

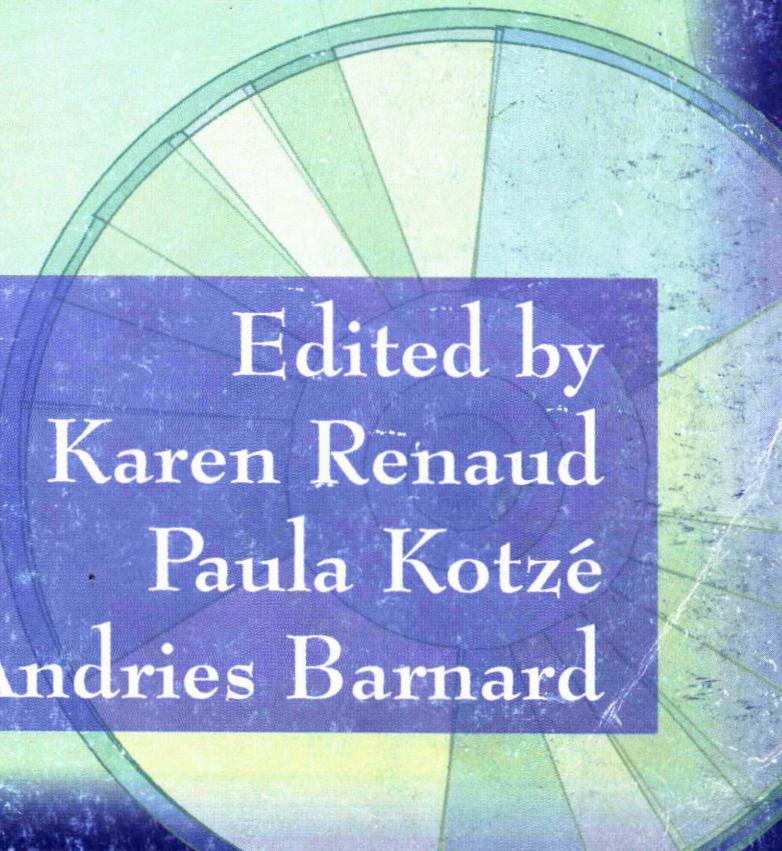
HARDWARE, SOFTWARE AND PEOPLEWARE



UNISA



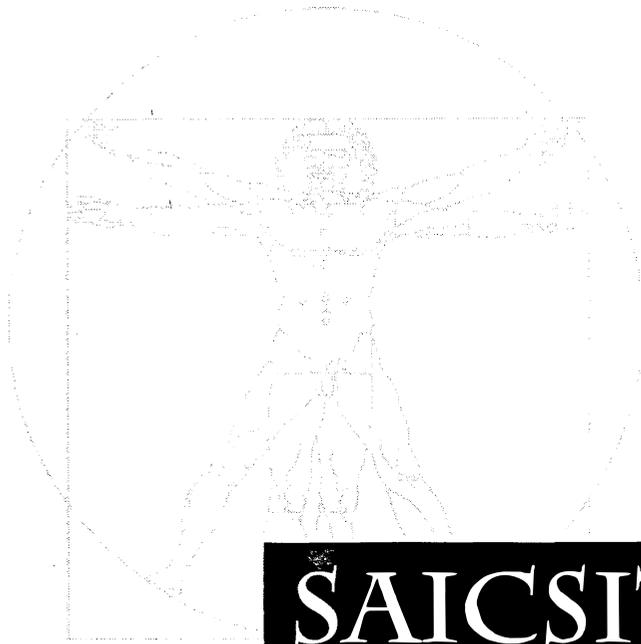
SAICSIT 2001



Edited by
Karen Renaud
Paula Kotzé
Andries Barnard

HARDWARE, SOFTWARE AND PEOPLEWARE

**South African Institute of Computer
Scientists and Information Technologists**
Annual Conference
25 – 28 September 2001
Pretoria, South Africa



SAICSIT 2001



Edited by Karen Renaud, Paula Kotzé & Andries Barnard
University of South Africa, Pretoria

Proceedings of the Annual Conference of the South African Institute of Computer Scientists and Information Technologists

First Edition, First Impression
ISBN: 1-86888-195-4

© The South African Institute of Computer Scientists and Information Technologists (SAICSIT)

Abstracting is permitted with credit to the source. Liberties are permitted to photocopying beyond the limits of South African copyright law for private use for research purposes. For other photocopying, reprint or republication permission write to the SAICSIT President, Department of Computer Science and Information Systems, UNISA, P O Box 392, Pretoria, 0003, South Africa.

The Publisher makes no representation, expressed or implied, with regard to the accuracy of the information contained in this book and cannot accept liability for any errors or omissions that may be made. The Publisher is not responsible for the use which might be made of the contents of this book.

Published by Unisa Press
University of South Africa
P O Box 392, Pretoria, 0003

Cover Design by Tersia Parsons

Editors: Karen Renaud, Paula Kotzé & Andries Barnard

Electronic Publication by the Editors

Printed by Unisa Press
2001

Table of Contents

Message from the SAICSIT President	iv
Message from the Chairs	vi
Conference Organisation	vii
Referees	viii

Keynote Speakers

<i>Cyber-economies and the Real World</i>	xi
Alan Dix	
<i>Computer-aided Instruction with Emphasis on Language Learning</i>	xiv
Lut Baten	
<i>Internet and Security Trends</i>	xv
Arthur Goldstuck	
<i>The Future of Data Compression in E-technology</i>	xvi
Nigel Horspool	
<i>Strategic Planning for E-Commerce Systems: Towards an Inspirational Focus</i>	xvii
Raymond Hackney	

Research Papers

Human-Computer Interaction / Virtual Reality

<i>The Development of a User Classification Model for a Multi-cultural Society</i>	1
M Streicher, J Wesson & A Calitz	
<i>Real-Time Facial Animation for Virtual Characters</i>	11
D Burford & E Blake	
<i>The Effects of Avatars on Co-presence in a Collaborative Virtual Environment</i>	19
J Casanueva & E Blake	

Education

<i>Structured Mapping of Digital Learning Systems</i>	29
E Cloete & L Miller	

Formal Methods

<i>The specification of a multi-level marketing business</i>	35
A van der Poll & P Kotzé	
<i>Finite state computational morphology - the case of the Zulu noun</i>	45
L Pretorius & S Bosch	
<i>Combining context provisions with graph grammar rewriting rules: the three-dimensional case</i>	54
A Barnard & E Ehlers	

Human-Computer Interaction / Web Usability

<i>Web Site Readability and Navigation Techniques: An Empirical Study</i>	64
P Licker, R Anderson, C Macintosh & A van Kets	
<i>Jiminy: Helping Users to Remember Their Passwords</i>	73
K Renaud & E Smith	

Information Security

<i>Computer Security: Hacking Tendencies, Criteria and Solutions</i>	81
M Botha & R von Solms	
<i>An access control architecture for XML documents in workflow environments</i>	88
R Botha & J Eloff	

Graphics and Ethics

<i>Model-based Segmentation of CT Images</i>	96
O Marte & P Marais	
<i>Towards Teaching Computer Ethics</i>	102
C de Ridder, L Pretorius & A Barnard	

Human-Computer Interaction / Mobile Devices

<i>Ubiquitous Computing and Cellular Handset Interfaces – are menus the best way forward?</i>	111
G Marsden & M Jones	
<i>A Comparison of the Interface Effect on the Use of Mobile Devices</i>	120
J Franken, A Stander, Z Booley, Z Isaacs & R Rose	
<i>The Effect of Colour, Luminance, Contrast, Icons, Forgiveness and Closure on ATM Interface Efficiency</i>	129
A Stander, P van der Zee, & Y Wang	

Object Orientation

<i>JavaCloak - Considering the Limitations of Proxies for Facilitating Java Runtime Specialisation</i>	139
K Renaud	

Hardware

<i>Hierarchical Level of Detail Optimization for Constant Frame Rate Rendering</i>	147
S Nirenstein, E Blake, S Windberg & A Mason	
<i>A Proposal for Dynamic Access Lists for TCP/IP Packet Filtering</i>	156
S Hazelhurst	

Information Systems

<i>The Use of Technology to Support Group Decision-Making in South Africa</i>	165
J Nash, D Gwilt, A Ludwig & K Shaw	
<i>Creating high Performance I.S. Teams</i>	172
D C Smith, M Becker, J Burns-Howell & J Kyriakides	
<i>Issues Affecting the Adoption of Data Mining in South Africa</i>	182
M Hart, E Barker-Goldie, K Davies & A Theron	

Information Systems / Management

<i>Knowledge management: do we do what we preach?</i>	191
M Handzic, C Van Toorn, & P Parkin	
<i>Information Systems Strategic Planning and IS Function Performance: An Empirical Study</i>	197
J Cohen	

Formal Methods

<i>Implication in three-valued logics of partial information</i>	207
A Britz	
<i>Optimal Multi-splitting of Numeric value ranges for Decision Tree Induction</i>	212
P Lutu	

Abstracts of Electronic Papers

<i>Lessons learnt from an action research project running groupwork activities on the Internet: Lecturers' experiences</i>	221
T Thomas & S Brown	
<i>A conceptual model for tracking a learners' progress in an outcomes-based environment</i>	221
R Harmse & T Thomas	
<i>Introductory IT at a Tertiary Level – Is ICDL the Answer?</i>	222
C Dixie & J Wesson	
<i>Formal usability testing – Informing design</i>	222
D van Greunen & J Wesson	
<i>Effectively Exploiting Server Log Information for Large Scale Web Sites</i>	223
B Wong & G Marsden	
<i>Best Practices: An Information Security Development Trend</i>	223
E von Solms & J Eloff	
<i>A Pattern Architecture, Using patterns to define an overall systems architecture</i>	224
J van Zyl & A Walker	
<i>Real-time performance of OPC</i>	224
S Kew, & B Dwolatzky	
<i>The Case for a Multiprocessor on a Die: MoaD</i>	225
P Machanick	
<i>Further Cache and TLB Investigation of the RAMpage Memory Hierarchy</i>	225
P Machanick & Z Patel	
<i>The Influence of Facilitation in a Group Decision Support Systems Environment</i>	226
T Nepal & D Petkov	
<i>Managing the operational implications of Information Systems</i>	226
B Potgieter	
<i>Finding Adjacencies in Non-Overlapping Polygons</i>	226
J Adler, GD Christelis, JA Deneys, GD Konidaris, G Lewis, AG Lipson, RL Phillips, DK Scott-Dawkins, DA Shell, BV Strydom, WM Trakman & LD Van Gool	

Message from the SAICSIT President

The South African Institute of Computer Scientists and Information Technologists (SAICSIT) was formed in 1982 and focuses on research and development in all fields of computing and information technology in South Africa. Now in the 20th year of its existence, SAICSIT has come of age, and through its flagship series of annual conferences provides a showcase of not only the best research from the Southern-African region, but also of international research, attracting contributions from far afield. SAICSIT does, however, not exist or operate in isolation.

More than 50 years have passed since the first electronic computer appeared in our society. In the intervening years technological development has been exponential. Over the last 20 years there has been a vast growth and pervasiveness of computing and information technology throughout the world. This has led into the expansion and consolidation of research into a diversity of new technologies and applications in diverse cultural environments. During this period huge strides have also been made in the development of computing devices. The processing speed of computers has increased thousand-fold and memory capacity from megabytes to gigabytes in the last decade alone. The Southern African region did not miss out on these developments.

It is hardly possible for such quantitative expansion not to bring a change in quality. Initially computers had been developed mainly for purposes such as automation for the improvement of processing, labour-reduction in production and automation control of machinery, with artificial intelligence, which made great strides in the 1980s, seen as the ultimate field to which computers could be applied. As we moved into the 1990s it was recognized that such an automation route was not the only direction in the improvement of computers. The expansion of processing power has enabled image data to be incorporated into computer systems, mainly for the purpose of improving human utilisation. For most computer technologies of the 1990s, including the Internet and virtual reality, automation was not the ultimate purpose. Humans were increasingly actively involved in the information-processing loop. This involvement has gradually increased as we move into the 21st century. Development of computer technology based not on automation, but on interaction, is now fully established.

The method of interaction has significantly changed as well. The expansion of computer ability means that the same function can be performed far more cheaply and on smaller computers than ever before. The advent of portable and mobile computers and pervasive computing devices is ample evidence of this. The need for users to be at the same location as a computer in order to reap the benefits of software installed on that computer is becoming an obsolete notion. Time and space are no longer constraints. One of the most discussed impacts of computing and information technology is *communication* and the easy accessibility of information. This changes the emphasis for research and development – issues such as cultural, political, and economic differences must, for example, be accommodated in ways that researchers have not previously considered. Our goal should be to enable users to benefit from technological advances, hence matching the skills, needs, and expectations of users of available technologies to their immense possibilities.

The conference theme for the SAICSIT 2001 Conference – *Hardware, Software and Peopleware: The Reality in the Real Millennium* – aims to reflect technological developments in all aspects related to computerised systems or computing devices, and especially reflect the fact that each influences the others.

Not only has SAICSIT come of age in the 21st century, but so has the research and development community in Southern Africa. The outstanding quality of papers submitted to SAICSIT 2001, of which only a small selection is published in this collection, illustrates both the exciting and developing nature of the field in our region. I hope that you will enjoy SAICSIT 2001 and that it will provide opportunities to cultivate and grow the seeds of discussion on innovative and new developments in computing and information technology.

Paula Kotzé
SAICSIT President

Message from the Chairs

Running this conference has been rewarding, exciting and exhausting. The response to the call for papers we sent out in March was overwhelming. We received 64 paper submissions for our main conference and twelve for the postgraduate symposium. We had a panel of internationally recognized reviewers, both local and international. The response from the reviewers was impressive – accepting a variety of papers and *mostly* returning the reviews long before the due date. We were struck, once again, by the sheer magnanimity of academia – as busy as we all are, we still manage to contribute fully to a conference such as SAICSIT.

After an exhaustive review process, where each paper was reviewed by at least three reviewers, the program committee accepted 26 full research papers and 14 electronic papers. Five papers were referred to the postgraduate symposium, since they represented work in progress – not yet ready for presentation to a full conference but which nevertheless represented sound and relevant research. The papers published in this volume therefore represent research of an internationally high standard and we are proud to publish it. Full electronic papers will be available on the conference web site (<http://www.cs.unisa.ac.za/saicsit2001/>).

Computer Science and Information Systems academics in South Africa labour under difficult circumstances. *The popularity of IT courses stems from the fact that IT qualifications are in high demand in industry, which leads in turn to a shortage of IT academic staff to teach the courses, even when posts are available. The net result is that fewer people teach more courses to more students. IT departments thus rake in ever-increasing amounts of state subsidy for their universities. These profits, euphemistically labelled “contribution to overhead costs”, are deployed in various ways: cross-subsidization of non-profitable departments; maintenance of general facilities; salaries for administrative personnel, etc. Sweeteners of generous physical resources for the IT departments may be provided. We have yet to hear of a University in South Africa where significant concessions have been made in terms of industry-related remuneration. At best, small subventions are provided. As a result, shortages of quality staff remain acute in most IT departments – especially at senior teaching levels. What is even worse is that academics in these departments have to motivate the value of their conference contributions and other IT outputs to selection committees, often dominated by sceptical academic power-brokers from the more traditional departments whose continued survival is underwritten by IT’s contribution to overhead costs.*¹

The papers published in this volume are conclusive evidence of the indefatigability and pertinacity of Computer Science and Information Systems academics and technologists in South Africa. We are proud to be part of such a prestigious and innovative group of people.

In conclusion, we would like to thank the conference chair, Prof Paula Kotzé, for her support. We also specially thank Prof Derrick Kourie for his substantial contribution. Finally, to all of you, contributors, presenters, reviewers and organisers – a big thank you – without you this conference could not be successful.

Enjoy the Conference!
Karen Renaud & Andries Barnard

¹ This taken almost verbatim from Professor Derrick Kourie’s SACLA 2001 paper titled: “*The Benefits of Bad Teaching*”.

Conference Organisation

General Chair

Paula Kotzé

Programme Chairs

Karen Renaud
Andries Barnard

Organising Committee Chairs

Lucas Venter, Alta van der Merwe

Art and Design

Tersia Parsons

Sponsor Liaison

Paula Kotzé, Chris Bornman

Secretarial & Finances

Christa Prinsloo, Elmarie Havenga

Marketing & Public Relations

Klarissa Engelbrecht, Elmarie van
Solms, Adriaan Pottas, Mac van der
Merwe

Audio Visual

Tobie van Dyk, Andre van der Poll,
Mac van der Merwe

Program Committee

Bob Baber – McMaster University, Canada
Andries Barnard – University of South Africa
Judy Bishop – University of Pretoria
Andy Bytheway – University of the Western Cape
Andre Calitz – University of Port Elizabeth
Elsabe Cloete – University of South Africa
Carina de Villiers – University of Pretoria
Alan Dix – Lancaster University, United Kingdom
Jan Eloff – Rand Afrikaans University
Andries Engelbrecht – University of Pretoria
Chris Johnson – University of Glasgow, United Kingdom
Paul Licker – University of Cape Town
Paula Kotzé – University of South Africa
Derrick Kourie – University of Pretoria
Philip Machanick – University of the Witwatersrand
Gary Marsden – University of Cape Town
Don Petkov – University of Natal in Pietermaritzburg
Karen Renaud – University of South Africa
Ian Sanders – University of the Witwatersrand
Derrick Smith – University of Cape Town
Harold Thimbleby – Middlesex University, United Kingdom
Theda Thomas – Port Elizabeth Technikon
Herna Viktor – University of Pretoria, South Africa
Bruce Watson – Universities of Pretoria and Eindhoven
Janet Wesson – University of Port Elizabeth

Referees

Molla Alemayehu	Klarissa Engelbrecht	Pekka Pihlajasaari
Trish Alexander	David Forsyth	Nelisha Pillay
Adi Attar	John Galletly	Laurette Pretorius
Bob Baber	Vashti Galpin	Karen Renaud
Andries Barnard	Wayne Goddard	Ingrid Rewitzky
John Barrow	Alexandr� Hardy	Sheila Rock
Judy Bishop	Scott Hazelhurst	Markus Roggenbach
Gordon Blair	Johannes Heidema	Ian Sanders
Arina Britz	Tersia H�rne	Justin Schoeman
Andy Bytheway	Chris Johnson	Martie Schoeman
Andr� Calitz	Bob Jolliffe	Elsje Scott
Charmain Cilliers	Paula Kotz�	Derek Smith
Elsabe Cloete	Derrick Kourie	Elm� Smith
Gordon Cooper	Les Labuschagne	Adrie Stander
Richard Cooper	Paul Licker	Harold Thimbleby
Annemieke Craig	Philip Machanick	Theda Thomas
Thad Crews	Anthony Maeder	Judy Van Biljon
Quintin Cutts	David Manlove	Alta Van der Merwe
Michael Dales	Gary Marsden	Andr� van der Poll
Carina de Villiers	Thomas Meyer	Tobias Van Dyk
Alan Dix	Elsa Naud�	Lynette van Zijl
Dunlop Mark	Martin Olivier	Lucas Venter
Elize Ehlers	Don Petkov	Herna Viktor
Jan Eloff		Bruce Watson
Andries Engelbrecht		Janet Wesson

Conference

Sponsors



Keynote Abstracts

Knowledge Management: Do we do what we preach?

Meliha Handzic^a

Christine Van Toorn^b

Peter Parkin^c

The University of New South Wales, Sydney, Australia

^am.handzic@unsw.edu.au, ^bc.vantoorn@unsw.edu.au, ^cp.parkin@unsw.edu.au

Abstract: *The aim of the case study reported in this paper was to provide a cultural audit of a university school as a typical knowledge-based organisation. The subjects were 24 academic staff members who participated in the study on the voluntary basis. The study found multiple cultures coexisting within the school. However, a fragmented type of culture characterised by the lack of social interaction and commonly shared goals among academics dominated. Contrary to popular belief within the knowledge management field, the study found that none of this diminished the school's competitive position. These findings suggest that there may not be one generic type of culture that ensures organisational success in knowledge society. Rather, success may be contingent upon how well culture fits the business environment in which it competes.*

Keywords: *Knowledge management, Corporate culture, Case study*

Computing Review Categories: H.0, K.6

1. Introduction

There is a widespread agreement that knowledge will become a major factor of organisational success or even survival in the new-age economy. It has been described as the principal fuel and the currency that will drive the economy (Devlin [6]), a key resource of tomorrow's organisations in the most competitive society we have yet known (Drucker [7]), and a hidden gold embodied in the minds and hands of organisational participants (Stewart [17]). In the new economy, companies will increasingly differentiate themselves on the basis of what they know, and how successful they are in making that knowledge productive. Knowledge management is an emergent response to the need to accelerate both the creation of knowledge and its application to physical resources in the battle for competitive advantage or survival. The central task of those concerned with knowledge management is to determine ways to better cultivate, nurture and exploit knowledge at different levels and in different contexts. Arguably, knowledge management can create sustainable competitive advantage for organisations.

A global model of knowledge management (Andersen [1]) suggests four organisational initiatives - leadership, culture, technology and measurement - as major enablers to facilitate knowledge management processes and foster the development of new knowledge. A recent literature review (Baxter and Chua [3]) revealed western theorists' central preoccupation with technology, particularly codified repositories and information processing, as enablers of 'explicit' objective and systematic knowledge. On the other hand,

eastern theorists, seem to have realised that knowledge creation is highly dependent upon corporate culture. The focus is on 'tacit' knowledge that people derive from their experiences and through sharing (Nonaka and Takeuchi [13], Nonaka [14]). In recent years, organisations have begun to recognise that a large proportion of the knowledge needed by the business is not captured on hard drives and filing cabinets, but rather kept in the heads of people. Sources report that between 40% (Andersen [2]) and 90% (Hewson [10]) of the needed knowledge is, in business terms, tacit.

It is argued that people's behaviour and values contribute most to the circulation of tacit knowledge in organisations. Yet, little has been known of the ways in which tacit knowledge is actually shared, conditions under which this sharing occurs, or the impact it has on performance. Therefore, it is not surprising that there is a currently growing appreciation and interest in the issues of culture in knowledge management among researchers and practitioners alike. The main purpose of the current study is to provide some insights into values and behaviours that define a culture of a knowledge-intensive organisation. More specifically, the study will (i) conduct a cultural audit of a university school to identify its current organisational values, and (ii) determine congruence between current organisational culture, and normative values and behaviours as suggested by knowledge management theorists.

2. Literature Review

Classical studies of organisational culture can be divided into two distinct camps. The scientific camp promotes quantitative

approaches, information processing paradigm and the science of strategy. On the other hand, the humanistic camp, recognises the importance of the sharing of values among employees and the creation of a corporate culture which determines how a company thinks and behaves. It is argued that shared experiences lead to shared values, culture, in this sense is a learned product of group experience. Schein [16] defines culture as a pattern of basic assumptions - invented, discovered or developed by a given group as it learns to cope with its problems of external adaptation and internal integration. These assumptions 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. Pfeffer [15] stresses the importance of beliefs, he considers organisations as systems of shared meanings and beliefs, in which critical administrative activity involves the construction and maintenance of belief systems which assure continued compliance, commitment and positive effect on the part of participants.

More recently, Nonaka and Takeuchi [13] criticised these theories for having failed to recognise the importance of knowledge in organisations and their potential to change and create. These two theorists argued that the organisation that wishes to cope dynamically with the changing environment needs to be one that creates knowledge, not merely processes it. The organisational members must not be passive, but active agents of innovation. They suggest that new knowledge will always begin with the individual, and that making personal knowledge available to others is the central activity of the knowledge-creating company. Within this context, the central task of knowledge management is to create an architecture to facilitate the circulation of personal know-how to potential users. According to Garvin [8], the first step in building a learning organisation is to foster an environment conducive to individual learning, that is to allow experimentation and time to gain experience, and then, to open up boundaries and stimulate the exchange of ideas.

A more general spiral knowledge model (Nonaka and Takeuchi [13]) assumes that the process of sharing will result in the organisational amplification and exponential growth of working knowledge. The knowledge spiral characterises both the conversion of personal knowledge into a form of collective

intelligence and the subsequent appropriation of that objectified knowledge by others for their own work. This happens through processes of socialisation, externalisation, internalisation and combination. Socialisation refers to the ways in which tacit knowledge is transferred from one organisational participant to another through shared experiences and empathy. Externalisation describes attempts at articulating personal knowledge for the benefit of others. Internalisation illustrates the acquisition of personal knowledge through learning by doing. Combination refers to the coupling of previously disparate aspects of organisational knowledge by an individual to create new ways of understanding.

Boisot [4] recognises that much of the knowledge previously thought to be universal is often specific to a culture and draws back on deeply rooted and value-laden assumptions of human organisational and institutional functions. He argues that culture remains the means by which non-generic information is transmitted either within a given generation of agents or from one generation to the next. The extent to which knowledge is structured and shared defines a culture. Some cultures prefer to deal in knowledge that is well codified, abstract and unambiguous, others thrive on ambiguity and vagueness. The latter often becomes a source of personal power for those who have access to the knowledge relative to those who do not. Some organisations encourage the pursuit of learning through sharing of one's stock of knowledge assets, others through hoarding it. Boisot believes that the structuring of knowledge through acts of codification and abstraction helps knowledge diffusion.

A number of knowledge management projects involving the establishment of an environment conducive to more effective knowledge creation, transfer and use were studied by Davenport et al. [5]. These projects tried to build awareness and cultural receptivity to knowledge, as well as establishing initiatives which attempt to change behaviour relating to knowledge, and to improve the knowledge management process. The main findings indicated that a knowledge friendly culture is difficult to create if it does not already exist. It has components such as people with positive orientation to knowledge, intellectually curious, willing and free to explore, and encouraged in their knowledge creation and use; people who are not inhibited in sharing knowledge, alienated or resentful of the

company, and who do not fear that sharing knowledge will cost them their jobs.

The notion that culture is community, an outcome of how people relate to one another is asserted by Goffee and Jones [9]. Community is built on shared interests and mutual obligations and thrives on cooperation. It can be characterised by two types of human relations: friendliness among the members of a community and its ability to pursue shared objectives. These determine four types of culture: fragmented, networked, mercenary and communal. Some of the benefits of friendliness are an enjoyable work environment which helps morale and *esprit de corps*, creativity fostered through teamwork and sharing of information, openness to new ideas, freedom of expression, acceptance of out-of-the-box thinking and working beyond the formal requirements of a job. Some of the drawbacks may involve a reluctance to disagree or criticise, a tendency to compromise and the development of cliques. Some of the benefits of shared objectives are a high degree of strategic focus, swift responses to competitive threats, an intolerance of poor performance, a strong sense of trust that can translate into commitment, and loyalty to the organisation's goals and purpose. Among drawbacks, cooperation may not occur if the individual benefits are not clear, or when roles and responsibilities are strictly divided. The authors do not advocate any one type of culture type over another, but instead urge the need to know how to assess one's organisational culture and determine whether it fits the competitive situation.

Recognising the importance of culture in building knowledge management communities, the main objective of the current study is to conduct a cultural audit of a university school, and to assess whether it's culture affects its current competitive position. In order to identify a culture it is necessary to assess a number of aspects of human relationships. The present study will focus particularly on social interaction and shared values, as these two aspects have been suggested by past literature as most important and generic defining factors.

3. Research Methodology

3.1 Research Design and Variables

A case study approach was chosen as the preferred research method for the current investigation, as it examines a phenomenon of interest in a natural setting. In addition, its

main purpose is to describe the things the way they are and draw meaning from social contexts, rather than to investigate cause-and-effect relationships. Therefore, it is considered a suitable approach for the current research involving audit of the corporate culture of a specific real-world organisation. A case study methodology is often associated with research about human affairs (Yin [18]). The proponents of this approach also argue that the results of a case study can provide a greater level of depth and understanding of many aspects of a social phenomenon than is possible using other methods (Lee [11]). However, some authors warn that it requires careful planning and attention to detail in order to establish validity (Miles and Huberman [12]).

Two aspects of corporate culture investigated in this study were: *interactivity* and *communability*. Interactivity was defined in terms of voluntary interaction among organisational members. It was measured in terms of the following: "People here try to make friends and to keep their relationships strong", "People here get along very well", "People in our school often socialise outside the office", "People here really like one another", "When people leave our school, we stay in touch", "People here do favours for others because they like one another", "People here often confide in one another about personal matters", and "Overall, there is a high level of social interaction in our school".

Communability was defined in terms of the organisation's ability to pursue shared goals. Particular items included: "Our school understands and shares the same business objectives", "Work gets done effectively and productively by our school", "Our school takes action to address poor performance", "Our school's collective will to achieve is high", "When opportunities for competitive advantages arise, our school moves quickly to capitalise on them", "We share the same strategic goals", "We know who our competition is", and "Overall, there is a high sense of community here". Subjects' responses were captured on a 7-point Likert scale with disagree/agree as anchor points. Low/high interactivity or communability was indicated by scores less/greater than 4 respectively. A score of 4 indicated an undecided position.

The measuring instrument used in this study was based on the instrument previously tested and used in the literature (Goffee and Jones [9]). Modifications to the wording were made

to reflect specifics of the organisation studied and two new items (overall social interaction and sense of community) were added.

3.2 Subjects and Procedure

The university school studied offers undergraduate and graduate programs of study, operates research center and seminars, and produces scholarly articles, and is a highly renowned institution. Participants in the study were academic staff with full time employment who were with the school for more than six months and had no intention of leaving it within the next six months. To minimise potential threats to validity, questionnaires were distributed to all academics who satisfied the specified criteria, their answers were anonymous and given without researchers' presence. Participation was voluntary, 24 out of 29 distributed questionnaires were completed and returned, this return rate of 83% ensures that data are representative.

4. Results

Descriptive analysis of data was performed using a number of techniques as suggested by Miles and Huberman [12] to identify patterns and themes, clusters, and ensure plausibility of findings. Firstly, in order to identify a central tendency in participants' perceptions, the average scores of their responses to relevant questionnaire items were calculated. The mean score obtained for interactivity was 3.67. The mean score for communability was 3.45. Further analysis was performed to identify the most frequently reported scores. These were 2.50 and 2.75 for interactivity and

communability respectively. Additional analysis found that half of the scores for interactivity had values below 3.87, and below 3.19 for communability. Scores less than 4 indicated that the subjects tended to perceive the level of interactivity and communability in their organisation as being low.

Further analysis of the data was performed by relating individual participants' assessments of two dimensions - interactivity and communability in order to determine a potential dominant type of culture. Responses were categorised into low/low (fragmented), high/low (networked), low/high (mercenary) and high/high (communal) type of culture depending on average scores for interactivity and communability dimensions respectively. From the results shown in Figure 1, it can be seen that 10 responses clearly fell into fragmented, 4 into networked, 1 into mercenary and 5 into communal categories. The remaining 4 responses were undecided. These results indicate that the majority of participants tended to perceive their organisation as a fragmented culture. Such finding is consistent with the earlier reported perceived tendency towards low interactivity and low communability.

5. Discussion

5.1 Main Findings

The main findings of the current research indicate that the university school investigated was a predominantly fragmented culture, characterised by the general lack of social interaction, as well as the lack of commonly

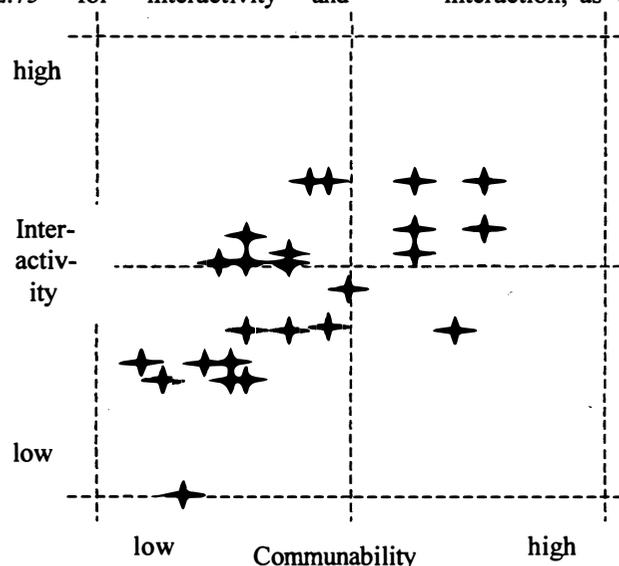


Figure 1. Participants' perceptions of interactivity and communability

shared goals among its academic staff. This was demonstrated by low scores obtained for participants' perceptions of both interactivity and communability.

In particular, the study found that participants tended to hold rather negative perceptions of interactivity. This was demonstrated by average and median response scores below 4 (out of 7) and was also evidenced by the most frequently given response score being well below 4. Such results clearly indicate a low level of social interaction existing among academic staff members in the school. This finding is further supported by notes of one of the researchers who observed academics for one week during the mid-session period. These observations indicated that people mostly worked on their own, they tended to keep their individual office doors shut, or in many cases worked from home. In addition, only a few academics attended a research seminar given by a former colleague during that week. However, small groups of people did occasionally meet for a morning tea or coffee session.

One potential reason for a low level of social interaction found in the school may be that most academics are highly specialised and do their work alone, or with scholars from other institutions who share similar interests (Goffee and Jones [9]). Indeed, the school teaches 41 different undergraduate and 25 graduate subjects and has 81 different active research projects. Arguably, that highly specialised researchers and teachers may not necessarily need input from other staff members. They may feel highly confident in both their teaching and research abilities and may not be inclined to seek advice from others.

The study also found a general lack of shared goals among academics in the school. This was demonstrated by low average, median and mode scores (all below 4 out of 7) found in participants' perceptions of communability. These negative perceptions seem to reflect a low level of consciousness of organisational membership among academic staff. According to Goffee and Jones [9], this is not surprising. Academics usually have no affinity for the institution that employs them because standards and controls are set outside individual institutions by international professional associations. Furthermore, the career prospects of an academic are more likely to be determined by their research output rather than participation in the shaping of institutional goals and strategies.

A fragmented culture with low interactivity and communability found in the university school studied here is in great contrast to the normative characteristics of a knowledge-enabling culture prescribed by knowledge management literature (Davenport [5], Nonaka and Takeuchi [13]). High levels of social interaction and commonality of goals are regarded by the knowledge management literature as the most important facets of a knowledge creating organisation, and its ability to perform competitively in a new knowledge society. Yet, our study found that the lack of social interaction and commonly shared goals did not diminish the competitive position of the university school examined. It is a highly renowned institution, with an excellent research and teaching reputation.

One of the greatest fears in organisations lacking social interaction and common goals is the worry of employees losing focus or urgency about their work (Goffee and Jones [9]). However, highly autonomous academics may be motivated rather than alienated by the freedoms of the fragmented organisation, and may guide themselves to ever higher levels of knowledge and performance. It is therefore not surprising that in the context of the university school studied, its fragmented culture was not detrimental to its success. Furthermore, there are reports of similar success in other professional organisations that employ highly trained individuals who have idiosyncratic work styles. This suggests that there is no one generic prescribed model of corporate culture that ensures success, rather, it depends on the context.

5.2 Limitations and Directions for Future Research

It is important to note that the current research was limited in its purpose to analysing current culture of the university school in terms of two general aspects of human relationships: interactivity and communability. The study did not address the issue of people's satisfaction with their organisational culture. Yet, successful organisations need both satisfied employees and strong performance. The study also did not attempt to address the question of change from one type of culture to another type of culture. Yet, organisations need to be aware of the dynamic nature of the fit between organisational culture and business environment. Future research may look at some of these issues. Further research is also necessary to systematically address these issues in different tasks and contexts, and

among different knowledge workers, if a better understanding of the area is to be achieved.

6. Conclusion

The aim of this study was to provide a cultural audit of a university school as a typical knowledge-based organisation. The study revealed a dominant fragmented type of culture characterised by the lack of social interaction and commonly shared values and goals among academic staff. The study also found that this appears not to have diminished the school's competitive position. Contrary to the prescriptions of knowledge management literature, these findings suggest that there is no one generic type of culture that ensures success. The success of a particular culture may be contingent upon its fit to the business environment within which it operates.

7. References

- [1] The Global Best Practices Research Team. The Knowledge Management Practices Book. Arthur Andersen, January 1998.
- [2] Arthur Andersen Office of Training and Education. BC Knowledge Management. Arthur Andersen. 1998.
- [3] J. Baxter and W.F. Chua. Now and the Future. *Australian Accounting Review*, 9 (3): 3-14, 1999.
- [4] M.H. Boisot. *Knowledge Assets: Securing Competitive Advantage in the Information Economy*. Oxford University Press, New York, 1998.
- [5] T.H. Davenport, D.W. DeLong and M.C. Beers. Successful knowledge management projects. *Sloan Management Review*, 39 (2): 43-57, 1998.
- [6] K. Devlin. *Infosense: Turning Information into Knowledge*. W.H. Freeman and Company, New York, 1999.
- [7] P.F. Drucker. *Post-Capitalist Society*. Harper Business, New York, 1993.
- [8] D.A. Garvin. Building a Learning Organisation. In *Harvard Business Review on Knowledge Management*, Harvard Business School Press, Boston, 1998.
- [9] R. Goffee and G. Jones. What Holds the Modern Company Together? In *Harvard Business Review on Managing People*, Harvard Business School Press, Boston, 1999.
- [10] D. Hewson. Start Talking and Get to Work. *Business Life*, November: 72-76, 1999.
- [11] A. Lee. A Scientific Methodology for MIS Case Studies. *MIS Quarterly*, 12(3): 33-50, 1989.
- [12] M.B. Miles and M.A. Huberman. *Qualitative Data Analysis*. Sage, London, 1994.
- [13] I. Nonaka and H. Takeuchi. *The Knowledge Creating Company: How Japanese Companies Create the Dynamics of Innovation*. Oxford University Press, New York, 1995.
- [14] I. Nonaka. The Knowledge-Creating Company. In *Harvard Business Review on Knowledge Management*, Harvard Business School Press, Boston, 1998.
- [15] J. Pfeffer. Management as Symbolic Action. In *Research in Organisational Behaviour*, L.L Cummings and B.M Staw (eds), 3: 1-52, 1981.
- [16] E.H. Schein. *Organisational Culture and Leadership*. Jossey-Bass, San Francisco, 1985.
- [17] T.A. Stewart. *Intellectual Capital: The New Wealth of Organisations*. Doubleday, New York, 1997.
- [18] R. Yin. *Case Study Research: Design and Methods*. Sage, London, 1988.