the university.   Feedback

obtained was incorporated into subsequent versions of the artifact till changes and improvements became stable and only marginal changes are observed in iterations. Throughout the process, we kept a record of observations of the artifact "in-use," and the consequent, iterative, continuous, improvements to our artifact. The culture instrument in use is the OCAI culture measurement instrument. For the GDSS system we used Spilter, a commercial – web-based GDSS developed in The Netherlands and available free for research. The IT artifact we produced was named the OCAI-Spilter system.

Table 2. Summary of the ADR Process in the OCAI-Spilter Integration.

Stages and Principles	ARTIFACT	
Stage 1: Problem Formulation		
Principle 1: Practice Inspired Research	Research is driven by the need to develop and test a computer based group discussion tool for group discussions and deliberations about coming to a group consensus for culture change using the results of OCAI	Recognition: a. Shortcomings of the existing manual process used to reach consensus using the OCAI instrument b. Scalability of the tool
Principle 2: Theory Ingrained Artifact	Use of the OCAI instrument to reach the desired culture of SUTD through the use of GDSS	
Stage 2: BIE		
Principle 3: Reciprocal Sharing	Group process losses were expected to be an on-going problem as a result of manual intervention. Problems encountered will be used as design principles for the IT artifact	Alpha Version: The artifact conceived should address the issue of participation and group process losses

Principle 4: Mutually influencing roles	The ADR team will include HR personnel from SUTD and an undergraduate student.	Beta Version: Prototype developed to speed up the decision making process of desired culture will be called the OCAI-Spilter Artifact.
Principle 5: Authentic and concurrent evaluation	The OCAI-Spilter software will be tested out with focus groups to gauge the usability of the survey. The GDSS platform for culture change will be tested out with the senior management team for group decision making before it is rolled out to the wider group	
Stage 3: Reflection and Learning		
Principle 6: Guided Emergence	The OCAI-Spilter should be an emerging evolution as the programmers and users work together to improve its usability and collation of survey results, as well as for culture change	Emerging Version and Realization: The IT artifact should be continually refined through continuous feedback
Stage 4: Formalization of Learning		
Principle 7: Generalized outcomes	New set of design principles should be articulated for the OCAI-Spilter artifact, plus the GDSS platform for achieving culture change	Ensemble Version: An ensemble embodying the design principles for achieving the desired culture through OCAI-Spilter

ADR = action design research: GDSS = group decision support systems: HR= human resources: IT = information technology: OCAI= organisational culture assessment instrument: SUTD = Singapore University of Technology and Design

The proposed BIE form selected in this research is the **Organization Dominant BIE.** Organizational Dominant BIE, is used as the project deals with intervention of culture at the organisational level. The OCAI-Spilter artifact is deployed in the design iterations and tested

with members of the university. Feedback obtained was incorporated into subsequent versions of the artifact till changes and improvements become stable and are only marginal. Throughout the process, we kept a record of observations of the artifact "in-use," and the consequent iterative, continuous improvement to our artifact.

3.2 <u>Functional Requirements and Design Principles</u>

The Design Principles of the OCAI-Spilter artifact included:-

1. Automating the OCAI culture survey within the Spilter system to allow for easier access and participation by respondents

2. Graphing, collecting and consolidating culture survey data through the use of the Spilter system to establish the current and desired culture

3. Enabling the culture alignment process by establishing common understanding of current and desired culture of SUTD through the use of group discussion within the Spilter system.

4. Using the Spilter system to brain-storm ideas for culture change from perceived current to desired organizational cultures.

We examined the process model of an organisation dominant BIE in the building of this OCAI-Spilter Artifact. This is illustrated in Figure 8:

OCAI-SPILTER BIE CYCLE – Organisation Dominant

OCAI-Spilter deployed early in the design cycle

OCAI-Spilter improved through design iterations

Contributions

ADR Researchers

ADR Team

HR Dept

Staff, Faculty & Students

Alpha Version

Beta Version

OCAI-Spilter

- Automated OCAI survey tool
- Culture Alignment using GDSS technology
- Ideas for culture change using GDSS

Platform for effective alignment of culture and values within members of the community in SUTD

The OCAI-Spilter prototype allow users to
- Easily participate in the OCAI culture survey
- Join in the Group discussions for culture change without process losses

Figure 6 Organisation-Dominant BIE in the OCAI-Spilter Project

3.2.1 Design Iterations and Functional Requirements. The design process in the development of the OCAI-Spilter included the following steps.

1. Developing functional requirements

2. Building usable screens for the prototype

3. Building iterations with organisational intervention in the prototype

4. Finalising the prototype after the feedback and iterations

5. Reflection and abstraction of learning principles

The following design iterations were developed during the functional requirements of each stage of the prototype.

37
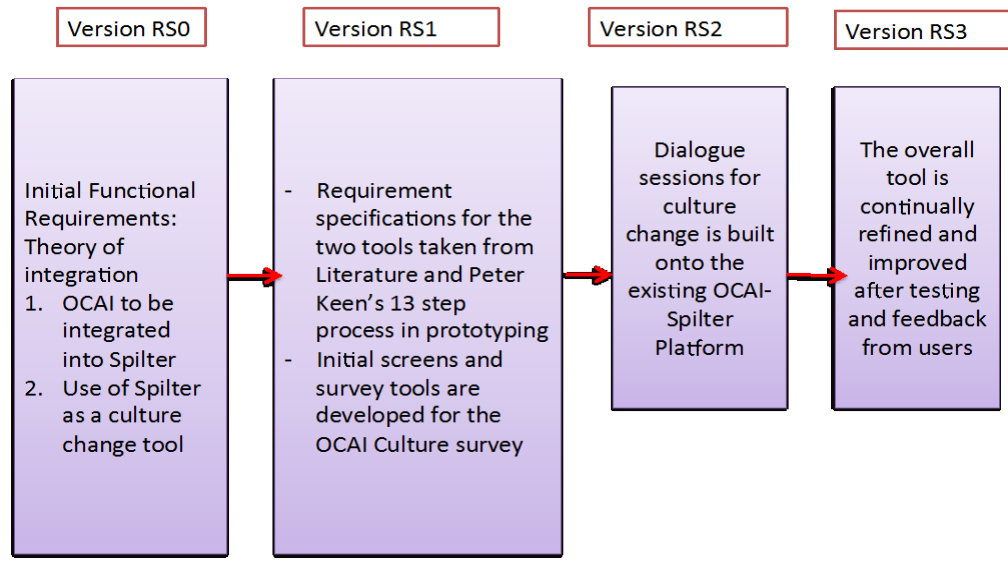
Design Iterations

Figure 7. Design Iterations.

<u>Version RS0</u>

The design principles of the OCAI-Spilter artifact at Version 0 include:-

1. Automating the OCAI culture survey within the Spilter system to allow for easy participation and understanding of the current and desired culture states of the institution.

2. Creating a platform in Spilter for discussion on the results of the culture survey, obtaining alignment on desired culture and generating ideas to close the gap.

3.2.2 OCAI-Spilter Implementation Requirements:

Community and Groupings:

The Singapore University of Technology and Design (SUTD) community includes four sub-groups: Senior Management Team (about 22 persons) Faculty (about 150 persons); Staff (about 300 persons); and students (approximately 600 persons). For the data to be meaningful and based upon the opinions of people immersed in the SUTD culture, we only

surveyed senior management, staff, students and faculty that have been with the university for at least one year.

Given the different stakeholder groups currently prevalent at SUTD, we partitioned and compared sub-groups in the SUTD community, as follows:

- Senior management

- Faculty

- Students

- Staff

Need for Computer Support

Given the relatively large sizes of each of these groups, manual inter and intra-group discussions and manual and verbal dialogues are likely to be chaotic, time-consuming, inefficient, and subject to process-losses. Thus, some sort of a computer-based group discussion and decision support is needed to assist this process.

The two tools developed and evaluated in this thesis are:

1. The OCAI-Spilter survey that assess the current and desired organisational cultures

2. A platform and a methodology using the Spilter software to engage various stakeholder groups (i.e. administration, faculty, staff, and students) in discussing the requirements and actions for culture change. This platform is the Group Decision Support System (GDSS) that uses the Spilter software.

The next design iteration of the prototype is named RS1

RS1

We continued to refine the requirement specifications by examining at the initial requirements (RS0) and modifying them by adding additional requirements derived from our literature review (Chapter 2)to produce an enlarged set of Requirements Specifications,

namely, RS1 This will involve STAGE II of the ADR methodology, including Deployment, Evaluation, and Iteration. During this stage, Principal 3: (Reciprocal Shaping), Principal 4: (Mutually Influencing Roles): Principal 5: (Authentic and Concurrent Evaluation), Principal 6: (Guided Emergence), Principal 7: (Generalized Outcomes) of the ADR Methodology were used.

Part 1: OCAI culture survey (Reciprocal Shaping)

The OCAI tool was used in this research to assess current culture versus the desired culture. This is a necessary first step for culture change. Our OCAI-Spilter integration team embarked on Peter Keen's thirteen step process in the prototype development of the OCAI-GDSS system. (Meador & Keen, 1984) These steps has been explained in Chapter 2, section 2.3

A) OCAI Survey

We utilised the features in the Spilter tool to automate the OCAI survey. The development process included the following steps:

1. Survey Building

2. Survey Registration

3. Survey Dissemination

4. Survey Monitoring

Spilter Screens

The flow of the survey sequence was mapped to ensure that the process of culture alignment was taken into consideration. The following screen illustrates the flow of the OCAI Spilter cultural survey and alignment process:

<u>**Screen 1: OCAI Survey Flow:**</u>

The screenshot of the Spilter-OCAI screen below shows the process flow:

The subsequent screen shots of the OCAI-cultural alignment process are as follows.

Screen 2: Introduction Screen:

An introductory message from the SUTD President explained the purpose of the OCAI survey for organisational culture building. It also encouraged staff and faculty to partake in this exercise by filling in the OCAI survey to share what they perceive and thought of the current and desired organisational culture at SUTD. The message from the President also assured all participants of anonymity.

Screen 3: Registration Screen:

In this screen, the users key in their location, gender and employee type.

Screen 4: Dominant Characteristics Screen (Current):

The fourth screen takes the participants through what they think are the dominant characteristics of the current SUTD culture. The four questions in each dimension make up a total of 100 points, and participants rank each of the question from highest to lowest based on a distribution of 100 points.

Screen 5: Dominant Characteristics Screen (Desired):

The fifth screen takes the user through what (s)he thinks are the dominant characteristics of the desired SUTD culture. Each of the four questions make up a total of 100 points, and participants rank each of the question from highest to lowest based on a distribution of 100 points.

Screen 6: Ending Screen:

The ending screen thanks all participants for their feedback.

6. Survey Analysis

MS-Excel was used to analyse the data collected by the survey.

Version RS2

Group Discussion for Culture Change using Spilter as an EMS tool.

After Version RS1 was developed, we proceeded with Version RS2 where the OCAI-Spilter GDSS was being used as a tool for culture change. This was done through group discussion and group decision-making. We took the following steps to incorporate the discussion screens.

Stage 1

Version 1: Developed the prototype of the Spilter screen for group discussions to include the purpose of the meeting, as well as the desired culture types that have arised as a result of the OCAI survey.

The system was configured to allow for brainstorming and idea generation for culture change. Please see the process map below for enabling OCAI discussions using Spilter.

PROCESS FLOW for enabling group discussion on culture change using the Spilter system

.
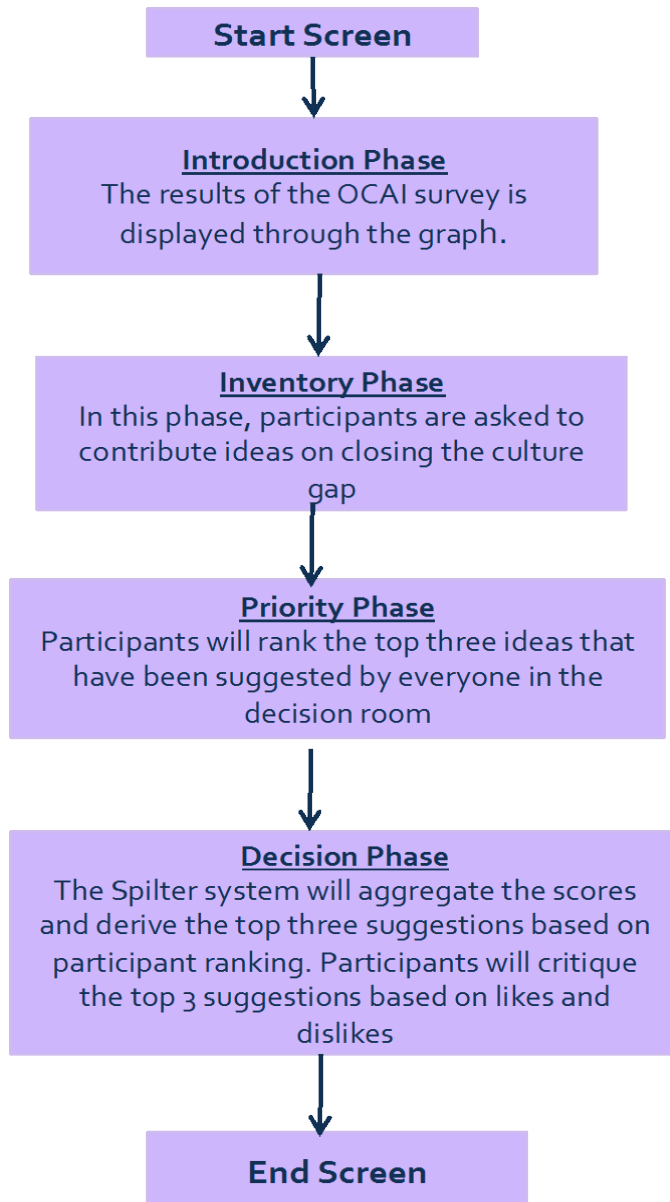
Figure 8. Process Map for group discussion

Screen 1:

Screen shots of the flow of culture discussion is displayed in the Spilter system.
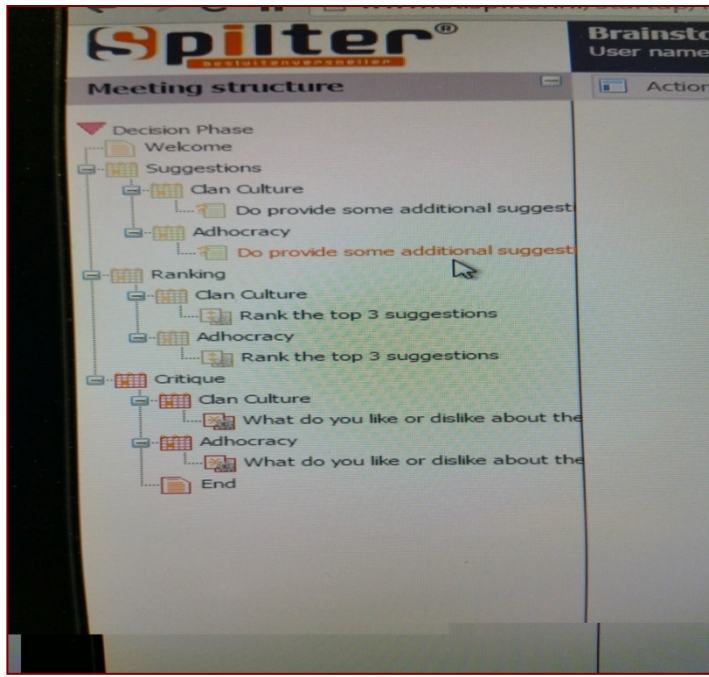
The team was taken through the following screen shots of the GDSS system for culture change discussion.

Screen 2: Start Screen
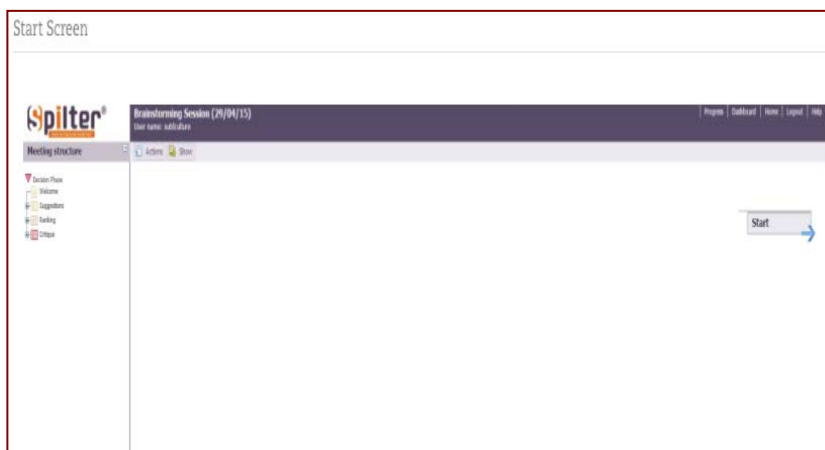
Screen 3: Welcome Screen

Participants were shown a screen outlining the results of the culture survey which demonstrated a dominant clan and adhocracy culture. It also explained the clan and adhocracy culture.

Screen 4:

Suggestion Screen

Participants were then taken to the next screen where they were asked to give suggestions to help the institution move towards the desired clan culture. At this stage, all participants were able to see each other's ideas in real-time being populated on the screen. All answers were anonymous at this point. This is to encourage participants the room to freely suggest ideas without being pre-evaluated.

Screen 5: Ranking Screen

After successfully inputing all of their ideas, participants were able to see all of the ideas being populated and were able to rank the top three ideas that they liked.

Screen 6: Critique Screen

On this screen, they were asked to critique the ideas and express what they liked or did not like about these ideas for culture change.

3.2.3 Prototype Evaluation: Version RS3

Finally, the software was tested out with a pilot group for its functionality and features. Suggestions gathered were incorporated into the final prototype. The following sections review the software evaluation protocol and steps used.

Prototype Evaluation

One of the aims of this exercise was to evaluate the user friendliness and interface of the OCAI-Spilter software for culture change. The feedback was used to help improve the interface so that staff, students, administration, and faculty could find this a purposeful and easy platform on which to share on ideas for culture change at SUTD. The feedback from the previous session was used to improve the interface progressively so that there is a continuous iteration to improve the Spilter software tool according to action design research (ADR) methodology.

It is important for us to evaluate the artifact to validate the usability, ease of learning as well satisfaction with the features of the software. This evaluation is according to the Technology Acceptance Model (Davis, 1989) that states that users come to accept a technology based on perceived usefulness and ease of use. We used accredited instruments and literature for developing the survey which were extracted from Table 10 below:

Table 3. Methodology for Software User Testing was Extracted and Adapted from the following sources.

Acronym	Instrument	Reference	Institution	Example
QUIS	Questionnaire for User Interface Satisfaction	Chin *et al*, 1988	Maryland	27 questions
PUEU	Perceived Usefulness and Ease of Use	Davis, 1989	IBM	12 questions
NAU	Nielsen's Attributes of Usability	Nielsen, 1993	Bellcore	5 attributes
NHE	Nielsen's Heuristic Evaluation	Nielsen, 1993	Bellcore	10 heuristics
CSUQ	Computer System Usability Questionnaire	Lewis, 1995	IBM	19 questions
ASQ	After Scenario Questionnaire	Lewis, 1995	IBM	3 questions
PHUE	Practical Heuristics for Usability Evaluation	Perlman, 1997	OSU	13 heuristics
PUTQ	Purdue Usability Testing Questionnaire	Lin *et al*, 1997	Purdue	100 questions
USE	USE Questionnaire	Lund, 2001	Sapient	30 questions

The evaluation of the Spilter-OCAI integration system was conducted using two methods.

1. An **online questionnaire survey** to gather feedback on the Spilter software regarding technology frustration.

   o Usefulness

   o Ease of use

   o Ease of learning

   o Satisfaction with the software.

2. A **structured focus group interview** to gather qualitative feedback on the OCAI-Spilter software on:

   o What respondents liked best about the software

   o What respondents liked least about the software and

   o What improvements they would suggest or recommend.

This interview was facilitated step-by-step according to each screen of the Spilter software to gather the feedback in a structured manner

3.2.4 Reflection and Learning. Principles for reflection included three key principles:

- Reflect on the design and redesign during the project

- Evaluate adherence to principles

- Analyse intervention results according to stated goals

The OCAI-Spilter integration should be subject to continuous improvement as the programmers and users work together to improve its usability as a survey tool and platform for culture change. The transition from version RS0 to version RS3 provided for a prototype that was used effectively to measure the culture gap between current and desired cultures and provided a platform for stakeholders to discuss and share ideas for closing the culture gap.

We used statistical methods to analyse the coefficients to test the reliablity of data. The validity of the data will be explained in chapter 4, section 4.3.1. In addition, we also employed mean averages of the responses to analyse the results of the OCAI survey across corporate and stakeholder groups. We also analysed the mean averages of each dimension of culture and the views of each stakeholder groups on these dimensions.

Part 1: OCAI Spilter Survey

We used two ways to review the results of the OCAI survey administered on the Spilter platform. Firstly the effectiveness of the digital survey vis-vis the manual platform was determined. We also analysed the participation rate for the same survey administered manually versus using the Spilter platform. Secondly, we collected feedback from focus groups on the ease-of-use of the Spilter platform, and with each iteration, how the tool could be refined and improved.

Part 2: Spilter survey on current vs desired culture.

Data were collected from staff, faculty and students. Results of the survey were used to compare perceptions of culture between four groups, namely: management, faculty, staff and students. The averages of the six characteristics of culture, namely dominant characteristics, organisational glue, management of employees, organisational leadership, strategic emphasis

and criteria for success were aggregated and presented for each of the categories of employees mentioned above.

Part 3: Collated data were used as a basis for group discussions using the Spilter platform.

There were two parts to this data collection:

1. Ideas were sought from each category of employees to propel culture change. The scalability of the tool was observed through the rate of participation rate. The speed by which the use of GDSS/EMS could accelerate change versus the manual change methods was also assessed.

2. Feedback from each focus group was obtained regarding the ease-of-use of the Spilter platform, and the feedback was used to further fine-tune and improve the OCAI-Spilter artifact. The feedback obtained during the interaction sessions asked the questions about:

   a. Ease of use of the Spilter system

   b. Ideas and suggestions for improvement

   c. Observations on how people interact with the software

3.2.5 Conclusions regarding the effectiveness and usefulness of the Digital GDSS Platform and its Application. The conclusions from the surveys conducted on all of the different groups of faculty, staff and students gave us an idea about their current perceptions of the current SUTD culture and their preferences as to what it should be. A strong set of design principles based on:

   o Reflection on the design and redesign during the project

   o Adherence to principles

   o Analysis of intervention results according to stated goals

were derived from the iterations of the different versions of the OCAI-Spilter prototype. These principles would be useful in the future design of such tools to achieve culture alignment, as well as in the implementation of successful culture change programs for SUTD.

Chapter 4: DATA COLLECTION AND RESULTS

4.1 Participants Response Rates

The entire SUTD population including senior management, staff, faculty and students participated in the survey. For ensuring that participants had a good understanding of the SUTD culture, only persons who had been with SUTD for at least one year were surveyed. Inclusion criteria were staff, faculty, and senior management who had at least 1 year of service, and sophomore and senior students in their 2nd and third year of studies. The general demographics and participation rate are illustrated in the next following graphs.

a) Participation Rates
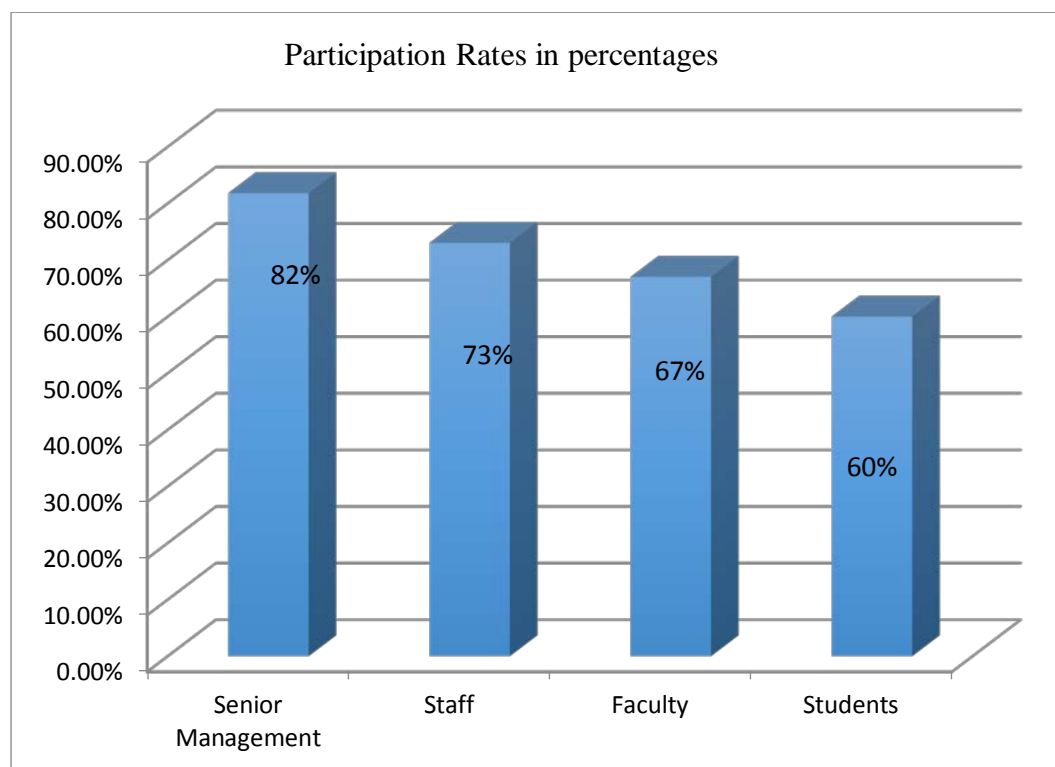
Figure 9. Participation Rates.

b. Participants Profile

Table 4. Percentage distribution of Nationality of participants

	Nationality of participants				
	Asia	Europe	North America	Antarctica	Australia Oceania
Senior Management	72.3%	0.0%	27.7%	0.0%	0.0%
Faculty	65.0%	27.0%	5.0%	1.0%	2.0%
Staff	100.0%	0.0%	0.0%	0.0%	0.0%
Students	99.7%	0.0%	0.0%	0.0%	0.3%

Table 5. Length of Service of Participants

	Length of Service	
	Less than 3 years	More than 3 years
Senior Management	88%	11%
Faculty	17%	83%
Staff	75%	25%

4.2 Results on Efficiency of the Artifact: OCAI-Spilter versus Manual Method

Table 6. Results with respect to Efficiency.

	Face to Face Sessions	Spilter	Improvement Rate
Participation Rate	Admin Staff: 24.65% Faculty: 14.9%	Admin Staff: 73% Faculty: 67%	Admin Staff: 48.5% Faculty: 52%
Time taken to fill in Survey	1 hour per person	30 minutes per person	Time Savings: 30 minutes per survey
Generation of ideas to achieve desired culture	3 hours at Senior Management retreat conducted a year before using pens and flipcharts	1 hour for session using OCAI-Spilter	2 hour improvement for idea generation session

(The senior management team only participated in the manual version of the OCAI survey, so no data is available for comparison)

1. The results showed a major improvement in the participation rate of stakeholders for the manual method versus using the OCAI-Spilter based method. The percentages by which participation improved ranged from from 48% for staff to 52% for faculty.

2. The results also showed a time savings of 30 minutes for every survey undertaken by the OCAI-Spilter versus the manual version

3. There was a 200% improvement in the time needed to generate ideas for a culture change session with the OCAI-Spilter versus the face to face interaction when the system was pilot tested with the senior management team. In the initial manual pilot

test, it took the team half a day to derive five general ideas to facilitate collaboration and innovation within the university. After the OCAI-Spilter artifact was introduced, it only took 1 hour to generate more than 20 agreed ideas for culture change. These ideas revolved around reducing hierarchy, introducing innovation through entrepreneurial activities and improving teamwork through social lubrication.

4.3   Description of Data about Culture Change Using the Tool and Methodology

With the deployment of the OCAI- Spilter for survey building and alignment of desired culture, we collated and gathered the following data:-

a.   The current and desired states of culture

b.   The current and desired states of culture amongst the different stakeholder groups

c.   The current and desired states of culture for different geographical regions, mainly Asia, Europe and North America

d.   The current and desired states of culture for each dimension of culture for each stakeholder group

4.3.1 OCAI Validity and Reliability. The instrument validity and reliability for the OCAI has been established through numerous studies (Berrio, 2003; K. Cameron & Freeman, 1991; Collett & Mora, 1996; Quinn & Spreitzer, 1991; Zammuto & Krakower, 1991). More recently, Yu and Wu (2009, p. 40) reported on a large number of empirical studies that have established the reliability and validity of the CVF and OCAI citing Howard (1998), Lamond (2003), Denison and Mishra (1995), and Ralston, Terpstra-Tong, Terpstra, Wang, and Egri (2006).

Since this is a digital version of the OCAI, we would need to re-evaluate reliability. Cronbach's alpha was used to assess the inter-correlations of test items to determine reliability through internal consistency of test scores. Alpha was developed by Lee Cronbach

in 1951 to provide a measure of the internal consistency of a test or scale; it is expressed as a number between 0 and 1. Internal consistency describes the extent to which all the items in a test measure the same concept or construct and hence it is connected to the inter-relatedness of the items within the test. (Tavakol, M., & Dennick, R, 2011).

Table 14 illustrates that values in this research study are in agreement with a study of culture conducted by Zammuto & Krakower (1991) to investigate culture completed by 1300 respondents from higher education institutions. Both the current culture and preferred culture alpha coefficients in our study are greater than 0.70, which is deemed to indicate internal consistency or reliability (Vierra, Pollock, & Golez, 1988).

Table 7: Internal Consistency.

	Reliability Coefficients for Current	Reliability Coefficients for Preferred	Comparison Reliability Coefficients
Culture Type	SUTD	SUTD	Cameron & Quinn (2006)
Clan	0.80	0.78	0.82
Adhocracy	0.79	0.82	0.83
Market	0.79	0.74	0.67
Hierarchy	0.79	0.79	0.78

4.3.2 Results of Organization-Wide OCAI Scores. We will now go through in detail the results of the OCAI culture survey administered to the entire community.
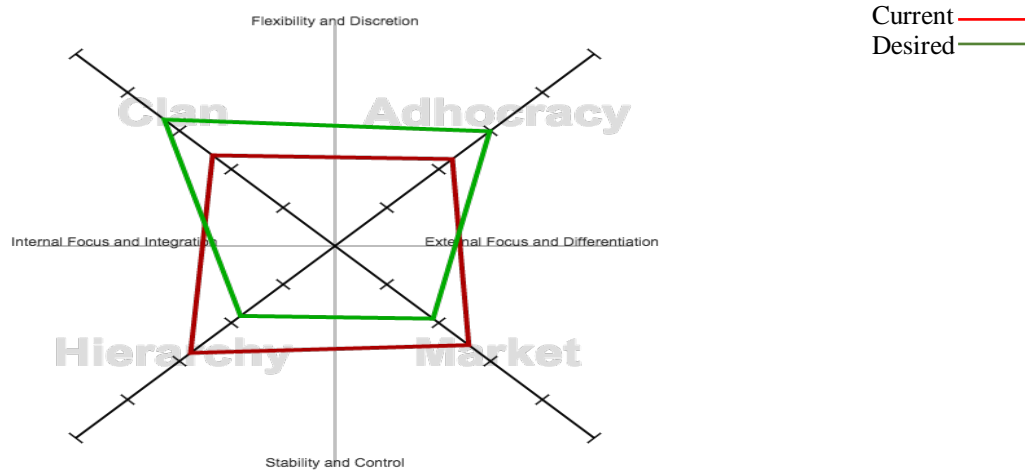
Figure 10. Results of Organizational Wide OCAI.

Table 8. OCAI Numerical Results for Overall Culture.

	Current Mean	**Desired Mean**
Clan	23.61	32.92
Adhocracy	22.64	29.87
Market	25.81	18.92
Hierarchy	27.85	18.22
Dominant	Hierarchy	Clan
2nd Highest	Market	Adhocracy
Lowest	Clan	Hierarchy
Main Dimensions	Stability and Control	Flexibility and Discretion

Current Culture: The dominant current culture as perceived by all stakeholder groups was hierarchy (mean = 27.85). The second dominant perceived culture is market (mean = 25.81). The lowest current culture quadrant was that of adhocracy (mean = 22.64). No strong

dominant culture was demonstrated due to the equally strong current perceptions of Hierarchy and Market balanced with quite similar mean scores for Clan and Adhocracy.

Preferred Culture: The dominant preferred culture as perceived by all stakeholder groups was clan (mean = 32.92). The second dominant preferred culture is adhocracy (mean = 29.87). The lowest preferred culture quadrant is that of hierarchy (mean = 18.22) which previously was the most prevalent culture.

4.3.3 Results of Each Stakeholder Group

A) SENIOR MANAGEMENT
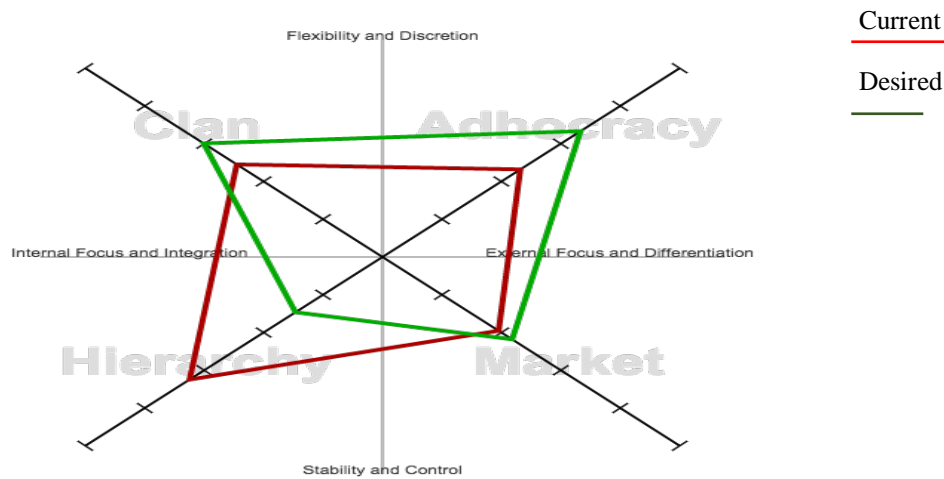

Figure 11. OCAI Graph for Senior Management Group.

Table 9: OCAI Scores for Senior Management Group.

	Current Mean	Desired Mean
Clan	24.51	30.09
Adhocracy	23.19	33.33
Market	19.54	21.81
Hierarchy	32.45	14.63

Dominant	Hierarchy	Adhocracy
2nd Highest	Clan	Clan
Lowest	Market	Hierarchy
Main Dimensions	Internal Focus and Integration	Flexibility and Discretion

Current Culture: The currently dominant current culture as perceived by senior management was hierarchy (mean = 32.45). The second dominant perceived culture was clan (mean = 24.51). The lowest current culture quadrant was that of market (mean = 19.54). In the case of Senior Management, a strong perception of hierarchy exists about the current culture.

Preferred Culture: The preferred dominant culture as perceived by senior management was adhocracy (mean = 33.33). The second preferred dominant culture is clan (mean = 30.09). The lowest preferred culture quadrant is that of hierarchy (mean = 14.63). Both clan and adhocracy score quite high as the preferred culture. The senior managers would prefer significantly lower hierarchical and control scores for the organisation.
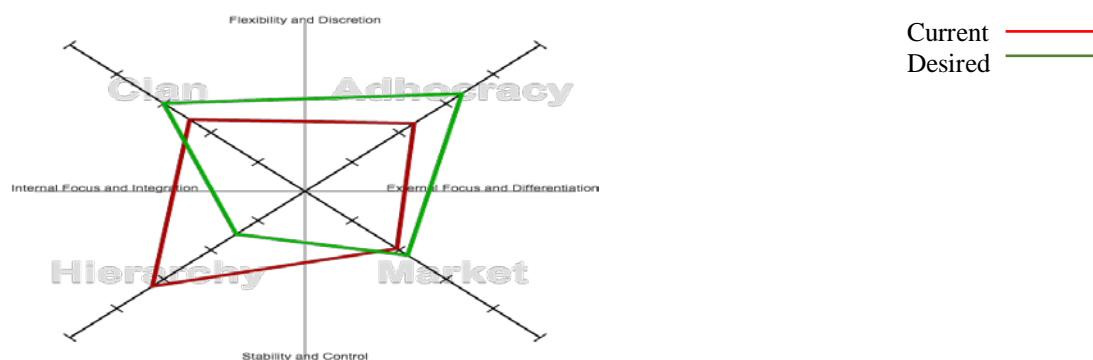
B) STAFF

Figure 12. Graph for Staff Group.

	Current Mean	Desired Mean

Clan	23.61	31.83
Adhocracy	23.04	25.18
Market	26.68	20.35
Hierarchy	26.67	22.64
Dominant	Market	Clan
2nd Highest	Hierarchy	Adhocracy
Lowest	Clan	Market
Main Dimensions	Stability and Control	Flexibility and Discretion

Table 10. OCAI Results for Staff Group.

Current Culture: The currently dominant current culture as perceived by the staff is with almost equal strengths, both market (mean =26.68) and hierarchy (mean=26.67). The lowest current culture quadrant is that of adhocracy (mean =23.04). The clan scores do not differ significantly from the adhocracy scores.

Peferred Culture: The dominant preferred culture as desired by staff groups was clan (mean=31.8). The second dominant preferred culture is adhocracy (mean=25.18). The lowest preferred culture quadrant is that of market (mean =20.35).
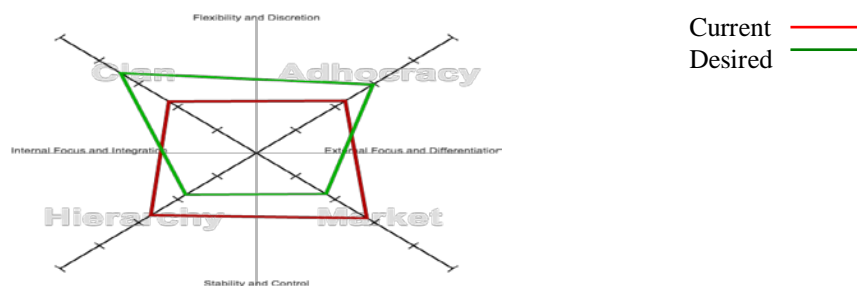
C) Faculty

Figure 13: OCAI Survey for Faculty.

Table 11: OCAI results for Faculty.

	Current Mean	**Desired Mean**
Clan	22.36	34.56
Adhocracy	22.60	29.68
Market	28.13	17.74
Hierarchy	26.92	18.03
Dominant	Market	Clan
2nd Highest	Hierarchy	Adhocracy
Lowest	Clan	Market
Main Dimensions	Stability and Control	Flexibility and Discretion

Current Culture: The currently dominant culture as perceived by faculty is market (mean = 28.13). The second dominant perceived culture was hierarchy (mean = 26.9). These two scores suggest that the faculty perceive that the current SUTD organisational culture emphasizes a market and control orientation. The lowest current culture quadrant was that of clan (mean = 22.8) but that does not differ very much from the market quadrant. No strong dominant culture was demonstrated due to the equally strong current perceptions of hierarchy and market balanced with quite similar mean scores for clan and adhocracy.

Preferred Culture: The dominant preferred culture as perceived by faculty was clan (mean = 34.56). The second dominant preferred culture was adhocracy (mean = 29.68). The lowest preferred culture quadrant was that of market (mean = 17.74). The strong dominant score here was for a clan culture. The significant increases on the clan and adhocracy dimensions,

and the decreases on the market and control dimenstions strongly indicate that the faculty would like to see an increase in collegiality and innovation, even at the expense of control and market-orientation, at SUTD.

D) Students
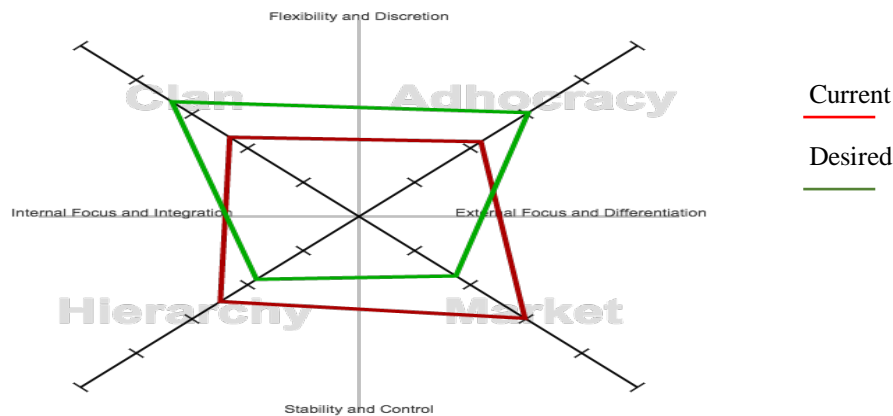
Figure 14. OCAI Survey for Students.

Table 12. OCAI Scores for Students.

	Current Mean	Desired Mean
Clan	23.28	33.62
Adhocracy	21.97	30.48
Market	29.85	17.48
Hierarchy	24.91	18.42
Dominant	Market	Clan
2nd Highest	Hierarchy	Adhocracy
Lowest	Adhocracy	Market
Main Dimensions	Stability and Control	Flexibility and Discretion

4.3.4 Perception of Culture by Regions. Since SUTD has employees from over 25 countries, it was interesting to review perceptions of culture by region. For the purpose of this study, we segment the population by 3 regions, namely: Asia, Europe and North America.
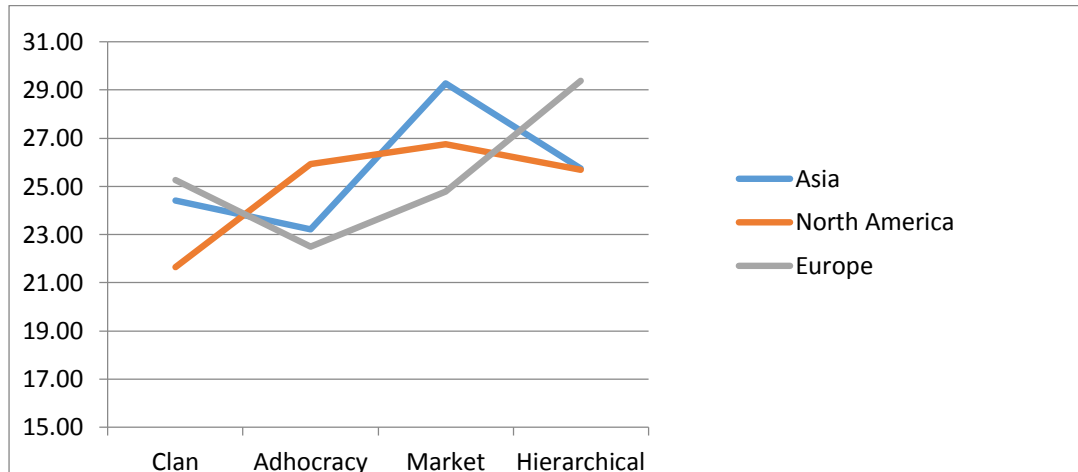
Figure 15: Estimated Means Score of Each Region on Current Culture.

Stakeholders in Asia viewed the current SUTD culture as market-oriented followed by North Americans. Stakeholders in Europe however viewed the current SUTD culture as dominantly hierarchical.
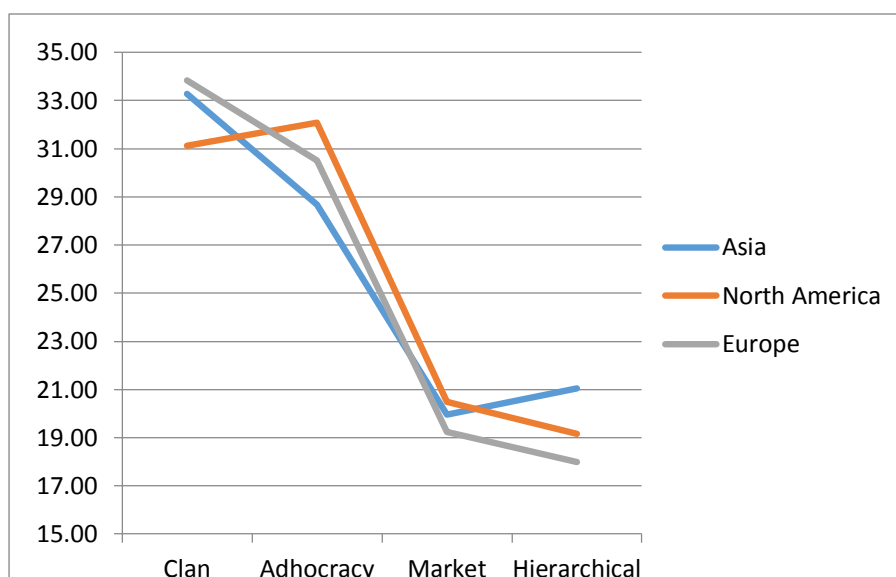
Figure 16. Estimated Means Scores of Each Region on Desired Culture.

Stakeholders in both Europe and Asia desire to have greater levels of the collegial clan culture while stakeholders in North America desired a greater adhocracy culture, although the difference between clan and adhocracy is minimal. These results too are intuitive, as North Americans aer considered to be more innovative than Europeans and Asians, whereas the Asians and Europeans are supposedly more collectivist and clan oriented.

4.3.5 Perceptions of Each of the Six Dimension of Culture. As explained in Chapter 2 (section), in an OCAI measurement, an organisation's culture is reflected along six behavioural dimensions. The next set of results are derived from these six cultural dimensions of the OCAI survey. We reviewed the degree in which all four stakeholder groups were aligned (or not) in terms of their dimensions of cultural values. The six behavioural perception of the dimensions current culture were:

1. Dominant Characteristics: The overall characteristics of the organisation

2. Organisational Leader: Perception of the leadership style that currently dominates the organisation

3. Management of Employees: How employees are managed and how they view the working environment

4. Organisational Glue: The mechanisms that hold an organisation together

5. Strategic Emphasis: This defines the key strategic areas and emphasis on which an organisation places its key goals and priorities

6. Criteria of Success: The factors that determines success for an organisation and are greatly valued

Table 13. Perceptions of the Six Dimensions of Culture by Different Stakeholder Groups.

DIMENSION	Senior Management		Faculty		Staff		Students	
	Current	Desired	Current	Desired	Current	Desired	Current	Desired
Dominant Characteristics	Hierarchy	Adhocracy	Hierarchy	Clan	Market	Clan	Market	Clan
Organisational Leadership	Hierarchy	Adhocracy	Clan	Clan	Clan	Clan	Market	Clan
Organisational Glue	Hierarchy	Clan	Hierarchy	Clan	Market	Clan	Hierarchy	Clan
Management of Employees	Hierarchy	Clan	Clan	Clan	Clan	Clan	NA	NA
Strategic Emphases	Hierarchy	Adhocracy	Market	Clan	Hierarchy	Clan	Market	Clan
Criteria of Success	Hierarchy	Adhocracy	Market	Clan	Hierarchy	Clan	Market	Clan

The results for the six dimensions of culture as viewed from the above chart tell us that:

1. Senior management viewed most existing dimensions of culture as hierarchical. However the scores between hierarchy and adhocracy were only differentiated by 0.2 for the behavioural dimension on criteria of success. It was rated at 27.5 for adhocracy and 27.72 for hierarchy.

2. Senior management would like to see more adhocracy in the desired culture for most dimensions except for organisational glue and management of employees. This may set up opposing expectations among faculty, staff, and students. While they see senior management asking for adhocracy along four behavioural dimensions, they see them as opposing adhocracy along the two dimensions that may threaten their managerial control.

3. Faculty viewed the dominant characteristics and organisational glue of the current culture as hierarchical while the leadership style and management of people were viewed as clan. They did see elements of the university being market driven when it came to its strategic emphases and success factors. Faculty would desire a clan approach towards all dimensions of culture. This desire emphasizes faculty desire for collegiality in all behaviours.

4. Staff viewed the current dominant characteristics and organisational glue to be that of a market driven culture and agreed with the faculty that the management of employees and the leadersship organisation were that of a clan type. Interestingly they viewed the current strategic emphases and criteria of success to be that of hierarchical.

5. Similarly to faculty, staff would prefer a clan approach towards all dimensions of culture.

6. Students viewed most elements of the current culture to be that of a market driven culture. However, similarly to both staff and faculty, they prefered a clan approach to all behavioural dimensions of culture.

4.3.6 Description of Culture Change Using the Tool and Methodology. As the process of culture change is a long continuing process, we will only illustrate the use of the tool for culture change discussions with pilot groups that included the senior management team, staff and faculty. These three sessions were facilitated using the GDSS technology in Spilter to create a Decision Room where stakeholders were invited to share their ideas for culture change, poll and rank the ideas, and critique them. Firstly, a Spilter brainstorming session was conducted with the senior management team on March 2014, in which the GDSS tool was used for

brainstorming of culture change initiatives. Whereas the first computer-unassisted session for cultural alignment took half a day, the GDSS tool for culture change took about one hour to complete, and participants used the tool to suggest ideas for culture change. Within that one hour session, a total of 50 ideas were generated out of which 10 ideas were prioritized for culture change. Two more sessions of using the OCAI-Spilter tool for discussion of change ideas were conducted with a total of 13 staff comprising of staff and faculty. More than 30 ideas for closing the culture gap were generated with the OCAI-Spilter tool.

Validation of the Instrument: Lastly, a user survey was conducted with this group of thirteen staff and faculty who piloted the use of the OCAI-Spilter session for culture change. We collated the following responses regarding the usability of the software.
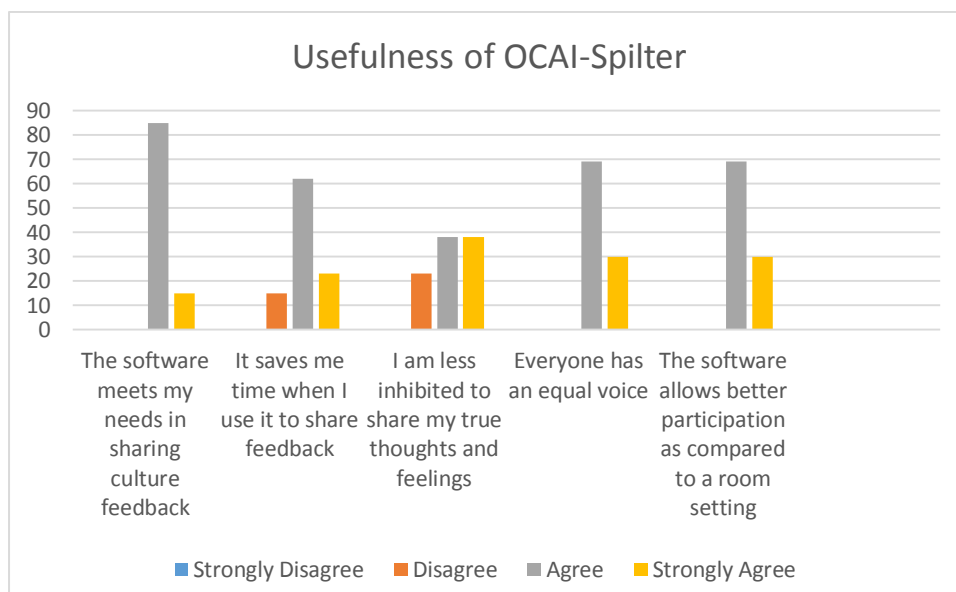

 Figure 17. Usefulness Of The Ocai-Spilter Artifact.

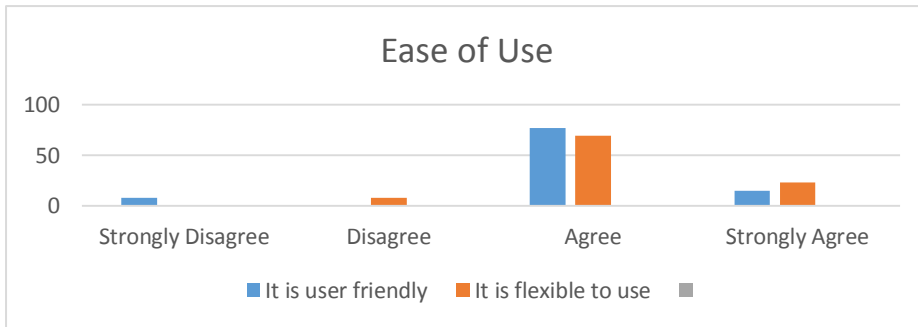91% of respondents rated the artifact as useful

Figure 18   Ease of Use of OCAI -Spilter Artifact

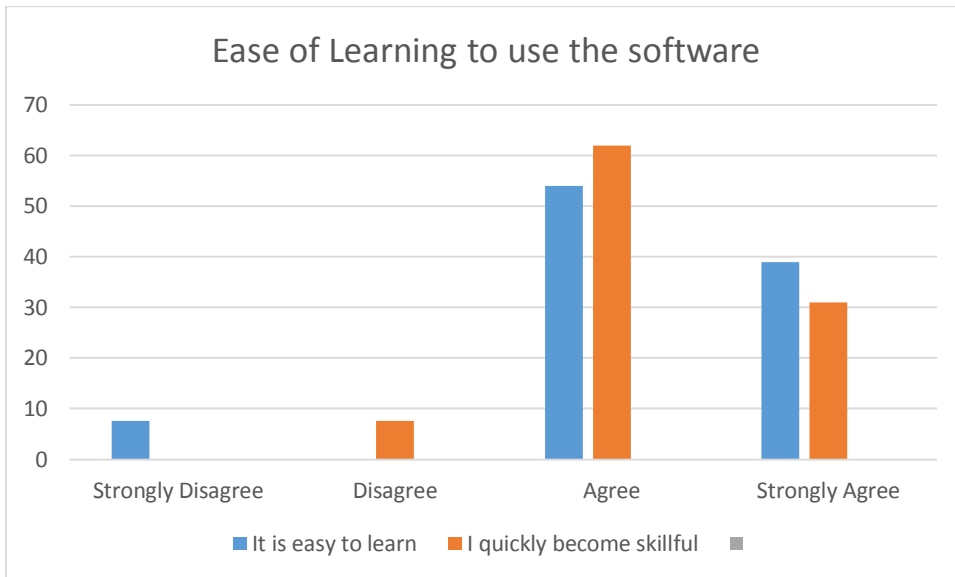91% of respondents rated the artifact as easy to use.

Figure 19. Ease of Learning OCAI-Spilter.

96% of respondents indicated that it was easy to learn how to use the artifact
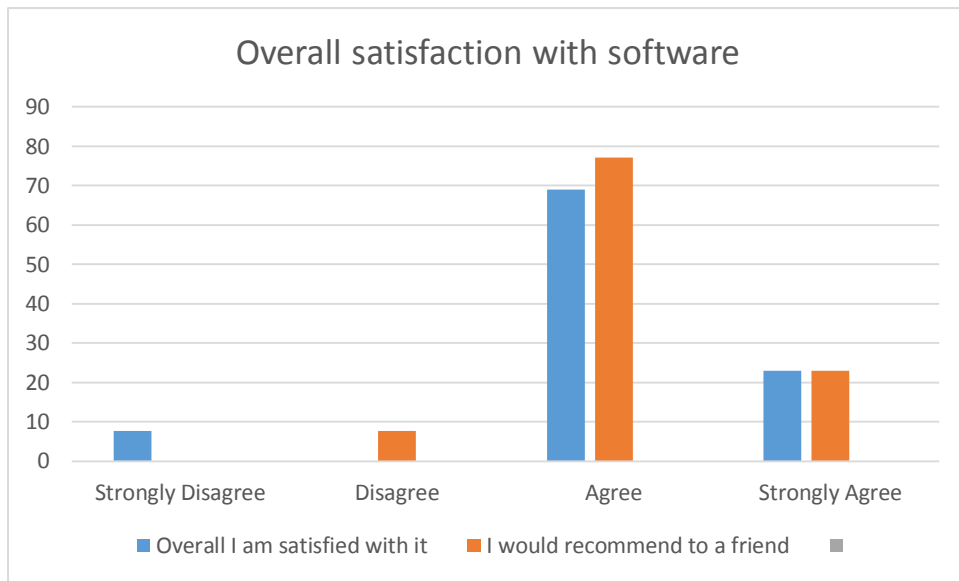
Figure 20. Overall Satisfaction with the OCAI-Spilter Artifact.

96% of respondents indicated that they are overall satisfied with the artifact.

4.4 Consequences of building, intervention and evaluation of OCAI-SPILTER

After going through some of the unanticipated consequences, the design team reviewed the design principles and made adjustments and enhancements. Table 14 outlines our revised set of design principles.

TABLE 14: New Design Principles Derived

DESIGN PRINCIPLE	CONSEQUENCES
Allows for maximum participation	-Tool was successfully built for anytime, anywhere participation of the culture survey using a web browser. (anticipated) -Survey has to be exported to excel as Spilter does not have a data processing function (unanticipated)
Reduce process losses	Reduction in process losses (anticipated) Participants felt the system was less intrusive as compared to face to face meetings
Time Savings	Reduced the elapsed and clock-time it took to fill up the OCAI survey. Only need to navigate 4 to 5 screens. (anticipated) Time savings achieved for idea generation (anticipated)

	Spilter does not work well with internet explorer (unaticipated)
Generation of ideas for culture change	Maximum participation (anticipated)
	Anonymity allowed for freedom to share ideas and suggestions (anticipated)
	More ideas collected than one could handle (unanticipated)

SUMMARY

In summary, this chapter focused on reporting data on the efficiency of the OCAI-Spilter artifact when deployed in real life conditions. Efficiencies in terms of improving participation rates, time taken to complete the survey, as well as idea generation were reported. We also analysed data that were generated using the tool and methodology. The reliability of this data was confirmed through a high co-efficient generated through this study as compared against a study of culture conducted by Zammuto and Krakower (1991) completed by 1300 respondents from higher education institutions. The overall results of this culture survey indicated a current perception of SUTD as having a hierarchical and market driven culture. Stakeholders indicated a preferred culture of clan and adhocracy instead. We also analysed the results by stakeholder groups. They seemed to be desiring increases in a clan and adhocracy-orientation; where as desiring lesser amounts of hierarchy and control. Next, we looked at perceptions of culture by regions. It was interesting to note that Asia and North America had the same current perceptions of the current culture as compared to Europe. In terms of desired culture, both Asia and Europe preferred a clan culture while North America preferred a more adhocracy culture. Lastly, perceptions of current and preferred culture were analysed along the six cultural dimensions of dominant characteristics, organizational leadership, organizational glue, management of employees, strategic emphasis and criteria of success. Stakeholders viewed most dimensions of the current culture as hierarchical except

for success criteria and management of employees. It was however, noteworthy to find that all stakeholders groups wanted a clan approach to all dimensions of culture.

Then next portion of the results chapter focused on the use of the OCAI-Spilter for obtaining consensus on the agreed culture and for facilitating discussions on ideas for culture change. The tool was tested with 18 senior management participants and proven that it was able to effect more ideas within an hour of brainstorming as compared to the manual method. In a second pilot testing with staff and faculty, the tool proved effective in eliciting new ideas and obtaining consensus. A user survey was conducted on this group of 13 users to rate the usefulness, ease of use and learning, as well as overall satisfaction with the OCAI-Spilter artifact. The high results of over 90% confirmed the successful deployment and use of the OCAI-Spilter tool. Finally, a new set of design principles were derived from the gradual refinement of the tool.

CHAPTER 5: CONCLUSION

5.1 Summary

This Masters Thesis employed the use of action design research to build an IT artifact; namely the OCAI-Spilter, used to intervene and facilitate in culture change at the Singapore University of Technology and Design. We designed, developed and deployed a discussion tool to support this participatory process: This discussion tool allowed the members of various stakeholder groups and the groups themselves to participate in and collectively influence this discussion. In the use of this tool, all stakeholder groups were able to provide their inputs, and groups and members of the group should feel that they are being heard. Such a consensus building exercise is essential to get everyone's commitment to the culture change.

The requirements for this tool, in Chapter 1, specified that the tool should (1) measure and identify the perceived current and desired cultural profiles of each group, (2) represent these current and desired culture profiles explicitly, and present the representations to all members in a group, for all to review and understand them, (3) provide a means for discussing these profiles to arrive at a consensus profiles (4) allow a large number of people to participate in the discussion process (be scalable) and (5) ameliorate the possibility of process losses. These requirements of the tool came from understanding of the culture change process and the problems encountered during the process, the deficiencies in available tools currently in the market, as well as obtaining feedback from users. Our research also described the development of this tool using extant literature regarding culture, group decision support systems, action design research and prototyping to derive the functional specifications for the artifact. The artifact was deployed through iterative cycles and improved with each cycle to derive the final version.

The results reported in Chapter 4 indicated that the tool was indeed very effective in improving participation rates in the OCAI survey and also obtaining alignment between stakeholders at SUTD. The pilot testing showed that the OCAI-Spilter is a very user-friendly tool and participants found the software to be effective for group discussions on culture change as well as generating ideas to facilitate culture change.

The Research Produced 4 outcomes:

- A computer artifact that can facilitate culture change

- Design principles and design knowledge about using OCAI and organisational culture change.

- A computer tool that can be scaled up to reach large group of stake-holders.

- Ideas for change projects

5.2 Contributions to Practice and Academia

This research has contributed to practice as currently there are no tools in the market that can help speed up culture change. We have demonstrated in Chapter 4 and Chapter 5 that the tool has reduced the cycle time it took for participation, discussion and coming to a consensus on culture change. It also increased the participation rate of employees in the culture change project. All of these factors facilitate change management in a more efficient and effective manner. Most of the culture change programs currently being executed in organisations are long and tedious and take years to complete. The advent of the OCAI-Spilter artifact has opened up the possibilities for organisations to successfully manage their culture change initiative in a speedy and effective manner. This can prove to be an invaluable resource to help align employees to achieve change in a rapidly globalised world.

As for academia, the new design principles developed can be used as learning points to develop future tools for cultural change and organisational intervention. The ideas can also be used in research pertaining to human resource development and organisation development projects that involved large groups of people.

5.3 Limitations of the Research

First, this study was primarily conducted in an educational setting that was localised and with no overseas subsidiary. The university was set up from scratch and from day one, the culture has been defined. The team could define what it wanted and the type of culture that it

needed. The people that they set out to recruit were aligned with the vision and mission of the university. This could be one of the reasons why the project has been successful.

If this project was carried out in a global organisation with a long history, we might not see such quick positive results and successful alignment.

Second, OCAI by itself has quite a narrow definition and was mainly developed for educational settings. Thus, culture change using this tool in a complex multi-organisation might not be so easily achieved. Firstly, we are not sure if the assumption that the use of the artifact and availability of the discussion tool can actually help move the current culture values towards the preferred culture. Although successful initiatives can be launched as in the case of SUTD, the measure of change will have to be measured over time to see if the culture has actually shifted to the desired culture. Secondly, even if the above change took place; the innovativeness of the organisations may not actually change within a short period of time. This would require an objective measure of innovativeness such as more patents, more publications etc. The research does not test for this.

Finally an assumption inherent in the averaging process was that each stakeholder group has equal influence over the desired culture and culture change. That may not be true; as top management may have more influence; or perhaps staff or faculty may have more influence as they may passively resist change. We could test this assumption by asking who determines the culture and placing more weight on responses from this group of people. However, we will also need to be cautious about this at it might block culture change in large hierarchical organisations. Lastly, it is unknown whether the use of the artifact and availability of the discussion tool can actually help move the current culture values towards the preferred culture. If the change does take place, it may not actually change the innovativeness of the

organizations. A future study could measure the effectiveness of the tool for culture change by looking at an objective measure of innovativeness.

REFERENCES

Axelrod, R., & Cohen, M. D. (2000). *Harnessing complexity: Organizational implications of a scientific frontier*. New York, NY: Free Press.

Baker, K. A. (2002). Organizational Culture. Retrieved October 10, 2014, from Organizational Culture 06.08.02.doc

Beaudouin-Lafon, M., & Mackay, W. E. (2003). Prototyping Tools and Techniques. In J. A. Jacko & A. Sears (Eds.), *Handbook of Human-Computer Interaction* (pp. 1006–1031). Mahwah, NJ: Lawrence Eribaum Associates Inc. Retrieved from https://www.lri.fr/~mackay/pdffiles/Prototype.chapter.pdf

Berrio, A. A. (2003). An organizational culture assessment using the competing values framework: A profile of Ohio State University Extension. *The Journal of Extension*, *41*(2). Retrieved from http://www.joe.org/joe/2003april/a3.php/pmc/index.php

Bremer, M. (2012). *Organizational culture change: Unleashing your organization's potential in circles of 10*. Overijsse, Netherlands: Kikker Groep.

Camburn, B., Dunlap, B. U., Kuhr, R., Viswanathan, V. K., Linsey, J., Jensen, D. D., … Wood, K. L. (2013). Methods for prototyping strategies in conceptual phases of design: Framework and experimental assessment. In *Proceedings of the ASME 2013 International Design Engineering Technical Conferences & Computers and Information in Engineering Conference* (pp. V005T06A033–V005T06A033). New York, NY: American Society of Mechanical Engineers.

Cameron, K., & Freeman, S. (1991). Culture, congruence, strength, and type: Relationship to effectiveness. *Research in Organizational Change and Development*, *5*, 23–58.

Cameron, K. S., & Quinn, R. E. (2011). *Diagnosing and changing organizational culture: Based on the competing values framework* (3rd ed.). San Francisco, CA: Jossey-Bass.

Christensen, Clayton, Eyring, J Henry. (2011). The Innovative University (1st Ed.). San Francisco, CA: Jossey-Bass

Coch, L., & French Jr., J. R. P. (1948). Overcoming resistance to change. *Human Relations*, *1*(4), 512–32. http://doi.org/10.1177/001872674800100408

Cole, R., Purao, S., Rossi, M., & Sein, M. (2005). Being proactive: where action research meets design research. *ICIS 2005 Proceedings*, 27.

Collett, L., & Mora, C. (1996). MOM data analysis. Retrieved from http://www.academia.edu/3589242/MANAGING_CULTURAL_DIVERSITY_INTEGRATI ON_VALUES_AND_MANAGEMENT_SKILLS

Denison, D. R., & Mishra, A. K. (1995). Toward a theory of organizational culture and effectiveness. *Organization Science, 6*(2), 204–23.

Fralinger, B., & Olson, V. (2011). Organizational culture at the university level: A study using the OCAI instrument. *Journal of College Teaching & Learning, 4*(11), 85–98.

Gregor, S., & Hevner, A. R. (2013). Positioning and presenting design science research for maximum impact. *MIS Quarterly, 37*(2), 337–356.

Guger, C., Schlögl, A., Neuper, C., Walterspacher, D., Strein, T., & Pfurtscheller, G. (2001). Rapid prototyping of an EEG-based brain-computer interface (BCI). *IEEE Transactions on Neural Systems and Rehabilitation Engineering, 9*(1), 49–58. http://doi.org/10.1109/7333.918276

Howard, L. W. (1998). Validating the competing values model as a representation of organizational cultures. *International Journal of Organizational Analysis, 6*(3), 231–50.

Huber, G. P. (1984). Issues in the design of group decision support systems. *MIS Quarterly, 8*(3), 195–204. http://doi.org/10.2307/248666

Iivari, J., & Venable, J. R. (2009). Action research and design science research - Seemingly similar but decisively dissimilar. In *ECIS 2009 Proceedings* (p. Paper 73). Retrieved from http://aisel.aisnet.org/cgi/viewcontent.cgi?article=1025&context=ecis2009

Lamond, D. (2003). The value of Quinn's competing values model in an Australian context. Journal of *Managerial Psychology, 18*(1), 46–59.

Levin, I., & Gottlieb, J. (2009). Realigning organizational culture for optimal performance. *Organizational Development Journal, 27*(4), 31–46.

Meador, C. L., Guyote, M. J., & Keen, P. G. W. (1984). Setting priorities for DSS development. *MIS Quarterly, 8*(2), 117–29. Retrieved from http://www.jstor.org/stable/249348

Nunamaker, J. F., Dennis, A., Valacich, J., Vogel, D. R., & George, J. F. (1991). Electronic meeting systems. *Communications of the ACM, 34*(7).

Orlikowski, W. J., & Iacono, C. S. (2001). Research commentary: Desperately seeking the "IT" in IT research--A call to theorizing the IT artifact. *Information Systems Research, 12*(2), 121–34.

Ouchi, W. G. (1980). Markets, bureaucracies, and clans. Administrative Science Quarterly, 25(1).

Quinn, R. E., & Rohrbaugh, J. (1983). A spatial model of effectiveness criteria: Towards a competing values approach to organizational analysis. *Management Science, 29*(3), 363–77.

Quinn, R. E., & Spreitzer, G. M. (1991). *The psychometrics of the competing values culture instrument and an analysis of the impact of organizational culture on quality of life.* Bingley, U.K.: Emerald Group Publishing.

Ralston, D. A., Terpstra-Tong, J., Terpstra, R. H., Wang, X., & Egri, C. (2006). Today's state-owned enterprises of China: Are they dying dinosaurs or dynamic dynamos? *Strategic Management Journal, 27*(9), 825–43.

Schein, E. H. (2004). *Organizational culture and leadership* (3rd ed.). San Francisco, CA: John Wiley & Sons, Inc.

Scott, T., Mannion, R., Davies, H., & Marshall, M. (2003). The quantitative measurement of organizational culture in health care: A review of the available instruments. *Health Services Research, 38*(3), 923–45. http://doi.org/10.1111/1475-6773.00154

Sein, M. K., Henfridsson, O., Sandeep, P., Rossi, M., & Lindgren, R. (2011). Action Design Research. *MIS Quarterly, 35*(1), 37–55.

Smith, M. E. (2003). Changing an organisation's culture: Correlates of success and failure. *Leadership and Organization Development Journal, 24*(5), 249–61.

Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha.*International journal of medical education*, *2*, 53.

Valacich, J. S., Dennis, A. R., & Connolly, T. (1994). Valacich, Joseph S. Organizational Behavior and *Human Decision Processes, 57*(3), 448–67.

Van den Berg, P. T., & Wilderom, C. P. (2004). Defining, measuring, and comparing organisational cultures. *Applied Psychology, 53*(4), 570–82.

Vierra, A., Pollock, J., & Golez, F. (1988). *Reading educational research* (2nd ed.). London, UK: Pearson.

Vitharana, P. (2003). Risks and challenges of component-based software development. *Communications of the ACM*, *46*(8), 67-72.

Yu, T., & Wu, N. (2009). A review of study on the competing values framework. *International Journal of Business and Management, 4*(7), 37–42. Retrieved from http://ccsenet.org/journal/index.php/ijbm/article/viewFile/3000/2770

Zammuto, R. F., & Krakower, J. Y. (1991). Quantitative and qualitative studies of organizational culture. In W. A. Pasmore & R. W. Woodman (Eds.), *Research in Organizational Change*

and Development: An Annual Series Featuring Advances in Theory, Methodology and Research (pp. 83–114). Greenwich, CT: JAI Press Inc.

APPENDICES

Appendix A

Organizational Culture Assessment Instrument

The purpose of the OCAI is to assess six key dimensions of organizational culture. In completing the instrument, you will be providing a picture of how your organization operates and the values that characterize it. No right or wrong answers exist for these questions, just as there is no right or wrong culture. Every organization will most likely produce a different set of responses. Therefore, be as accurate as you can in responding to the questions so that your resulting cultural diagnosis will be as precise as possible.

Instructions for completing the Organizational Culture Assessment Instrument (OCAI).

You are asked to rate your organization in the questions. To determine which organization to rate, you will want to consider the organization that is managed by your boss, the strategic business unit to which you belong, or the organizational unit in which you are a member that has clearly identifiable boundaries. Because the instrument is most helpful for determining ways to change the culture, you'll want to focus on the cultural unit that is the target for change. Therefore, as you answer the questions, keep in mind the organization that can be affected by the change strategy you develop.

The OCAI consists of six questions. Each question has four alternatives. Divide 100 points among these four alternatives depending on the extent to which each alternative is similar to your own organization. Give a higher number of points to the alternative that is most similar

to your organization. For example, in question one, if you think alternative A is very similar to your organization, alternative B and C are somewhat similar, and alternative D is hardly similar at all, you might give 55 points to A, 20 points to B and C, and five points to D. Just be sure your total equals 100 points for each question.

Note, that the first pass through the six questions is labeled "Now". This refers to the culture, as it exists today. After you complete the "Now", you will find the questions repeated under a heading of "Preferred". Your answers to these questions should be based on how you would like the organization to look five years from now.

1. Dominant Characteristics		Now	Preferred
A	The organization is a very personal place. It is like an extended family. People seem to share a lot of themselves.		
B	The organization is a very dynamic entrepreneurial place. People are willing to stick their necks out and take risks.		
C	The organization is very results oriented. A major concern is with getting the job done. People are very competitive and achievement oriented.		
D	The organization is a very controlled and structured place. Formal procedures generally govern what people do.		
	Total		
2. Organizational Leadership		Now	Preferred
A	The leadership in the organization is generally considered to exemplify mentoring, facilitating, or nurturing.		
B	The leadership in the organization is generally considered to exemplify entrepreneurship, innovating, or risk taking.		
C	The leadership in the organization is generally considered to exemplify a no-nonsense, aggressive, results-oriented focus.		

D	The leadership in the organization is generally considered to exemplify coordinating, organizing, or smooth-running efficiency.		
	Total		

3. Management of Employees		Now	Preferred
A	The management style in the organization is characterized by teamwork, consensus, and participation.		
B	The management style in the organization is characterized by individual risk-taking, innovation, freedom, and uniqueness.		
C	The management style in the organization is characterized by hard-driving competitiveness, high demands, and achievement.		
D	The management style in the organization is characterized by security of employment, conformity, predictability, and stability in relationships.		
	Total		

4. Organization Glue		Now	Preferred
A	The glue that holds the organization together is loyalty and mutual trust. Commitment to this organization runs high.		
B	The glue that holds the organization together is commitment to innovation and development. There is an emphasis on being on the cutting edge.		
C	The glue that holds the organization together is the emphasis on achievement and goal accomplishment. Aggressiveness and winning are common themes.		
D	The glue that holds the organization together is formal rules and policies. Maintaining a smooth-running organization is important.		
	Total		

5. Strategic Emphasis		Now	Preferred
A	The organization emphasizes human development. High trust, openness, and participation persist.		

		Now	Preferred
B	The organization emphasizes acquiring new resources and creating new challenges. Trying new things and prospecting for opportunities are valued.		
C	The organization emphasizes competitive actions andachievement. Hitting stretch targets and winning in the marketplace are dominant.		
D	The organization emphasizes permanence and stability. Efficiency, control and smooth operations are important.		
	Total		
6. Criteria of Success		**Now**	**Preferred**
A	The organization defines success on the basis of the development of human resources, teamwork, employee commitment, and concern for people.		
B	The organization defines success on the basis of having the most unique or newest products. It is a product leader and innovator.		
C	The organization defines success on the basis of winning in the marketplace and outpacing the competition. Competitive market leadership is key.		
D	The organization defines success on the basis of efficiency. Dependable delivery, smooth scheduling and low-cost production are critical.		
	Total		

Appendix B

A Worksheet for Scoring the OCAI

Scoring the OCAI is very easy. It requires simple arithmetic calculations. The first step is to add together all A responses in the Now column and divide by six. That is, compute an average score for the A alternatives in the Now column. You may use the worksheet on the next page to arrive at these averages. Do this for all of the questions, A, B, C, and D. Once you have done this, transfer your answers to this page in the boxes provided below.

NOW Scores

☐	1A	☐	1B
☐	2A	☐	2B
☐	3A	☐	3B
☐	4A	☐	4B
☐	5A	☐	5B
☐	6A	☐	6B
☐	Sum (total of A responses)	☐	Sum (total of B responses)
☐	*Average (sum divided by 6)*	☐	*Average (sum divided by 6)*

☐	1C	☐	1D
☐	2C	☐	2D
☐	3C	☐	3D
☐	4C	☐	4D
☐	5C	☐	5D
☐	6C	☐	6D
☐	Sum (total of C responses)	☐	Sum (total of D responses)
☐	*Average (sum divided by 6)*	☐	*Average (sum divided by 6)*

PREFERRED Scores

☐	1A	☐	1B
☐	2A	☐	2B
☐	3A	☐	3B
☐	4A	☐	4B
☐	5A	☐	5B
☐	6A	☐	6B
☐	Sum (total of A responses)	☐	Sum (total of B responses)

	Average (sum divided by 6)

	Average (sum divided by 6)

	1C
	2C
	3C
	4C
	5C
	6C
	Sum (total of C responses)
	Average (sum divided by 6)

	1D
	2D
	3D
	4D
	5D
	6D
	Sum (total of D responses)
	Average (sum divided by 6)

NOW	
A (Clan)	
B (Adhocracy)	
C (Market)	
D (Hierarchy)	
Total	

PREFERRED	
A (Clan)	
B (Adhocracy)	
C (Market)	
D (Hierarchy)	
Total	

An example of how culture ratings might appear in a specific situation:

NOW	
A	55
B	20
C	20
D	5
Total	100

PREFERRED	
A	35
B	30
C	25
D	10
Total	100

SUMMARY ASSESSMENT DATA
OW

Scores										
A										
B										
C										
D										
Total	100									

Scores										
A										
B										

C									
D									
Total	100								

REFERRED CULTURE SCORES

Scores									
A									
B									
C									
D									
Total	100								

Scores									
A									
B									
C									
D									
Total	100								