An Empirical Analysis on the Promotion of MOT based Training Comparing Japanese and International Institutions

Dissertation submitted in partial fulfillment
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Abstract

MANAGEMENT of Technology (MOT) is a key enabler of innovation, education, training and sustainable business growth. However, MOT presents numerous ongoing challenges to organizations against a backdrop of global competition owing to: the increasing costs and complexities of technologies; accelerated technological changes; technical innovations; and the reduction in product development life cycles. The empirical study was conducted using the interaction survey method with in-depth interviews on a sample size of 250 international faculties and students of Business Schools in both Japan and Vietnam. The proposed framework is utilized as an integrated training mechanism in the academic and business domains towards evaluating the hybrid learning and teaching performances of academics and its students. The following are the pivotal contributions of the research: This study analyzed the current status of the existing infrastructure and its related digital technologies in the selected institutions; During data collection, it was observed that several gaps and challenges were faced by the business students and faculties using the existing systems. In order to overcome the gaps perceived, a general purpose Cloud enabled Learning Management System termed "Coalition Agents Cloud (CA-Cloud)" Computing Architecture was proposed, prototyped and deployed for training in the selected departments. The introduction of innovative technologies and Hybrid training methodologies decreased the students' failure rates and elevated the motivations and performances of students and faculties respectively making the research viable. Disruptive innovation played an important role in the policy making of the selected institutions implying that policy recommendations and decision making should be dealt with prudence and pragmatism.

Keywords: CA-Cloud, Faculties, Hybrid Learning, Japan, Management of Technology, Students, Vietnam.

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'Ellam Vallar Eeraivanukku Nandri'!!!
(Thanks to The Almighty GOD, in Tamil)!!!

- Christine Amaldas

Declaration

I hereby declare that, I have produced this thesis without the prohibited assistance of third parties and without making use of external aids other than those specified. This thesis is composed of my original work, and contains no materials previously published or written by another person except where due references have been made to the best of my knowledge. I have clearly stated the contributions of others to jointly-authored works in the thesis, including statistical assistance, survey design, data analysis, significant technical procedures, professional editorial advice, and any other original research work used or reported in the thesis. Information that has been derived from published and/or unpublished works of others has been cited or acknowledged appropriately.

The content of my thesis is the result of the work I had carried out since the commencement of my research higher degree candidature and does not include a substantial part of work that has been submitted to qualify for the award of any other degree or diploma in any university or tertiary institution. I have clearly cited which parts of my thesis, if any, have been submitted to qualify for another award. I acknowledge that the copyright of all materials contained in this thesis resides with me as the sole author. I have obtained copyright permission from the respective copyright holders to reproduce materials in this thesis which has been duly acknowledged.

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- Christine Amaldas

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Glossary

AACSB - *International Association to Advance Collegiate Schools of Business*

AI - *Artificial Intelligence*

Amazon EC2 - *Amazon Elastic Compute Cloud*

AOM - *Academy of Management*

APA - *American Psychology Association*

API - *Application Programming Interface*

APM - *Agent based Peer Manager*

ASCILITE - *The Australasian Society for Computers in Learning in Tertiary Education*

AWC - *Asynchronous Weak Commitment*

B2B - *Business to Business*

BBS - *Bulletin Board System*

CA-Cloud - *Coalition Agents Cloud computing architecture*

CAM - *Cronbach Alpha Method*

CAT - *Coalition Advertisement Token*

CBL - *Classroom Based Learning*

CBT - *Computer-Based Training*

CD-ROM - *Compact Disc Read-Only Memory*

CEOs - *Chief Executive Officers*

CES - *Course Evaluation Survey*

CGI - *Common Gateway Interface*

CHRIST - *Classification of Heuristics for Resource procurement, enhancing Innovative, Sustainability of Technology management*

CMS - *Content Management System*

COTS - *Commodity–Off–The–Shelf*

CPE - *Continuous Professional Education*

CPU - *Central Processing Unit*

CSCL - *Computer Supported Collaborative Learning*

CSV - *Comma-Separated Value*

CVLE - *Classroom Based Virtual Learning Environment*

DCSP - *Distributed Constraint Satisfaction Problem*

DHCP - *Dynamic Host Configuration Protocol*

EITM - *European Institute of Technology Management*

FOC - *Free of Charge*

FTP - *File Transfer Protocol*

GGF - *Global Grid Forum*

GPA - *Grade Point Average*

GP-GPU - *General-Purpose Graphics Processing Unit*

GUI - *Graphic User Interface*

HPC - *High Performance Computing*

HRM - *Human Resource Management*

HTML - *Hyper Text Markup Language*

IaaS - *Infrastructure as a Service*

IBT - *Internet-Based Training*

ICT - *Information & Communication Technology*

IP - *Internet Protocol*

IQ - *Intelligence Quotient*

IRAs - *Internet Rich Applications*

IT - *Information Technology*

KQML - *Knowledge Query & Manipulation Language*

LCMS - *Learning Content Management System*

LMSs - *Learning Management Systems*

LSEPS - *London School of Economics & Political Science*

MABs - *Multi-Author Blogs*

MBA - *Masters of Business Administration*

MCQs - *Multiple Choice Questions*

MLP - *University of Cambridge Manufacturing Leaders Programme*

MOOC - *Massive Open Online Course*

MOODLE - *Modular Object-Oriented Dynamic Learning*

MOT - *Management of Technology*

MS Excel - *Microsoft Excel*

MTI - *Management & Technology Infrastructure*

NUS - *National University of Singapore*

NWS - *Network Weather Service*

OERs - *Open Educational Resources*

OLAT - *Online Learning And Training*

OLEs - *Online Learning Environments*

OpenCL - *Open Computing Language*

OpenGL - *Open Graphics Library*

OSS - *Open Source Software*

P2P - *Peer-to-Peer*

PaaS - *Platform as a Service*

PDAs - *Personal Digital Assistants*

PHP - *Perl, Hypertext Pre-Processor*

Q&A - *Questions & Answers*

QoS - *Quality of Service*

RADs - *Role Activity Diagrams*

RAM - *Random Access Memory*

RP - *Rich Picture*

S&P 500 - *Standard & Poor's 500*

SaaS - *Software as a Service*

SCORM - *Sharable Content Object Reference Model*

SSM - *Soft Systems Methodology*

STaaS - *Storage as a Service*

TAGSs - *Task Assignment by Guessing Sizes*

TBL - *Technology Based Learning*

TCO - *Total Cost of Ownership*

TEL - *Technology-Enhanced Learning*

TERI - *The Energy & Resources Institute (TERI or formerly Tata Energy Research Institute)*

TML - *Technology Mediated Learning*

TV - *Television*

U.K. - *United Kingdom*

U.S.A. - *United States of America*

UDDI - *Universal Description, Discovery and Integration*

VCI - *Virtual Classroom based Interactions*

VMs - *Virtual Machines*

WBT - *Web-Based Training*

WebCTs - *Web Course Tools*

WSDL - *Web Services Definition Language*

Chapter 1

Introduction

[T]he ardent and pure in heart among the teachers are able to attract and leave more lasting impressions in the mind of the taught than. those who are loaded with academic qualifications for teaching.

– Swami child Bhavanda

1.1 Background

MANAGEMENT of Technology (MOT) in applied education is considered as one of the most important developmental issues facing Asiatic countries. The youth of these countries are dependent on education as their future resources towards development of their respective societies. Management education obtained major attention and big budgets from all walks of life as an artificial scenario created to make education available to every individual's requirements and beliefs towards societal development through economic incentives. Utilizing this 'management based educational system', students and professionals were expected to develop themselves to ensure their future along with the future of their families and their surrounding societies. In conjunction to such an aspiration, it is believed that management studies related to students' academic excellence and professional achievements utilizes a process of systematic teaching systems imposing numerous examples from relevant business experiences. Numerous experts have very recently raised several concerns about the current state of management research and pedagogy (e.g., Porter & McKibbin, 1988; Leavitt, 1989; Hambrick, 1994; Mintzberg & Gosling, 2002; Donaldson, 2002; Pfeffer & Fong, 2002) focusing on the lack of confluence of management research on management "best practices" and the lack of effectiveness of management education on the performance of business students in the industries and the academia (Ghoshal, 2005:76). Ghosal (2005), in his article raises a very different concern by arguing that academic research related to conducting business and management has had some very significant and negative influences on management. These influences have been less at the level of adoption of a particular theory and more at the incorporation, within the world-view of managers, of a set of ideas and assumptions that have come to dominate much of management research. More specifically, he suggested that by propagating ideologically inspired amoral theories, business schools have actively freed their students from any sense of moral responsibility (*ibid*). [1]

Supporting research and evidences (Chia, 2005; Chia & Holt, 2008; Ham-

[1] Amaldas *et al.* (2012b). Understanding Academic Assessment Mechanisms: A Case Study on the Impact of Western Education Influences in Asia. *Proceedings of Frontiers in Education: Computer Science & Computer Engineering (FECS)'12*, 2, 625-631, Las Vegas, Nevada, U.S.A., CSREA Press.

brick, 1994; Mintzberg & Gosling, 2002; Donaldson, 2002; Pfeffer & Fong, 2002) indicate that the mastery of business concepts by students lead them into business pathways taking them to the next level but miserably failing to teach them moralities and ethical values. The ultimate goal must be to go from the pretense of knowledge to the substance of knowledge with respect to teaching business concepts. The nature of the academic process naturally favors building on the existing edifice of theory instead of starting over, on fresh ground (Ghoshal, 2005:81). Business mechanisms assume that people can behave opportunistically and draws its conclusions for managing people based on that assumption which can induce managerial actions that are likely to enhance opportunistic behavior among people (Ghoshal & Moran, 1996). Ultimately, if the trend in management theory is to be reversed, only business school academics can do so. This is not going to be easy. Another theory by (Osterloh & Frey, 2003), draws on the prescriptions of corporate governance on the assumption that managers cannot be trusted making managers less trustworthy. Due to this, many ideas and initiatives such as the use of Six Sigma (a methodology for minimizing mistakes and maximizing value) in businesses have been generated to improve the quality of the management processes, thus, ensuring the quality of the teaching and learning processes (at least in management based education) to be competent within the context of research and development and its findings with respect to the industry. In terms of policy making, all educational policy makers must plan various strategies besides providing sufficient learning facilities (technological infrastructures) and trained academics (faculty support) within institutions equally.

This study was conducted using the interaction survey method with in-depth personal interviews consisting of open ended questions with 250 international academics (respondents consisting of Japanese and Foreign teaching staff) chosen for the study based in Japan and Vietnam. The instruments employed in the study were specifically developed to encompass all tasks and duties based on teaching specifications formulated towards the MOT framework utilized at the department of Business and Management Studies and the department of Information and Communications Technology (ICT). Specific elements explored were factors influencing MOT adoption and usage in teaching environments including: Gender, Skillset, Age, Class Handling, Teaching Experience and Intrinsic and Extrinsic motivation levels such as Competitiveness, Popularity of students, Passing rates, Job Satisfaction, Teaching Interests and Workload. The discussions in this research focus on the factors that influence the intrinsic and extrinsic motivation levels in international tenured academics and contractual teaching staff in Management and Business departments with respect to the adoption of MOT related methodologies. A set of hypotheses were defined to test the variety of variables needed to deduce the relationship between teaching and adoption of MOT as a framework.

Indicators are useful for monitoring progress towards specific regional goals. Adequate and affordable education have been key enablers of economic development with the transition being from subsistence agricultural economies to modern industrial and service-oriented societies. Management based education is central to improving social and economic well-being, and is indispensable to most industrial and commercial wealth generating societies. Education has been the key factor towards relieving poverty, improving human welfare and raising living standards. Most countries depend on education and educational resources (such as the internet today) as a source of knowledge capital that is constantly evolving towards life long learning. This lack of access to modern educational services severely limits socio-economic development prevalent in many developing societies such as India and Vietnam which is an integral part of sustainable socio-economic development.

1.1.1 Site Selection for the Study

The research was conducted at various institutions in two specific regions in the Asia Pacific namely: Japan and Vietnam. The University, namely addressed here as Institution A, is set in the land of the rising sun (Japan) with its picturesque beauty overlooking the Pacific Ocean. The two towers speaks of the height to which a university should rise upto since its infancy years. The founding principles: Freedom; Peace; and Humanism. The fundamental structure with the faculty and student body comprises of both foreign and domestic talents globally to adapt a truly Asian international campus especially in embracing intercultural and diversified environment of people (race) together with religion, culture and heritage. The University, known as Institution B, is located in one of the most dynamic emerging countries in the East Asia region, Hanoi, Vietnam. A fascinating country with scenic beauty which is developing rapidly with multiple new avenues of opportunities emerging every day, with immense growth and constantly adapting to changes (Contingency theory) would be the next best location to do field research with daily case studies in development and change (Adapted from Amaldas *et al.*, 2010). The founding principals: Optimum Quality of Teaching and inculcating a English speaking campus environment. The basic pillars are the faculty and student body which consists of both foreign and domestic talents worldwide. The parent University forms the basis of the education structure. Students body comprises of children of farmers to Diplomats which attributes to the diversity of unity and contributes to the wealth of knowledge shared in any given discipline.

The main reason for conducting this research on site was the fact that the researcher was working as an academic in these institutions which paved the pathway for deploying the right research instruments in gathering primary and secondary sources of data from business related departments. The site selection was specifically made due to the following sources of information made available during field research: (a) the familiarity of the institutions and the availability of resources to the researcher, leading to speedy accrual of primary and secondary data sources during field trips; (b) known issues pertaining to the MOT adoption levels prevailing in these sites comparing current and previous field survey information was also one of the criteria for deploying data collection in the selected institutions; (c) immediate access to numerous stakeholders such as local administration, academics, students and faculty data such as course experience and class performance, government officials, and other stakeholders with reference to an institutional environment, etc; and (d) the lack of knowledge towards the adoption of MOT at the policy level made the collection and evaluation of data using empirical methods a unique study. The research focuses on evaluating the current MOT potentials of applying hybrid learning mechanisms into the classroom environment using a holistic approach to the methodologies used in empirical evaluation of the two sites. Two Institutions were chosen for the purpose of identifying MOT Potentials in the selected sites. Field studies indicate commonality in educational levels and resources used in certain scenarios wherein a comparative approach of evaluating MOT adoption is undertaken using qualitative and quantitative methodologies. Viability of the study is verified using empirical evaluation followed by theorizing the feasibility of MOT potentials and adoption in an educational context with respect to business departments. A new MOT based High Performance Framework is proposed towards hybrid learning in the selected institutions in this study (Adapted from Amaldas *et al.*, 2013c).

1.2 Thematic Focus

It is every academic administrator's responsibility towards improving the quality of teaching and learning in tertiary institutions across the society. Research and academic "Think Tanks" such as the National University of Singapore (NUS), The Energy and Resources Institute or formerly known as Tata Energy Research Institute (TERI), Stanford, Harvard, etc., need to strategize mechanisms to instigate researchers and academics in the business domains to rethink their roles with respect to societal development. While the leaders of the Academy have duly expressed their concerns about the corporate scandals, they can do much more to create a new intellectual agenda that would support James Coleman's (1992) vision of the social sciences, providing actual help in what he described as "the rational reconstruction of society." Martin Seligman, through his actions in the American Psychological Association, has already shown what some of these actions can be (Ghoshal, 2005: 89). In this context, the tertiary institutions dealing with educating students in Management and Technology Infrastructure (MTI) development is responsible for implementing various educational support programs especially to inculcate the use and integration of educational technologies among academics and students to improve the effectiveness of the teaching and learning processes incorporated in business education. There are numerous claims that academic programs with respect to business and entrepreneurship education do not adequately prepare graduates for the "real world". Harvard Business Review for instance published an article on the subject as far back as 30 years ago (Livingston, 1971), later instigating several articles to publish on the topic since then, each offering different criticisms and recommendations (e.g., Dertouzos, Lester, & Solow, 1989; Porter & McKibben, 1988; Steiner & Wells, 2000; Mintzberg & Gosling, 2002; Pfeffer & Fong, 2002; Ghoshal, 2005; Nahapiet & Ghoshal, 1998; Bennis & O'Toole, 2005).

Managing technologies and enabling learning based on technological domains with respect to business is not a new concept. For example, in an interview conducted by the Academy of Management (AOM) indicated that Universities of Waterloo and Toronto currently deliver in-class technology entrepreneurship courses showcasing "classroom" learning which can be extended to the wider community. Educational resources need to be developed that can be edited for use in various teaching environments which could include: assignments; business development plans; and managing social networks. The definition formulated for MOT framework used in this research is based on the definitions of the European Institute of Technology Management (EITM, 2007), Khalil (2000), Tabbada (2000) and Kanz and Lam (1996). Khalil (2000) defines MOT as an interdisciplinary field that integrates science, engineering, and management knowledge and practice by viewing MOT as an interconnection amongst disciplines focusing on technology creation enabling service oriented economic incentives (Academic Perspective). EITM (2007) defines MOT as involving the effective identification, selection, acquisition, development, exploitation and protection of technologies needed to maintain a market position and business performance consistent with individual company goals (Industry Perspective).

On one hand, Kanz and Lam (1996) take the role of defining MOT using a more practical viewpoint as simplistic societal leveling linking the underlying use of technologies working together with people to achieve systematic methods towards applying knowledge in order to produce goods and services. On the other hand, Tabbada (2000) takes on a higher tier of academic perspective defining MOT as an educational research tool fabricated to manage the technology components of individual product life cycles, capitalize on process technology to gain competitive advantage; and integrate product and process technologies, thus, making MOT a technology enabler in service oriented economies. In this study, bridging the Academic and Industry Perspectives, MOT is defined as an educational framework that is utilized in engineering, science and management departments towards knowledge acquisition for the effective standardization and delivery of industry recognized courses as the core components in tertiary institutions. Utilizing this structure, the researcher intends to provide the necessary framework for the educational institutions and multinational organizations to gain competitive training advantages towards attaining desired levels of growth and performance on its students and future employees.

Motivation at the workplace is determined by three principles namely, intrinsic motivation, extrinsic motivation and basic psychological needs (Hackman, & Oldham, 1976). Motivation refers to action, direction, intensity and behavioral persistence (Gordon, *et al.*, 1983). The Two-Factor theory explored by (Herzberg, 1966; 1968) puts the stress on the importance of intrinsic and extrinsic motivational levels wherein psychologists indicate that intrinsic motivation is the direct result of the relationship between employees and their work which is usually self-instigating. Extrinsic motivation is formed based on the external environment of the workplace usually controlled by several variables directly or indirectly by different levels of stakeholders.

The relationship between intrinsic and extrinsic motivational levels indicates that when both results of the former and the latter are attractive, it will contribute positively to the motivation levels of the individual. In this context, career planning is directly affected by the employee's motivation levels that is influenced by his or her work environment (Holden, 1990, 1991). Employees, amongst others, are influenced by several factors, like environment and ecology, perception, memory, cognitive development, emotion, behavior and personality (Huitt, 2001). Rewards especially, can stimulate motivation and generate the actions required to do an activity (Enabou & Tirole, 2003). At the same time, emotional and material support enable staff to become more committed (Brandt, 1995) in doing an activity. Besides this, good and close relationships between staff also influence the commitment within staff (Nordin, 1997). In relation to this, training provided to teaching staff also improves commitment and job performance within them (Sahandri, 2008). Good communication in organizations also encourage job satisfaction, job performance and job commitment and these can be considered as assets in an organization (Sharifah & Balan, 2001).

1.2.1 Research Question

So far, we have discussed the need for MOT adoption and its utility as a tool for learning. We now explore the fundamental premise of how well this adoption takes place in developed and developing countries in comparison by formulating the following research question(s):

> *"To what extent does MOT adoption impact the learning and teaching methodologies with respect to classroom and online learning respectively?"*

The research looks directly at: (i) the motivational levels of international academic staff; (ii) the level at which they are comfortable in adopting and utilizing MOT framework in their teaching and curriculum development; and (iii) the impact this has on the students digesting materials with respect to the real world businesses in business departments are evaluated in the field research undertaken. A part of the research also answers the four crucial sub questions in the area as follows:

- Does the adoption of MOT as a framework have any effect on the motivation levels of international academics in management related departments?
- Technology integrated learning has its effects on learning...Is there any improvements in learning when utilizing technologies such as Technology Mediated Learning (TML), Classroom Based Learning (CBL), Learning Management Systems (LMS), Web Course Tools (WebCT) and other related technologies?
- To what extent does current systems satisfy the needs of the end user (in our case the students)?
- Do student ratings of instruction reflect a higher class satisfaction score in the hybrid learning environment when compared to the traditional face-to-face learning?

To answer these questions, the following hypotheses, assumptions and objectives were formulated in the following sections.

1.2.2 Hypotheses

Based on the research questions the following hypotheses is evaluated in the research with respect to faculty and students perceptions individually.

"Is there a significant difference in MOT based motivation and training awareness amongst the academics with respect to their Gender(Ho_1),

Skillset(Ho_2), Age(Ho_3), Class Handling(Ho_4), Teaching Experience (Ho_5) and Intrinsic and Extrinsic Work Motivational Factors(Ho_6)?"

The hypotheses (Ho_1 - Ho_6) tests the six variables listed above for statistical significance with regards to the adoption of MOT based motivation and training with respect to staff of the selected institutions (Japan and Vietnam).

"Is there a significant difference in student's performance when introduced to Traditional and Hybrid Learning environments with respect to their Ethnicity (Ho_1), Age (Ho_2) and Gender (Ho_3)"?.

The hypotheses (Alternate Ho_1 – Ho_3) tests the three variables listed for statistical significance with regards to the adoption of MOT based motivation and training with respect to students in the selected Institutions (Japan and Vietnam).

1.2.3 Theoretical and Conceptual Framework

Theoretical and conceptual frameworks in management theory and practice support understanding of an issue or area of study, providing structure, support, decision making and action. Before considering MOT principles in developing our framework which is the focus of this research, it is worth reviewing what is meant by the term 'framework'. There is little rigour or consistency in the literature in terms of definition, development and application of frameworks, and other related terms such as models, maps, methods, etc. In order to clarify this, the ‘meta-framework’ has been proposed by Shehabuddeen *et al.*, (2000) which structures a number of related terms for management representations and approaches according to two key dimensions: applied-conceptual and static-dynamic, defined as follows (Phaal *et al.*, 2004):

- Conceptual: concerned with the abstraction or understanding of a situation.
- Applied: concerned with concrete action in a practical environment.
- Static: concerned with the structure and position of elements within a system.
- Dynamic: concerned with causality and interaction between the elements of a system.

The design of any academic role is a vital contributor to an employee’s (faculty and students in our case) motivation to connect with innovation (Axtell et al., 2000; Hackman & Oldham, 1980; West & Farr, 1990). West (2003) suggests three specific approaches:

First, Action Theory (Frese & Zapf, 1994; Tschan & Cranach, 1996; West, 2003) views tasks with regards to hierarchical, sequential and cyclical process requirements. Tschan and Cranach (1996) argue that tasks should be deconstructed into: hierarchical requirements (goals and sub goals); sequential demands or restrictions imposed on the order where sub-tasks are conceded; and cyclical nature of information processing, e.g., planning, executing, and evaluation. Action Theory despite its potential has not been widely used (West, 2003).

Second, Socio-technical theory (Trist & Bamforth, 1951; Emery, 1959; Cummings, 1978; Cooper & Foster, 1971; Pearce & Ravlin, 1987; Cohen, 1994; West, 2003) presents the framework on the effects of task design upon workgroup innovation. Autonomous workgroups provides a structure that tries to meet the demands of the social and technical sub-systems of an organization. This theory proposes that the technical subsystems of any task unit have to be optimized and balanced consecutively with the social subsystem, whereby the technological and spatial working conditions should be designed to be part of human demands of the social system. The two subsystems are interconnected by team members' occupational roles and by co-operative and interdependent relationships. The key to an effective performance is whether the workgroup can control the variation in quality and quantity of task performance at the source (Cordery, 1999). This variance control implies innovation, as the workgroup will develop new ideas and improve methods of working with technologies in order to achieve control of variance in task performance appropriately. West (2003) claims that joint optimization of two subsystems are prone to take place when workgroups have the following characteristics:

- The team is a relatively independent organizational unit that is responsible for a given task.

- The tasks of members are related in content to create awareness of commonality of task which indirectly enables all the members to work interdependently.

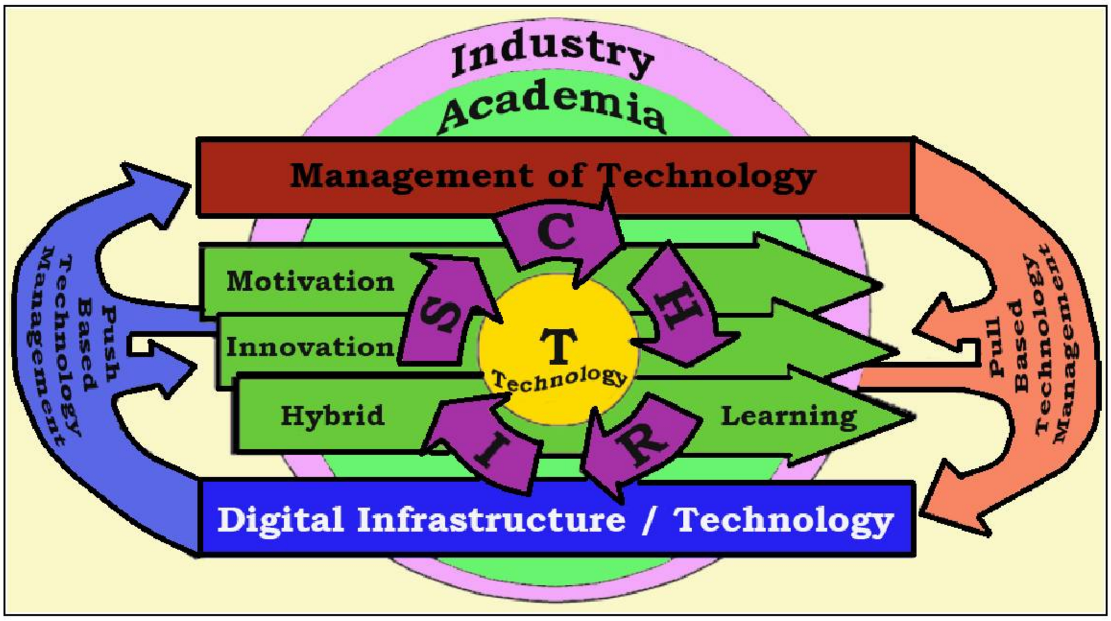
- The 'unity of product and organization' is for a group to perform the entire task; and group members can 'identify with their own product' (Ulich & Weber, 1996).

According to the theorists, the above characteristics will produce 'task orientation' being a state of interest and engagement produced by task characteristics (Emery, 1959). This condition (Nsenduluka, 2008:48) is related to the concept of intrinsic motivation that Amabile contends which is the foundation to creativity and innovation at work (Amabile, 1983; Amabile & Conti, 1999). Therefore, in accordance to socio-technical theory, the task is the focal point of a psychological view of activity as it represents the intersection between the group and the organization and therefore, is the optimum psychological element of working conditions (Nsenduluka, 2008:48). In the presence of the above three conditions of autonomous workgroups, there is a high tendency for specific groups to develop ideas; and implement new and improved products, processes or procedures. In accordance to the socio-technical theory, 'task orientation' or 'intrinsic motivation' (innovation), are evoked by completeness (i.e., whole tasks); varied demands; opportunities for social interaction; autonomy; opportunities for learning; and development possibilities for the task (Nsenduluka, 2008:48). A vital prerequisite for considering dynamic influences of psychological, social psychological and environmental factors upon group innovation is the recognition that task requirements and the relationship between the technical and social subsystems have a major influence on levels of group innovation. To summarize, the level of group autonomy (in an innovation-supportive organizational context) and the task requirements of completeness, varied demands, opportunities for social interaction, opportunities for learning, and development opportunities will predict group innovation (*ibid*:49).

Third, currently the best-known framework for studying the work design innovation relationship is the job characteristics model (Hackman & Oldham, 1976; 1980; Hackman, 1987; Oldham & Cummings; 1996; Spreitzer *et al.*, 1999). This framework is similar to the socio-technical approach as both propose a link between task design and innovation. A vital characteristic of job design paves the significance of the current research being 'self managed' which is group analogy to autonomy at the individual job level. Another characteristic is 'participation'. Regardless of strategic or operational management involvement in the decision-making processes, workgroups are allowed to contribute their decision (McGrath, 1984; Porter *et al.*, 1987; Porter & McKibben, 1988; Lawler *et al.*, 1974). Self-management and participation enhance group effectiveness including inclination for innovation by increasing members' sense of responsibility and ownership of the work (Nsenduluka, 2008:50). Other characteristics include: (1) 'task variety' - gives each member the chance to perform a number of tasks as a group; (2) 'task significance' - the manner in which the job impacts the lives or task of others regardless internal (immediate organization) or external environment. Members must have confidence that their group's work contribution has substantial benefits to both inside the organization or its customers (Hackman, 1987); and (3) (*ibid*) claims that group work should incorporate 'task identity' where the group completes an entire and individual piece of work. Identity helps to increase motivation as it increases a group's responsibility for meaningful piece of work (Nsenduluka, 2008:50).

Both Hackman and Oldham's (1996) job characteristics theory and socio-technical theory suggests that workgroup task design is critical for an employee's motivation, satisfaction, performance and innovation (Guzzo and Shea, 1992; West, 2003; Lantz and Brav, 2007). Both theories suggest that to positively impact employee reactions, the job must be designed to incorporate a variety of skills; it should be a wholesome and identifiable tasks which aids the members to view their efforts; the task should have significant impact on the lives of people; the team should have considerable autonomy and independence in determining how the work will be done; and regular and up-to-date feedback should be given so that the team can perceive their level of performance (Nsenduluka, 2008:50-51). The rationale is that task orientation, intrinsic motivation, and innovation are said to be evoked by autonomy or self management (at the group level), participation, task variety, significance, identity, and by completeness (whole tasks) and by learning and development opportunities (West 2003; Amabile 1983). As the level of analysis in this study is group oriented (Nsenduluka, 2008:51), the foregoing task characteristics will be treated as workgroup concepts (Spreitzer *et al.*, 1999).

Figure 1.1: Theoretical Framework



Source: Formulated by the Researcher, 2013

The theoretical and conceptual framework shown in Figure 1.1 on page 20 and Figure 1.2 on page 23 models the system within which technology management considerations can be explored (e.g., the technological innovation system of Betz, 1998, the technology system interfaces defined by Geistauts and Eschenbach, 1997, and the product development systems model of Simons and de Klerk, 1997). In this study, the Theoretical and Conceptual

Framework were created by the researcher on the theoretical principles of Applied and Dynamic models (Phaal *et al.* 2001) adapted from the Job Characteristics Model (Hackman & Oldham, 1976; 1980; Hackman, 1987; Oldham & Cummings, 1996; Spreitzer *et al.*, 1999). The importance of defining the system, including its boundaries, interfaces and elements, and the relationships between them, is supported by general systems theory (e.g. Arbnor and Bjerke, 1997, Ackoff, 1999, Jackson, 2000). A "Rich Picture" (RP) is an informal type of representation that can be used in conjunction with Role Activity Diagrams (RADs) to map the systems' processes. The RP is rated ultimately to be a flexible and universal communication tool unlike other graphical techniques like Data Flow Diagrams (DFDs), RP has no rules or constraints. RP is used as part of the Checkland's Soft Systems Methodology (SSM) (Checkland, 1981; Checkland *et. al.*, 1990; Davis *et. al.*, 1991; Dunning-Lewis, 1992; Wilson 1990). Novice learners can dabble with RP at ease as an artistic talent is never a critical concern. No expertise is required to interpret RPs compared to DFDs which needs the professionalism and knowledge of experts.

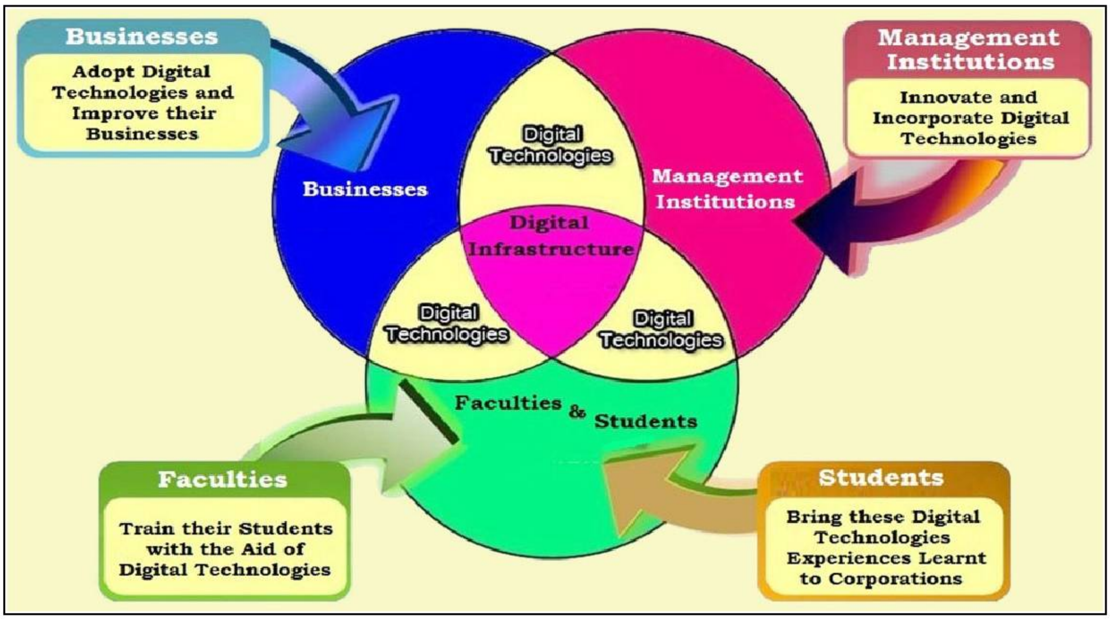
Graphical representations comprises of: Cloud (role, activity); Realistic icons (people, books, travel); Symbols (hats for roles in case study); Text (communications, explanations, thoughts); Arrows (relationships); Concrete aspects (examination); Cognitive aspects (development of understanding); Conflict (crossed swords); Emotion (satisfaction, puzzlement, humility); Abstract concepts (modules forming whole, deep thinking); Metaphor (quantum leap);

and Progression (muddle to clarity) and other key items suited as per the users' prerequisites. The 'soft' systems perspective (Checkland, 1981), where the importance of how people perceive and interact with the system is particularly relevant to technology management which requires co-operation between technological and commercial functions (Linstone, 1999).

The concepts discussed in this section constitutes of technology as an important resource in the selected institutions. Technology management processes operate on the technology base in the context of education and training systems providing the components for technology management as a framework. The overall aim of the framework is to support an understanding of how technological and commercial knowledge combines to support strategy, innovation and operational processes in the academia, in the context of both the internal and external environment (Phaal *et al.*, 2001).

This is a high-level framework that supports broad understanding of key aspects of technology management. The numerous particularly involved activities and aims that are associated with technology management practices in firms depends on the particular context and objectives followed. Detailed frameworks have been previously developed to support decision making and action in some of these more specific areas (e.g., Canez *et al.*, 2001, Shehabuddeen, 2001). At the heart of the framework lies the technology base of the institution which represents the technological knowledge, competences and capabilities that support the development and delivery of com-

Figure 1.2: Conceptual Framework



Source: Formulated by the Researcher, 2013

petitive products and services, and other organizational goals. Six technology management processes indicate, Classification of Heuristics for Resource Procurement enhancing Innovative Sustainability of Technology management (CHRIST) operating as follows:

- *Classification* of technologies that are not currently part of the institutions technology base but may be important in the future (e.g. LMS, CMS, Web-CT, Blackboard, etc.,).

- *Heuristics* of those digital technologies and infrastructure support needed by the institution for its future training and technological usage.

- *Resource Procurement* of the technologies that have been selected including Software licensing, Research and Development, compute resources, etc.

- *Innovative* usage and acquisition of technologies.
- *Sustainability* of the technological and infrastructural assets of the institution or organization. Examples include intellectual property rights, ethics, resource reservation, etc.
- *Technology management* involves the verification, validation and holistic usage of disruptive technologies and innovations adapted to the field of learning and management studies.

The CHRIST technology management processes defined do not operate in segregation and are generally not managed as separate 'core' academic processes. The various activities that constitute these management processes tend to be distributed within other academic processes (for instance, technology selection decisions are made during academic strategy and new courseware or content development). The link to core academic and industry processes is important, as these are the focus of management and action in education, and the means for ensuring sustainable productive output of the institutions. The aim of an effective technology management is to ensure that technological issues are incorporated appropriately into these processes, to form a technology management system that is coherent and integrated across and beyond specific academic processes and activities. The framework emphasizes the dynamic nature of the knowledge flow that must occur between the commercial and technological functions in the institution(s), linking to the strategy, innovation and operational processes towards an effective technology management. An appropriate balance must be struck between market 'pull' (i.e. market demand), and technology 'push' (i.e. market supply). Various 'mechanisms' can support the linkage of the commercial and technical perceptions, including traditional communication channels (e.g. forums, emails, blogs, etc.), cross-functional team meetings, educational tools, academic processes, faculty training, etc.

The specific technology management issues faced by institutions depends on the context (both internal & external), in terms of organizational structure, digital systems, infrastructure, demographics pertaining to the academic environment and challenges confronting the organization, which changes over time. Systems' thinking is a new paradigm set to revolutionize management practice in the 21st century (Adapted from Jackson, 2000). In this regard, Contingency theory is very relevant. Contingency theory is a behavioral concept that states that there is no single optimum manner to design organizational structures (Adapted from Amaldas *et al.*, 2010). This theory emerged in the 1950s in contrast to traditional organizational and management theory which primarily focused on organizational design stating that there is no superlative manner of structuring an organization (Morgan, 1998:44; Jackson, 2000:110). The optimal design depends on situational factors (contingent or contextual factors) as they tend to impose constraints on the organization (Drury, 2004:695-696; Jackson, 2000:110; Schlegel, 2011:70).

On one hand, the traditional method focused on task and structure and the human relations approach centers on people. Therefore, these approaches were “reductionist” as they concentrated on individual parts of the organization in isolation or “closed” angle ignoring the environment. On the other hand, the systems approach is “holistic” as it looks at an organization as a whole from an “open system” perspective having constant interaction with the environment (Adapted from Jackson, 2000:62). Time is a key dimension in technology management, in terms of synchronizing technological developments and capabilities with business and academic requirements, in the context of evolving markets, educational products and technology. Although time is not explicitly depicted in the framework, it is implicit in businesses and academia utilizing CHRIST technology management processes in future. The concept of ‘push’ and ‘pull’ technologies, which is a central feature of the technology management framework, is illustrated in Figure 1.1 on page 20, which shows how people, information, documents, resources, processes, etc. are connecting key business processes including commercial and technological perspectives (adapted from Muller, 1999). As noted above, technology management processes do not exist in isolation, and tend not to be managed as explicit ‘core’ business processes but rather as distributed activities within other business processes; the most fundamental of which being strategy, innovation and operations. Effective technology management requires that these relationships be understood and supported by effective knowledge management systems (i.e. 'push' and 'pull' mechanisms). The following objectives illustrate the complex relationships between these businesses and technology management processes in an academic setting.

1.2.4 Research Objectives

This study has been undertaken to: (1) Examine the extent to which selected departments and groups of classes were engaged in MOT based teaching delivery; (2) Determine the significance of MOT in promoting knowledge acquisition and industry exposure based growth; (3) Analyze the critical factors for success of the students at the industry level; (4) Assess the problems faced by small enterprises in managing technologies related to job training; and (5) Formulate recommendations for institutions and industry linkages towards the adoption and effective utilization of MOT based educational mechanisms. This study is specifically linked to:

- Find out the MOT based motivation and training awareness amongst International and Local academics or teaching staff in management departments in the selected tertiary institutions.
- Find out whether there is any significant difference in MOT based motivation and training awareness among the academics with respect to their: (a) Gender; (b) Skillset; (c) Age; (d) Class Handling; (e) Teaching

Experience; and (f) Intrinsic and Extrinsic Work Motivational Factors.

- Defining the level of influence of the chosen factors towards the MOT based training amongst international academics.
- Defining whether or not there is a significant relationship between work motivation and its academic staff and their performance within the selected institutions.
- Analyzing the work flow performance of Academics and its associative staff members.

1.3 Significance of the Study

The writings and explorations in this research can help with the adoption of MOT in business and management departments towards planning and implementing programs and activities to improve the quality of human capital and improve the staff performance levels to achieve its aims and objectives. The department in turn also needs to provide the infrastructure, work environment and job specifications, etc., to enable them to give excellent service for the customers (students, parents and other stakeholders) who are involved in the implementation of the activities. These major activities will contribute to the policy makers and governments to realize the importance of MOT in Education Development Planning towards strengthening the educational system of a country. The main contributions of this research are:

- This study analyses the status of the current MOT based infrastructure and its related digital technologies in tertiary institutions. Industry links indicate some of the key problems relating small to medium-sized enterprises with respect to training, identifying gaps faced by the immediate faculty and students (Adapted from Amaldas *et al.*, 2012b).

- The study sums up the characteristics of the MOT related technologies and digital infrastructure requirements and problems encountered during training of business students for the industries in business related departments. Hence, gaps in the Total Cost of Ownership (TCO) of Information and Communication Technology (ICT) resources and related training constraints were observable.

- A "Holistic" Software Architecture for modeling educational services using a prototype Coalition Agents Cloud (CA-Cloud) Computing Architecture was used in testing the performance of educational Cloud service;

- A Multi-agent based Cloud services Architecture (CA-Cloud) that utilizes Power server mechanics for modeling Coalition (team formation) based optimization in Clouds is proposed here as an alternative to traditional teaching and learning.

The fish bone diagram is used in this research as an analysis mechanism to provide a systematic manner to view the effects and the causes in a step-by-step process. Although it is a cause and effect diagram, it is referred to as a fish bone diagram because of the skeletal design of a fish as shown in 1.3 on page 32.

1.4 Structure of Thesis

The first chapter, besides outlining the objectives of the study briefly described the background to the research, the problem statement and elaborated on the relevant literature associated with the research. A conceptual framework was created towards understanding the idea behind utilizing MOT related technologies with the core focus being on the impact of MOT adoption and related technologies utilized by the faculty and students. The research implies that the job performance of the international academics strongly depends on various motivational factors with respective to the roles of international teaching staff that were inter-connected to each other. The introduction served as an example of current teaching standards in the business domains being presently deployed in various international institutions. In addition to this, definitions and notations were also provided in this chapter.

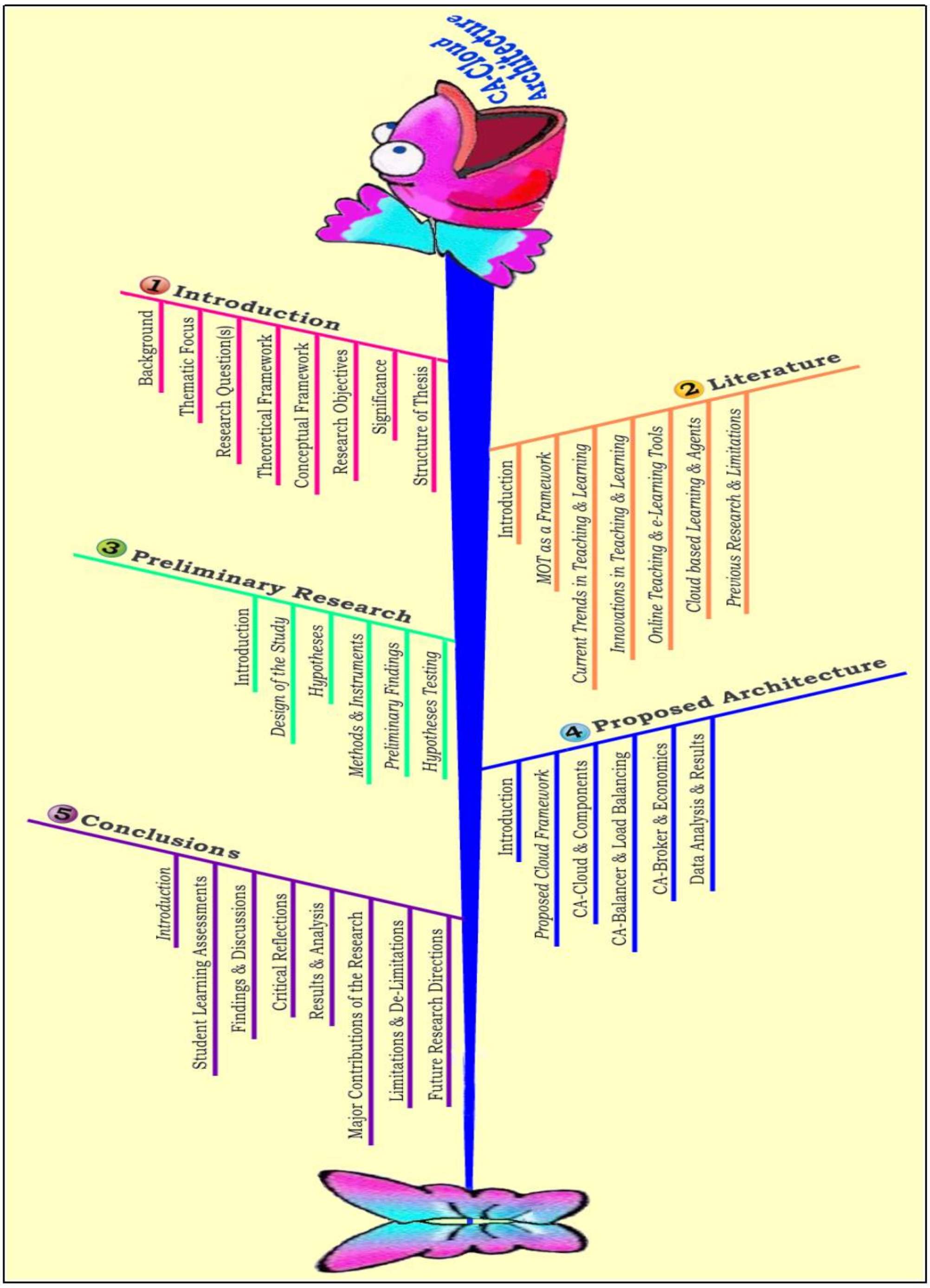
The second chapter, via an extensive literature review examines the MOT related technologies discussing about the penetration of MOT as a framework; digital technologies and ICT related services responsible for the management and training of business students who are absorbed into the industries with this know-how or tacit knowledge (Adapted from Amaldas *et al.*, 2013b).

The third chapter, describes the methodological framework and the instruments used in observing the impact of adopting MOT related technologies in the selected study sites. The discussions lead to the preliminary findings from the field work; objectives of the study and the theoretical framework incorporating MOT related technologies: WebCT, Cloud computing, LMS, etc., followed by the primary and secondary data collection during the field trips.

The penultimate chapter, talks about the various technological options available towards the adoption of MOT and its related technologies. Technology selection and justification followed by the goals of the research revisits the research questions, objectives and significance of the study. Hypotheses previously defined relates to the variables tested for correctness in this study; the rest of the chapter statistically explores the realms of MOT influence and adoption in various streams of teaching in numerous departments through the verification and validation of the data collected.

The concluding chapter of the thesis reiterates the objectives of the study, the research questions and discusses the extent to which they were achieved. Some of the limitations and de-limitations of the study, implications and policy recommendations are discussed followed by the future research directions.

Figure 1.3: Fish Bone Thesis Structure Map



Source: Formulated by the Researcher, 2013

1.5 Chapter Summary

This chapter introduced the concept of MOT adoption in the selected sites, namely, Institutions A (Japan, a developed country) and Institution B (Vietnam, a developing country). A theoretical and conceptual framework was created towards understanding the idea behind utilizing technology based teaching and learning outcomes in the selected sites with the core focus on LMS related technologies. The problem statement was defined based on the collected dataset followed by the objectives, assumptions and significance of the study undertaken. The forthcoming chapters in the thesis will have in-depth discussions on the implementation of the proposed framework; its significance; implications on intrinsic and extrinsic motivational levels of faculty; and students learning outcomes. The implementation of the CA-Cloud Architecture enabled the empirical evaluation of the data collected.

Chapter 2

Literature

This chapter discusses the literature review, implications and recommendations elaborated after introducing the gist of the thesis. The secondary sources of data collection through research, archival and published data are narrated after the introduction chapter.

2.1 Introduction

THis chapter provides a macro-societal perspective on Management of Technology (MOT) and its related strategies currently practiced in the two selected study sites. The introduction provides a review of literature on Hybrid Learning, Education and Educational technologies such as Learning Management System (LMS), Web-Course Tools (Web-CT) and High Performance Computing Architectures related to the study. Next, a thematic focus on educational related services are discussed: an introduction to Cloud computing, existing models and their layered design are presented[1]

2.2 What is a MOT Framework?

Technology management addresses the effective identification, selection, acquisition, development, exploitation and protection of technologies need to maintain a stream of products and services to the market (EITM, 2007; Gregory, 1995:392). MOT deals with all aspects of integrating technological issues into business decision making and is directly relevant to a number of 'core' business processes, including strategy development, innovation and new product development, and operations management. Vigorous technology management requires incorporating necessary knowledge flows between commercial and technological perspectives in an organization towards achieving a balance between market 'pull' and technology 'push'. The nature of these knowledge flows depends on both the internal and external context, including factors such as business aims, market dynamics, organizational culture, etc., (Phaal *et al.*, 2001a).

ICTs are changing the way our society stores and communicates information. Users of online resources are faced with two major questions: To what extent can I rely on what I am reading? and, How can I use it? or Can

[1]Some parts of this chapter has been adapted from Amaldas *et al.* (2013b). Understanding Academic Assessment Practices: A Case Study on the Impact of Western Educational Influences on Faculty & Students in Asia. *The International Journal of Creative Thinking & Educational Research, 10,* 40-51. ISSN 2301-3087.

I use it? The open nature of the World Wide Web has led to proliferation of both accurate and inaccurate information; in addition, a plethora of different approaches to copyright has been disseminated and re-purposed by both novices and experts in appropriate and inappropriate ways. Hence, a logical starting point is to look at the open nature of the Web and observe, what impacts information with respect to education in general. Over a decade ago, Clayton Christensen described the difference between sustaining and disruptive technologies (Christensen, 1997). Sustaining technologies improve current practices in a company or organization without requiring major alterations in a way things have always been done; disruptive technologies require dramatically different ways of operating. Christensen noted that well-established, successful companies often resist major changes in their business models and may be forced into bankruptcy by new competitors who are willing to embrace disruptive technologies. To date, professors and administrators appear to have been more than willing to accept sustaining technologies, like PowerPoint and Rich pictures, than to adopt practices that disrupt traditional methods of teaching. Information is so fundamental to the educational enterprise that significant changes in the way it is organized, used, and stored are very likely to be disruptive in the future.

The term "digital divide" has historically been referred to a division between those who have or do not have computers. A more dangerous separation may well be that some people will not have the training and experience needed to use computers in a more sophisticated and powerful manner. This divide will depend upon appropriate training in the use of new technologies as well as access to online information sources.

In this research, MOT is defined as an educational framework that is utilized in engineering, science and management departments towards knowledge acquisition for the effective standardization and delivery of industry recognized courses as the core components in tertiary institutions. Utilizing this framework, the researcher intends to provide the necessary framework for the educational institutions and multinational organizations to gain competitive training advantages towards attaining desired levels of growth and performance on its students and future employees (Adapted from Amaldas *et al.*, 2012d).

The role of technology management function in an organization is a value addition of certain technologies. Continuous development of technology is valuable as long as there is a value add-on for the customer and therefore, the technology management function in an organization should be able to argue when to invest on technology development and when to withdraw. Technology Management can also be termed as the integrated planning, design, optimization, operation and control of technological products, processes and services, a better definition would be the management of the use of technology for human advantage (Technology Management, 2012). A fundamental point when understanding how technology is acquired is that technology is not just a physical thing but also comprises of knowledge embedded at the hardware and software level. The acquisition of technological capability is therefore not a one-off process but a cumulative one in which learning is derived from the development and use of technology (Bennett & Vaidya, 2001). Technology Based Learning (TBL) constitutes of hybrid learning via electronic technology, including the Internet, Intranets, satellite broadcasts, audio and video conferencing, bulletin boards, chat rooms, webcasts, etc. TBL fosters greater accessibility to hybrid learning by offering anytime and anywhere content delivery. Furthermore, hybrid learning can be synchronous, when delivery occurs where instructors and learners meet at a specific time in a physical or virtual classroom, or it can be asynchronous, when the learning does not occur at a pre-specified time and thus, can be self-paced. Webinars or web based conferences, online forums, electronic mailing lists, wikis and virtual collaborative workspaces, blogs (weblog), simulations, LMS and Cloud based services are the most common delivery methods and tools used in a TBL environment (Cavus & Kanbul, 2010). There are numerous advantages to TBL in comparison to face-to-face learning. Five of the primary benefits are (Koller *et al.*, 2008): (a) Accessibility, offering anytime and anywhere delivery; (b) Training that is self-paced and matched to the learners needs; (c) Full scalability; (d) Timely dissemination of up-to-date information; and (e) Streamlined and effective learning delivery (Adapted from Amaldas *et al.*, 2012d).

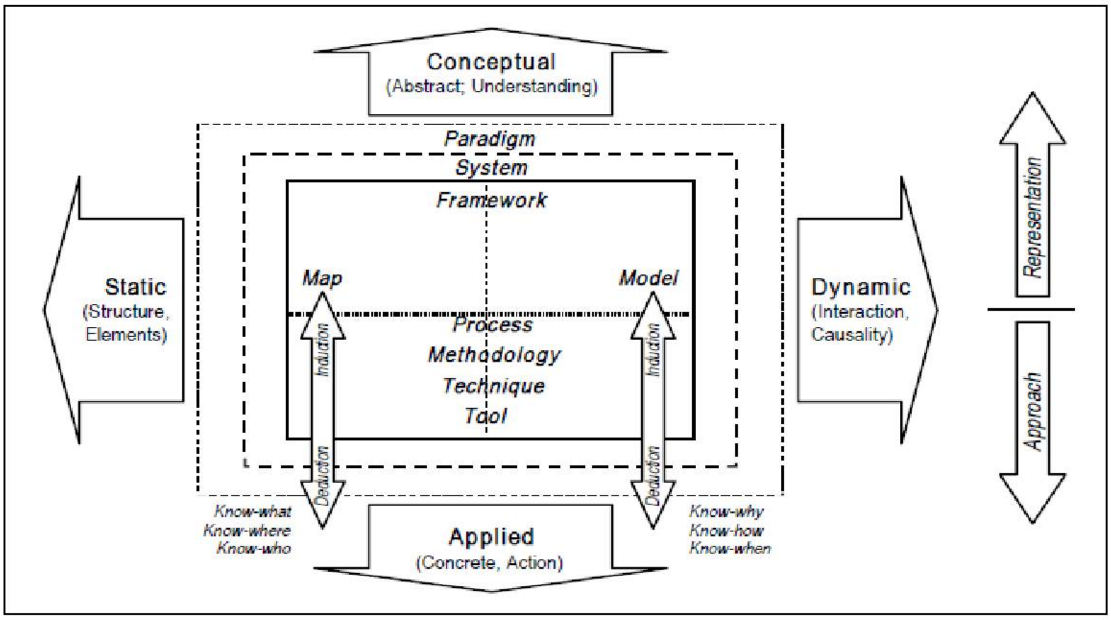
While the emerging field of technology management holds out the promise of supporting managers and administrators in dealing with the challenges associated with technology management, there are a number of practical and theoretical hurdles to overcome. Technology management is a multifunctional and multidisciplinary field, requiring inputs from both commercial and technical functions in an organization, and a synthesis of academic perspectives, such as engineering, economics, business studies, social science and psychology (e.g. Probert 1997; Farrukh *et al.,* 2000b; Phaal *et al.,* 2001b; Phaal *et al.,* 2000a). Currently, there are very few widely adopted methods for the practical application of technology management principles, and few universally accepted conceptual models or frameworks to underpin them. Research within the business schools globally aims to contribute towards addressing these gaps, focusing on the development of tools and frameworks for supporting administrators and managers in both the academia as well as the industry domains. This research aims to apply MOT principles and management concepts to the field of education and training of business students who are expected to be the future entrepreneurs of their respective societies. The study considers the meaning of the term 'framework', reviews a number of key technology management themes, and describes the development of a high-level framework for supporting technological innovation (As previously discussed in detail in Chapter 1). It is proposed that this framework provides a bridge between theory and practice (Phaal *et al.*, 2000b; Farrukh *et al.*, 2000a; Probert *et al.*, 2001). This is illustrated by examining the process for initiating technology road-mapping in the selected institutions, a technique that is a burgeoning force in both the industry and the academia which has been developed in parallel to the framework.

Theoretical and conceptual frameworks in management theory and practice aids in the perception of an issue or area of study, providing structure, support, decision making and action. The relationships between the various terms that refer to management representations are implied by the structure shown in the Figure 2.1 on page 42, adopting the following definitions (Phaal *et al.*, 2001a):

- A paradigm enumerates the established assumptions and conventions that underpin a particular perspective on a management issue.
- A system defines a set of bounded interrelated components working together to achieve a common goal and represents it within the context of a paradigm.
- A framework supports understanding and communication of structure and relationship within a system for a defined purpose.
- A map supports understanding of the static relationship between elements of a system.
- A model supports the understanding of the dynamic interactions between the elements of a system.

- A process is an approach for achieving a managerial objective, through the transformation of inputs into outputs.
- A procedure is a series of steps for operationalising a process.
- A technique is a structured way of completing part of a procedure.
- A tool facilitates the practical application of a technique.

Figure 2.1: Meta-Framework: Management Representations and Approaches



Source: Shehabuddeen et al., 2000

The relationship between 'representations', that tends to be conceptual in nature, and 'approaches', which has a tendency to focus on action, is critical. The key point is that conceptual frameworks exist largely in the mind and require practical devices (i.e. methods, processes, techniques and tools) to 'interface' with the real world, in terms of both the development (induction) and application (deduction) of frameworks. In this regard the meta-framework shown in Figure 2.1 on page 42 is closely related to organizational and personal learning cycles (e.g. the Kolb Learning Cycle (1984; 2005); Reeves, 1997). The application of the technology road-mapping approach, which is closely related to the technology management framework, backing the development of the structure and provides a means for the concepts contained within the framework to be applied in practice (Phaal *et al.*, 2001a).

2.3 Current Trends in Teaching and Learning

Education and entertainment have merged into what we would like to call as the edutainment industry wherein it has become a mandatory requirement for teachers and educators alike to impress their student crowds with a mix of both worlds. Granted that computing could be a serious thing as it can also be used as a tool for work, entertainment and multimedia content access, most gadgets such as smart phones, tablets, laptops and other portable tools are now embarking into the new realms of interactive gaming and education enabling new users to interact widely with their devices followed by dynamic (Continuous state) information updates. Teachers now need retraining to keep up with such devices to make them look hype inside and outside the classroom environments making them knowledgeably and fashionably acceptable these days. Gone are the days of traditional print media wherein teachers are now expected to serve as information pointers (pointing the students to do research using the right resources online and in libraries). Information and data generated by both students and staff need to be stored in compute resources which are streamlined for access on-demand by either party using online resources (google docs becoming a useful example here). The simplistic life of emailing and dropping assignments in the teacher's inbox is still a common place but is slowly and surely being replaced by electronic whiteboards or blackboards, LMS and Cloud computing services. Computing resources these days are becoming a mandatory requirement for educators and students to utilize resources in the form of online services and information portals. Managing these compute resources is a challenge not only financially but also at a technical level where educators are expected to update themselves constantly towards catering for such 'niche' areas with respect to ICT training, education and in particular, management of resources.

Studies indicate that a student's acquisition of operational skills is heavily dependent on the conceptual knowledge they acquire at an earlier stage of their education (Wickens, 1992). Consequently, students need to figure out how businesses fit the systems paradigm, and what types of subsystems are embedded within them. They also need to learn about the various elements making up the different types of subsystems in a business, along with how they work and interact.

During the 20th century, several well-respected management experts have published numerous books and articles emphasizing that businesses are complex social systems, and that management practices must change to be effective in this environment (Senge, 1990; Ackoff, 1994; Deming, 1994; Forrester, 1994). Initially, it appears that numerous universities have heard the criticisms on business paradigms and embraced the various experts' recommendations. Indeed, the systems concept has become omnipresent in business programs. For example, students are taught about material management systems, accounting and finance systems, and ICTs. Many institutions have gone a step beyond, integrating materials from multi-disciplinary areas of research and textual data. However, the important question is whether is it sufficient to prepare potential managers (Business students) to be successful in the near future (systems' age)? The underlying premise of this research is to evaluate the current 'best practices' of management education beyond merely teaching students about systems or integrating topics and to evaluate the use of MOT based education in delivering course materials and assessments to business students. It must help them develop systemic thinking abilities that will enable them to develop a richer apprehension of the complexities they will face on a daily basis in real world business scenarios.

Recent trends in teaching business related courses raise concerns that traditional approaches to educating and grooming future business leaders may be insufficient during the 21st century. Many business analysts claim that this is due to bad investments in short term return businesses but we tend to disagree. The age old concept of 'every employee is expendable' is being replaced by 'human resource is also a capital' which seems to be theoretical but is exceedingly practiced in existing companies. Taking Japan for example, product life cycles are rapidly decreasing, and in some industries like Sony and Sanyo, this is now measured in months. What most employees don't realize is that they are also dragged to be part of the products life cycle and as long as a service or product offered is in demand, there is a guarantee for employees to play a part in the production process. Product and process innovations are quickly diffusing throughout industries to become a standard practice (Gharajedaghi, 2005; Morris, 2003). Newer technologies are making it easier for companies, regardless of location, to compete globally, and to develop business ventures in non-industrialized nations adding to the competition in many industries. Every indication points out to these trends which are expected to continue in the future. More and more companies are participating in benchmarking and business-partnering programs, accelerating the rate at which organizations learn and trade upon new ideas and practices. Improvements in information technology are also making it easier to communicate these ideas, increasing the rate at which they are implementing both within and across industries. In addition, economic development in countries with weak enforcement of copyright and patent laws makes it difficult to prevent unauthorized use of legally protected intellectual capital, product and process technology (Fine, 2000). As a result, the managers have to gather and process information, consider the implications of various alternatives, and make decisions in this ever shrinking financial domain of businesses.

Technology Management or Management of Technology (MOT) is a set of management disciplines allowing organizations (including institutions) to manage their technological fundamentals to create competitive advantage. International students are the consequence of the whirlwind of changes that characterizes contemporary institutions. The trend of globalization and digital revolution is increasingly forcing students and universities to become internationally competitive in an 'increasingly globalized higher education marketplace' (Amaldas *et al.*, 2013c).

Typical concepts used in technology management are technology strategy (a logic or role of technology within an organization), technology forecasting (identification of possible relevant technologies for the organization, possibly through technology scouting), technology road mapping (mapping technologies to business and market needs), technology project portfolio (a set of projects under development) and technology portfolio (Technology Management, 2012).

There are many published definitions on 'technology' (e.g. Floyd 1997, Whipp 1991, Steele 1989). Examination of these definitions highlights a number of factors that characterize technology, which can be considered as a specific type of knowledge (although this knowledge may be embodied within a physical artifact - i.e. a machine, component, system or product), (Phaal *et al.*, 2001a). The key characteristic of technology that distinguishes it from more general knowledge types is that it is applied, focusing on the 'know-how' of the organization. While technology is often associated with science and engineering ('hard' technology), the processes which enable its effective application are also fundamental, e.g., new product and innovation processes, together with organizational structures and supporting communication/knowledge networks ('soft' aspects of technology).

Treating technology as a type of knowledge is helpful, as knowledge management concepts can be brought to bear usage (e.g. Stata, 1989; Nonaka, 1991; Leonard-Barton, 1995; Fleck, 1997; Pelc, 1997; Madhaven & Grover, 1998; Bowonder & Miyake, 2000). For instance, technological knowledge generally comprises both explicit and tacit knowledge. Explicit technological knowledge is what has been (or can be) articulated (e.g. a report, lecture, procedure or user guide), together with the physical manifestations of technology (e.g. equipment). Tacit technological knowledge is what cannot be easily articulated and which relies on training and experience (e.g. welding, or design skills).

Technology, in the business context, can best be considered as an important type of resource, and moreover, there are considerable linkages with other resource-based views of the firm (e.g. Wernerfelt, 1984; Dierickx & Cool, 1989; Penrose, 1995; Grant, 1996), such as competence (Hamel & Prahalad, 1994) and capability approaches (Teece *et al.*, 1997), and the general knowledge management literature. A key objective of technology management is to ensure that technological resources are effectively linked to business requirements, which is the focus of the technology management framework proposed in this research, and a key benefit of the technology road-mapping approach (Phaal *et al.*, 2001a).

Similar to 'technology', there are many definitions on 'technology management' in the literature (e.g. Roussel *et al.*, 1991, Gaynor, 1996). For the purpose of this research, the following definition is adopted from EITM:

> "Technology management addresses the effective identification, selection, acquisition, development, exploitation and protection of technologies (product, process and infrastructural) needed to maintain a market position and business performance in accordance with the company's objectives"[1]

This definition highlights two important technology management themes (Phaal *et al.*, 2001a):

- Establishing and maintaining the linkages between technological resources and company objectives is of great importance and represents a continuing challenge for many firms. This requires effective communication and knowledge management, supported by appropriate tools and processes towards the establishment of the commercial and technological

[1] EITM is a collaboration between a number of European universities: `http://www.mmd.eng.cam.ac.uk/ctm/eitm/index.html`.

functions in any given business or organization.

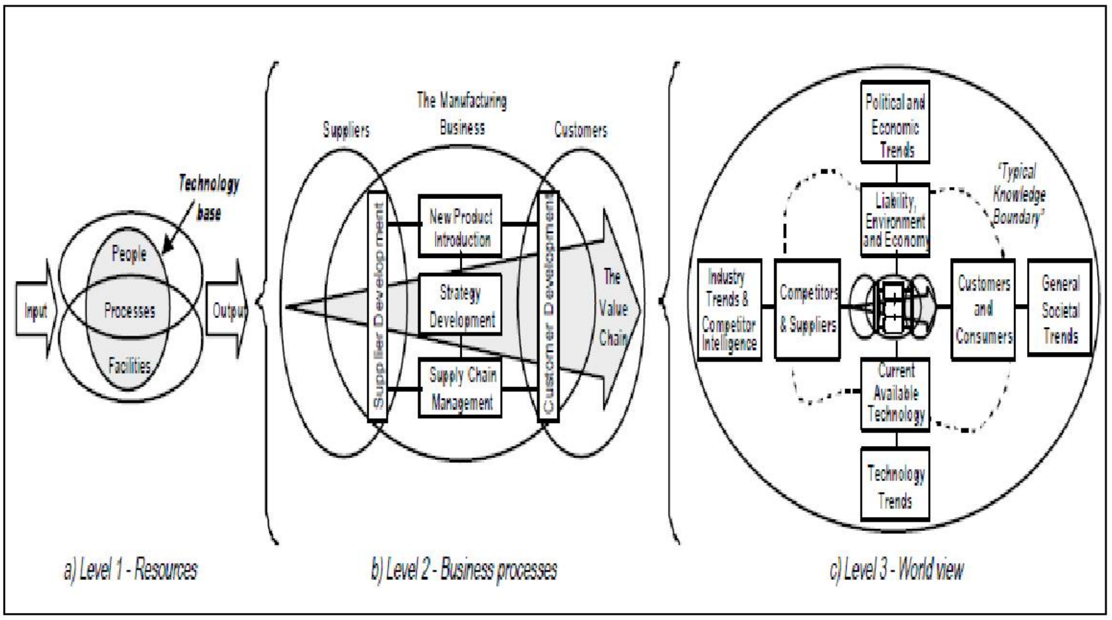
- Effective technology management requires a number of management processes, and the EITM definition includes the five processes proposed by Gregory (1995): identification, selection, acquisition, exploitation and protection of technology. These processes are not always very visible in firms, and are typically distributed within other business processes, such as strategy, innovation and operations.

The framework described in this research is primarily intended to support technology management in the academic sector, at the institutional level (although, owing to the generic nature of the high-performance framework, it is considered likely to have broader application areas in research and development). To improve the understanding of the framework, it is vital to define the system within which it applies, in the context of MOT.

The manufacturing business systems model that has been adopted is used by the University of Cambridge Manufacturing Leaders Programme (MLP), which forms the basis for a company audit (Hillier, 2001) - see Figure 2.2 on page 51. The MLP model is built up in three stages (or levels):

- Level 1: A simple resource-based process view, where resources are identified as comprising people and facilities(compute resources), which are combined with operational processes to transform inputs into required outputs. Based on the discussions above, the technology base

Figure 2.2: Cambridge Manufacturing Leaders' Programme Audit Model



Source: Hillier, 2001

of the firm can be considered to be a sub-set of these resources and processes.

- Level 2: Expansion of the model to the firm level, defining the manufacturing business, in the context of the value chain that links suppliers to customers, highlighting a number of important business processes. These processes are strategy development, supply chain management and new product introduction, supplemented by supplier and customer development processes.

- Level 3: Expansion of the model to include the business environment in which the firm operates: industry sectors; competitors and suppliers;

current available technology; customers and consumers; and liability, environment and economy. The broader trends that govern the evolution of this business environment is included in the model (i.e. industry trends, technology trends, general societal trends, and political and economic trends).

The U.S. National Research Council in Washington, D.C. for example, defined MOT as linking "engineering, science, and management disciplines to plan, develop, and implement technological capabilities to shape and accomplish the strategic and operational objectives of an organization" (Technology Management, 2012). While technology management techniques are themselves important to a firm's competitiveness, they are most effective when they complement the overall strategic posture adopted by the firm. The strategic management of technology tries to create competitiveness by incorporating technological opportunities into corporate strategies (U.S. Office of Technology Assessment, 1995).

As academics in tertiary institutions across the world experiment with technologies towards improving their overall course experiences, it is important to recognize that their role as teachers, has remained essentially the same over the years: to educate and inspire students, and to offer them the means to build stable foundations for a successful future. While teachers can continue to be highly effective with the traditional lecture-style instructional method, a new technological resource, that of web-based LMS, is spreading out globally (Georgouli, 2008). Research results demonstrate that, although innovation may build upon the technical prospects, concrete difficulties arise, caused by problems of incongruity at the level of the educational model (Griffiths, 2003) where learners perceive a shift in the educational culture causing stress and creating reluctance to participate. Moreover, traditionally-minded educators often disapprove or feel uncomfortable with this implied change in educational policy. After a long period of using LMS in tertiary education, it became obvious that these tools cannot reach their full potential if teachers are unwilling to adapt to a different teaching style, based on technology. In order to adapt to innovative teaching methods successfully, teachers must be retrained to develop their pedagogical autonomy towards the proficient use of technical tools, experimentation(s) and the discovery of new sound pedagogy that will enable them to foster it into university teaching curriculum. LMS, online learning platforms and other Internet Rich Applications (IRAs) are the most representative e-learning applications with the next step being the utilization of educational resources using Cloud based services. Some are open source software; others are commercially provided (Georgouli, 2008). In a constructivist environment, ICTs are currently used in a web-centric instructional delivery mechanism. In relation to this, higher education can be investigated as a mixed mode method of instruction that could involve web based and face to face teaching mechanisms which emulates constructivist models by learning the effects of student epistemological believes (Amaldas *et* *al.*, 2013c).

As the business environment continues to evolve, it is important to assess how effectively managers are being prepared to face these ever increasing challenges. Unfortunately, empirical evidence suggests that managers are not adequately prepared. There are daily financial reports from Wall Street showing that companies are failing to perform as expected. Poor performance has resulted in a high turnover rate among upper-level executives; the average tenure of new Chief Executive Officers (CEOs) is only about 18 months (Charan, 2005) and even lesser in small start-up companies. In the year 2000 alone, 40 CEO's of Fortune's top-200 companies were fired or asked to resign (Bossidy & Charan, 2002) due to poor management skills or financial oppression. For every successful new business there are 22 failures proceeding them in the United states alone as of 2012. For those that do survive the start-up phase, their average lifespan is only 11.5 years. The performance of the best organizations is not much better than the given statistics above. A recent study showed that an average of 30 companies drop off from the Fortune-500 list every year, and the average life of firms on the Standard and Poor's 500 (S&P 500: the stock market where 500 leading companies trading in the United States of America) is only 25 years (Morris, 2003)! Therefore, such businesses claim that academic programs in business do not adequately prepare graduates for the "real world". Harvard Business Review published an article on the subject as far back as 30 years ago (Livingston, 1971). Since then, several articles have been published on the topic, each offering different criticisms and recommendations (e.g., Dertouzos *et al.*, 1989; Porter & McKibben, 1988; Steiner & Wells, 2000; Mintzberg & Gosling, 2002; Pfeffer & Fong, 2002, Ghoshal, 2005; Bennis & O'Toole, 2005). The question remains: "How should a graduate business curriculum be designed to prepare business leaders to be successful in the 21st century?" and "What is the right mix of technologies and traditional teaching mechanisms needed towards bridging this gap?" Moreover, these are some of the questions several academic institutions are asking (Bisoux, 2005) to offer the right kind of courses suited for current management practices in businesses. Management based education is still based on traditional mechanisms and the management best practices are differing with every industry to a certain extent.

The utilization of distance-learning and e-learning systems as a supplement to in-class lectures, on which course announcements, homework assignments, lecture notes and slides can be posted, for Internet access (OECD, 2005). These days, we observe a movement in higher education leading from proprietary software to open source, for e-learning applications (Coppola, 2004). In fact, Open Source Software (OSS) development can provide the necessary flexibility to combine languages, scripts, learning objects and lesson plans, effectively, without the costs and rigidity of proprietary packages (Williams, 2003). An LMS is not limited to a strictly determined educational role: it may also function as a new means for communication.

Furthermore, we have to examine closely the use of these platforms at all educational levels (Pirani, 2004). Therefore, LMS and service oriented consumption of educational services become a crucial enabler of MOT based technologies and helps several technologies (e.g., Web services, Clouds, electronic Whiteboards, etc). This research discusses the need for MOT enabled high performance framework proposing a Cloud Services Architecture for improving information and compute access using LMS style mechanisms useful for educators and students alike provisioning services on demand via resource consumption.

2.4 Innovations in Teaching and Learning

Rapid developments in ICT and MOT sectors have provided rich sources of information generating innovation in teaching and learning amongst faculty and students in almost all disciplines. Many schools in developed economies such as the United States, Japan and developing coutries such as India, China and Vietnam have adopted different computer related technologies in learning and education. This embraces: the use of multimedia in the classroom (Schmid, 2008); communication technology (Alavi & Gallupe, 2003); technology-mediated distance learning (Brower, 2003) for undergraduate classes; on-line Masters of Business Administration (MBA) courses; and executive MBA programs (Arbaugh, 2005). More recently, Online Learning Environments (OLEs) and technologies as well as social media Internet technologies provides many new forms of communication that allows professors and students to exchange information and ideas across time and space in an university class settings. These new technologies may include discussion boards, weblogs, wiki, Question and Answer (Q&A) using mobile phones, synchronous chat environment, email, instant messaging, and Twitter, among others (e.g., Connell, 2006; Farmer, 2004; Fichter, 2005; Richardson, 2008). Technologies like Twitter enable us to know where the nodes of our community are, providing a sense of connectedness to and awareness of others even when the members of our community are not within the geographical range. All these changes may provide additional challenges to the process of teaching and learning. More than a decade ago, researchers have suggested that "as teachers have progressed from the use of blackboards and chalk, to overhead transparencies and computer-aided presentations, and now to multimedia, more research is needed to help guide the use of these tools to enhance learning" (Frost & Fukami, 1997, pp. 1276-1277). However, empirical evidence on the technology's ability to promote learning is not very robust (Thomas *et al.*, 2009).

Multimedia education involves more than one medium for the organization, information exchange, and interactive aspects of the learning experience. Proserpio and Gioia (2007) argued that we are no longer teaching a verbal, or even just a visual, but now a virtual generation of students. The values, communication styles, and life experiences of Mature/World War II Generation (born until 1945); Baby Boomers (1946 - 1965); Generation X (1966 - 1980) known as Gen-Xers; and Generation Y/Millennials (1981 - 2000) known as Gen-Yers are significantly different from that of baby boomers (Tang *et al.*, 2012; Catalyst, 2012). Optimal teaching and learning occur when teaching technologies and styles align with learning styles. Students with different age and gender may have different perceptions towards the traditional teaching and the use of new technologies (Caudron, 1997). University students with the new and the latest computer and technology in classroom settings may gain competitive advantage in the global market (Rice & Aydin, 1991).

Moreover, technology may have its negative effects, e.g., cyberloafing (Lim, 2002), cybercheating (Austin & Brown, 1999), technology based cheating (McCabe, Butterfield, & Trevino, 2006), and information overload that resulted in less learning (Mayer *et al.*, 2001; Mayer & Massa, 2003; Rockwell & Singleton, 2007). Administrators, professors, students, and employers are aware of the trend that the use of technology and computer in university classrooms will change future employees' efficiency and effectiveness in using the different types of technology on jobs in the competitive world market.

Very little research has addressed: (1) students' reactions to multimedia education (Connell, 2006; Mayer *et al.*, 2001; Schmid, 2008); and (2) the development of models and methodologies for the study of technology-mediated learning (Webster & Hackley, 1997). Research findings regarding students' perceptions may have important implications for administrators, faculties, students and employers, and enhance: the delivering of education to students; students' learning experience in college; and students' application of knowledge and skills in the real world of work (Thomas *et al.*, 2009).

Research suggests that in a study of distance education, students expected the class to be intrinsically interesting and enjoyable but at the end of the course, however, only 9% of the students suggested that the technology made the class more interesting (Cleveland & Bailey, 1994). Students' learning was affected interactively by their comprehension skills and course format. In general, students of all skill levels prefer the lecture courses over the Web-based courses. One's capability to interact with a given technology plays a significant role in one's expectations and performance. Students had a preference for teacher contact over the Internet instruction (Maki & Maki, 2002) and performed better on a post-test when taught through traditional lectures than when taught through the Internet (Faux & Black-Hughes, 2000).

Mayer's (2001) cognitive theory of multimedia learning postulates that adding interesting but extraneous materials may cause the learner to use limited cognitive resources on incidental process, leaving less cognitive capacity for essential processing. Presenting information in multiple modalities is only seen as advantageous to students who are able to actively process such information. Students must interact with these representations in meaningful ways. A redundancy effect is consistent with a dual-channel theory of multimedia learning in which apprehending substantial information can overload the visual information-processing channel, causing learners to split their visual attention between two sources. Presenting more materials may result in less understanding (Mayer *et al.*, 2001). Among different modalities of presentation (text only, text to audio, and text to audio to video), participants who were in the enhanced media-rich groups acquired less information from the presentation (Rockwell & Singleton, 2007). Therefore, more does not mean better (Thomas *et al.*, 2009).

2.4.1 Hybrid or Blended Learning Environment

Blended learning is an educational methodology that combines face-to-face classroom methods with computer-mediated activities (Strauss, 2012). According to its proponents, the strategy creates a more integrated approach for both instructors and students. The terms “blended,” “hybrid,” “technology-mediated instruction,” “web-enhanced instruction,” and “mixed-mode instruction” are often used interchangeably in the current literature research. Blended education, Hybrid learning, “Flipping the classroom” (Martyn, 2003) are different names used for the learning methods which combines classroom and online education which is currently the “in thing” as it is making the headlines worldwide. Technology-mediated learning refers to an environment in which the learner’s interactions with learning materials, peers, and/or instructors are mediated through information technologies (Alavi and Leidner, 2001).

While education experts continue to debate the efficacy of hybrid learning, it's very existence has challenged them to re-evaluate not just technology's place in (and out of) the classroom but also how to reach and teach students more efficiently and effectively. Of course, no educational model is one-size-fits-all, and some hybrid classrooms are probably more effective than others. According to a scientific literature review published by the Australasian Society for Computers in Learning in Tertiary Education (ASCILITE), a number of factors impact the success of hybrid learning. Teachers must be committed to and well trained in blended and hybrid education and its technologies, and students must have a clear understanding of what is expected of them in this new environment (Hosler, 2013).

In the course of higher education, blended or hybrid learning is a snazzy, yet relatively new tool, and not all professors apply the same techniques. Trends have emerged, for instance, most professors in blended classrooms use some version of a course management system application to connect with the students online. Blackboard and MOODLE are perhaps two of the best known Content Management System (CMS) applications in usage today. Through platforms like these, students can access video of lectures, track assignments and progress, interact with professors and peers, and review other supporting materials, like PowerPoint presentations or scholarly articles.

As blended education becomes increasing common, schools and professors tend to understand and implement it better. Even at this point of an early infancy stage, hybrid learning proves to be promising as it makes it an exciting time to be a student (*ibid*).

Hybrid courses blend face-to-face interactions such as in-class discussions, active work groups, and live lectures with typically web-based educational technologies such as online course cartridges, assignments, discussion boards, and other web-assisted learning tools (Buzzetto *et al.*, 2006). The degree to which the design of hybrid courses utilize traditional classroom and online learning environments varies, being largely dependent on the subject matter and overall nature of a course. Regardless of design, such courses may be expected to deliver instruction in both an asynchronous and synchronous mode and are becoming increasingly prevalent in today's society (Wu *et al.*, 2011). Pronominal to note is that the term hybrid is not used often in the United States of America (U.S.A.), where the standard term for this sort of education is called Blended learning (BCcampus, 2013).

2.4.1.1 Flip Teaching or Reverse Learning

Flip teaching (or flipped classroom) is a form of blended learning which encompasses of any type of technology adoption to leverage the learning in a classroom where a teacher can spend more time interacting with students instead of lecturing. This is most frequently being executed via teacher-created videos that students can view outside of their class time. It is also known as backwards classroom, reverse instruction, flipping the classroom, and reverse teaching (Tina, 2011). The traditional pattern of teaching is to assign students to read a section of a textbook after-school; this will be discussed the next day in class. Students would then be assigned an assessment for homework to reify their mastery of the topic. In flip teaching, the student first studies the topic by himself/herself, typically using video lessons created by the instructor (Ronchetti, 2010 & Greg, 2011) or shared by another educator, such as those provided by the Khan Academy, a non-profit organization with a mission and goal of changing the educational system for the good of every-one by rendering a free world-class educational service for anyone, anywhere, (Khan Academy, 2013).

All of the site's resources are available to anyone. It doesn't matter if you are a student, teacher, home-schooler, principal, adult returning to the classroom after 20 years, or a friendly alien just trying to get a leg up in earthly biology. Khan Academy's materials and resources are available to you completely Free of Charge (FOC). In the classroom, the pupil tries to apply the knowledge by solving problems and doing practical work (Diana, 2011 & Daniel, 2010). The role of the classroom teacher is then to tutor the student when they get stuck, rather than to impart the initial lesson. This allows time inside the class to be used for additional learning-based activities (Alvarez, 2012) including use of differentiated instructions and project-based learning (Bill, 2012).

2.4.2 Teaching Effectiveness and Learning Outcomes

Researchers have examined: teaching effectiveness (Frost & Fukami, 1997; Tang, 1997); teaching strategies, student learning/motivation (Cole, Field, & Harris, 2004); grades (Beatty, 2004; Clayson, Frost, & Sheffet, 2006); the validity of student evaluation, the reliability of teaching effectiveness (Wanous & Hudy, 2001); students and professors' attitudes towards teaching evaluation, personalities, and students' learning. In terms of teaching evaluation, students may evaluate professors, not on "task competency" (i.e., professors' knowledge of the subject matter, intrinsic to learning) but more on "communication competency" (i.e., professors' use of the technology, extrinsic to learning) (Webster & Hackley, 1997).

There was a classic example of teaching evaluation that depended on the presenter's entertainment value. In this scenario, an actor who knew nothing about the subject posed as a Professor (Doctor Fox). Doctor Fox, received excellent evaluations from the students due to the fact that he made jokes, smiled a lot and was a tremendous communicator, even though his performance had little or no educational content (Naftulin *et al.*, 1973). The present study specifically focuses on students' perceptions regarding professors' effectiveness in applying technologies. In order to avoid evaluation at the surface level and avoid the Dr. Fox effect, we focus on students' perceptions of both: (1) the material, or the content (e.g., present theory, research, and practice clearly); and (2) the presentation, or the process (e.g., become a better teacher, demonstrate knowledge, present materials clearly, stimulate interests, and enhance learning) (Cole *et al.*, 2004; Tang & Tang, 1987; Webster & Hackley, 1997). We believe that these aspects reflect students' perception of teaching effectiveness, i.e., teaching evaluation (Yuksel *et al.*, 2012).

The goal of institutional courses is to contribute towards effective learning. Learning outcomes in higher education are of considerable interest to students, professors, and researchers (Bergen & Kingston, 1994). Students' performance represents teaching effectiveness (Peters, Kethley, & Bullington, 2002). The Grade Point Average (GPA) is one of the best predictors of success in education. There is a moderate to higher correlations between Course Evaluation Survey (CES) scores and GPAs. The relationship between students' self-evaluation (using CES) and actual GPA was moderately powerful (Herman, 2003). Student satisfaction is related to both the GPA and their Professor's performance (Grayson, 2004). Students' self-reported behaviors in an instructional setting are significantly correlated with their faculty evaluations (Tang & Tang, 1987). Students' grades and their teaching evaluation can be explained by the reciprocity effect (Clayson *et al.*, 2006). Changes in expected grades between Weeks 6 and 13 resulted in a significant corresponding change in students' teaching evaluation. Further, the best predictors for GPA are academic self-efficacy and achievement motivation (Yuksel *et al.*, 2012).

2.4.3 Online Teaching and Electronic Learning Tools

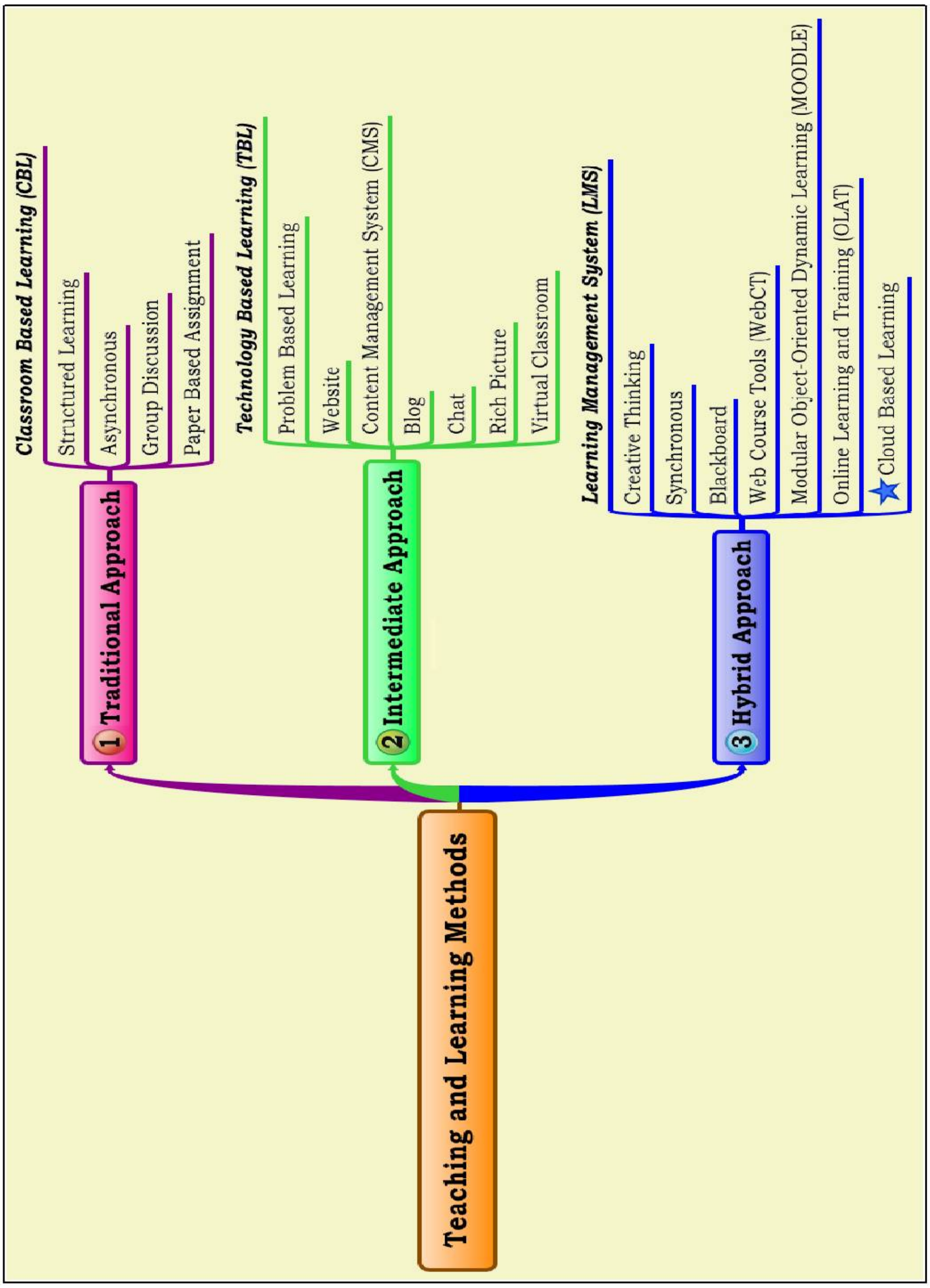
Teaching and Learning mechanisms as shown in Figure 2.3 on page 68, can be categorized as follows(Amaldas *et al.*, 2013d):

1. Traditional or Conventional Learning (Teacher centric);
2. Online or Electronic Learning (Student centric); and
3. Blended or Hybrid Learning (Student-Teacher centric).

2.4.3.1 Electronic Learning

Electronic Learning or E-learning refers to the use of various kinds of electronic media and ICTs in education. E-learning is an inclusive terminology for all forms of educational technologies that electronically or technologically support learning and teaching, depending on an emphasis on a particular aspect or component or delivery method, sometimes termed as Technology-Enhanced Learning (TEL), Computer-Based Training (CBT), Internet-Based Training (IBT), Web-Based Training (WBT), virtual education, or digital educational collaboration as shown in Figure 2.3 on page 68. E-learning includes numerous types of media that deliver text, audio, images, animation and video streaming which includes technology applications and processes such as audio or video tape, satellite Television (TV), Compact Disc Read-only Memory (CD-ROM), and computer-based learning, as well as local intranet/extranet and web-based learning. Information and communication systems, whether free-standing or network based can be: self-paced termed as asynchronous learning; or instructor-led known as synchronous learning. E-learning is suited to distance learning and flexible learning but it can also be used in conjunction with face-to-face teaching, in that case, the term blended learning is commonly applied (EDUCAUSE, 2013). It is universally thought that new technologies make a big difference in education (Techimpact, 2013). Many proponents of e-learning believe that everyone must be equipped with basic knowledge of technology, as well as utilize it as a medium to reach a particular goal.

Figure 2.3: Current Teaching and Learning Mechanisms



Source: Designed and formulated by the Researcher, 2013

2.4.3.2 Blogs and Forums

A blog (Blood, 2000) is a discussion or informational site published on the World Wide Web consisting of discrete entries ("posts") typically displayed in reverse chronological order (the most recent post appears first). Until 2009, blogs were usually the work of a single individual, occasionally of a small group, and often covered a single subject. More recently "Multi-Author Blogs" (MABs) have developed with posts written by a large pool of authors and are also edited professionally. MABs from newspapers, other media outlets, universities, think tanks, interest groups and similar institutions account for an increasing quantity of blog traffic. The rise of Twitter and other "micro-blogging" systems helps integrate MABs and single-author blogs into societal newstreams. Blog can also be used as a verb, meaning to maintain or add content to a blog. The emergence and growth of blogs in the late 1990s coincided with the advent of web publishing tools that facilitated the posting of content by non-technical users. Previously, a knowledge of such technologies as Hyper Text Markup Language (HTML) and File Transfer Protocol (FTP) had been required to publish content on the Web. A majority are interactive, allowing visitors to leave comments and even message each other via Graphic User Interface (GUI) widgets on the blogs, and it is this interactivity that distinguishes them from other static websites (Mutum, 2010). In that sense, blogging can be seen as a form of social networking. Indeed, bloggers do not only produce content to post on their blogs but also build social relations with their readers and other bloggers (Gaudeul *et al.*, 2010).

"A bulletin board is an online discussion site. It is sometimes also called a 'board' or 'forum'. It may contain several categories, consisting of sub-forums, threads and individual posts.", An Internet forum, or message board, is an online discussion site where people can hold conversations in the form of posted messages in an asynchronous manner (vBulletin, 2013). They differ from synchronous chat rooms in that messages are at least temporarily archived. Also, depending on the access level of a user or the forum set-up, a posted message might need to be approved by a moderator before it becomes visible. Forums have a specific set of jargon associated with them; e.g. a single conversation is called a "thread". A discussion forum is hierarchical or tree-like in structure: a forum can contain a number of sub forums, each of which may have several topics. Within a forum's topic, each new discussion started is called a 'thread' and can be replied to by as many people as possible. Depending on the forum's settings, users can be either anonymous or have to be registered with the forum in order to subsequently log-in to the system to post messages online. On most forums, users do not have to log in to read existing messages. Blog and forums are typically used as information sharing and storage solutions in education, making it mandatory for instructors and students to use on a regular basis with their regular academic work environment.

2.4.3.3 WebCT, Blackboard and MOOC

WebCT (Course Tools) or Blackboard Learning System (Blackboard, 2013), now owned by Blackboard, is an online proprietary virtual learning environment system that is licensed to colleges and other institutions and used in many campuses for e-learning. It is used for WebCT courses where instructors can add such tools as discussion boards, mail systems, and live chat, along with content including documents and web pages. The latest versions of this software are now called Webcourses. WebCT is significant in that it was the world's first widely successful course management system for higher education. At its height, it was in use by over 10 million students in 80 countries. WebCT's user interface has been criticized as needlessly complex and non intuitive. The "Vista" version of the product represented an attempt to derive balance between flexibility and ease of use, however, it has also been the target of ease-of-use criticisms. There were some apparent WebCT criticisms which includes: (1) problems using it in multiple tabs or browser windows; (2) heavy reliance on Java for its user experience; (3) usage of too many browser framesets; (4) issues with some features requiring pop-up blockers to be turned off; and (5) problems encountered in using standard browser navigation tools (i.e. the Back and Forward commands), (LSEPS, 2006; Source85, 2008). WebCT might not be as useful in Mathematics courses compared to courses in other field of study. Lectures and classes are augmented by the use of ICT and WebCT like most of its competitors does not meet all guidelines for accessibility (LSEPS, 2006). The Multiple Choice Questions (MCQs) has limited implementation with the WebCT as questions have to be renewed frequently as it can be passed around after a given time period. The learning system has to be simple and updated occasionally. Handwritten examinations are preferred to MCQ in WebCT as it is rather taxing (Poldaru, 2009).

A Massive Open Online Course (MOOC) is an online course aimed at large-scale participation and open access via the web. MOOCs are a recent development in distance education and often use open educational resources. Typically they do not offer academic credit or charge tuition fees. Only about 10% of the tens of thousands of students who may sign up complete the course (Lewin, 2013). MOOCs originated about 2008 within the Open Educational Resources (OERs) movement. Many of the original courses were based on connectivist theory, emphasizing that learning and knowledge emerge from a network of connections. The year 2012 became “the year of the MOOC” as several well-financed providers, associated with top universities, emerged, including (Coursera, 2013; Udacity, 2013; and edX, 2013). These were free courses designed specifically for interactive study via the web that is provided by MIT, Harvard and Berkeley, (Smith, 2012). Other universities scrambled to join in at the same time as established online educational providers (Blackboard Inc.) causing a “stampede.” Dozens of universities in Canada, Mexico, Europe and Asia have announced partnerships with the large American MOOC providers (Laura, 2012 and Tamar, 2013).

2.4.3.4 Virtual Classroom & Online Learning Environment

Students use the Internet to visit websites of business organizations and professional organizations cited in textbooks, conduct computer searches for academic and professional journals, prepare case studies and research papers, and use free online tutorial assistance, study guides with practice tests, etc. The Internet also provides access to current events, news, and many other types of information. Since the Internet is the largest library and laboratory, it becomes a popular tool for instruction. Trank and Rynes (2003) propose a model regarding the important institutional actors in the field of business/general education. The model involves: (1) businesses (corporations); (2) students; (3) media rankings; (4) accrediting organizations (particularly, The Association to Advance Collegiate Schools of Business (AACSB) - International); and (5) business schools. We trust that professors need to satisfy all stakeholders of business/general education. In order to achieve these goals, we believe, based on our review of the literature, that the use of computers/technologies in business/general classes should: (1) make the learning experience an interesting and enjoyable one (enjoyment/fun); (2) facilitate learning (learning); (3) enhance student's motivation (motivation); and (4) be applicable to career development (career) suggested by researches (Naftulin *et al.*, 1973; Richards & Aries, 1999; Tang & Tang, 1987). We examine these objectives for the use of technologies. Our discussion deals with tools to support synchronous one-way information delivery from professors to students. To support asynchronous/synchronous two-way interactions between professors and students, professors recently turn to social media based Internet technologies (e.g., discussion boards, weblogs, and wiki) and mobile devices (e.g., Questions and Answers (Q&A) using mobile phones) in university classrooms. Some researchers have even studied the effectiveness of these technologies (e.g., Connell, 2006; Farmer, 2004; Fichter, 2005; Richardson, 2008). OLEs and technologies (synchronous chat environment, email, instant messaging, etc.) may provide additional challenges, different social dynamics, and significant impact on the availability of the content, the design of the courses, and the nature of the communication (Farmer, 2004). These new OLEs add dynamic interactions to the process of teaching and learning (Thomas *et al.*, 2009).

OLEs plays a crucial role in terms of offering Virtual education. Virtual education refers to a form of distance learning in which the course content is delivered by various Internet methods such as course management applications, multimedia resources, and video-conferencing. Students and instructors communicate via these technologies. A virtual university provides higher education programs through electronic media, typically the Internet. Some are bricks-and-mortar institutions that provide online learning as part of their extended university courses while others solely offer online courses. They are regarded as a form of distance education. The goal of virtual universities is to provide access to the part of the population who would not be able to attend a physical campus, for reasons such as distance - where students live too far from a physical campus to attend regular classes; and the need for flexibility - some students want to study at home whenever it is convenient for them. Some of these organizations exists only as loosely tied combines of universities, institutes or departments that together provides a number of courses over the Internet, television or other media, that are separate and distinct from programs offered by the single institution outside of the combine. Others are individual organizations with a legal framework, yet are named "virtual" because they appear only on the Internet, without a physical location aside from their administration units. Still other virtual universities can be organized through specific or multiple physical locations, with or without actual campuses to receive program delivery through technological media that is broadcast from another location where professors give televised lectures.

2.4.3.5 Self Study through Mobile Life Style

The term M-Learning, or "Mobile learning", has different meanings for different communities. Although related to e-learning, educational technology and distance education, it is distinct in its focus on learning across contexts and learning with mobile devices. One definition of mobile learning is: Any sort of learning that happens when the learner is not at a fixed, predetermined location, or learning that happens when the learner takes advantage of the learning opportunities offered by mobile technologies (Mobilelearning, 2013).

In other words, with the use of mobile devices, learners can learn from various locations.

The objective of M-learning is to provide the learner the ability to assimilate learning anywhere and at any time (Crescente *et al.*, 2011). The term covers: learning with portable technologies including but not limited to handheld computers, MP3 players, notebooks, mobile phones and tablets. M-learning focuses on the mobility of the learner, interacting with portable technologies, and learning that reflects a focus on how society and its institutions can accommodate and support an increasingly mobile population. There is also a new direction in M-Learning that gives the instructor more mobility and includes the creation of, on the spot and in the field learning materials that predominately uses smartphone with special software such as AHG Cloud Note. Using mobile tools for creating learning aides and materials becomes an important part of informal learning. M-learning is convenient in that it is accessible from virtually anywhere. M-Learning, like other forms of E-learning, is also collaborative. Sharing is almost instantaneous among everyone using the same content, which leads to the reception of instant feedback and tips. This highly active process has proven to increase examination scores from the fiftieth to the seventieth percentile, and cut the dropout rate in technical fields by 22 percent (Saylor, 2012). M-Learning also brings strong portability by replacing books and notes with small Random Access Memory (RAM)s, filled with tailored learning contents. In addition, it is much simpler to maneuver mobile learning for an effective and entertaining experience (*ibid*).

2.4.3.6 Content Management System (CMS) and Learning Management System (LMS)

A LMS is a software application for the administration, documentation, tracking, reporting and delivery of educational courses or training programs (Ellis, 2013). LMSs range from systems for managing training and educational records to software for distributing online or blended/hybrid college courses over the Internet with features for online collaboration. Colleges and universities use LMSs to deliver online courses and augment on-campus courses. Corporate training departments use LMSs to deliver online training, as well as automate record-keeping and employee registration. Most LMSs are Web-based to facilitate access to learning content and administration. They are also used by educational institutions to enhance and support classroom teaching and offering courses to a larger population of learners. LMSs are used by regulated industries (e.g. financial services and biopharma) for compliance training. These are all categorized as the cardinal dimensions of the LMSs: Student self-service (e.g., self-registration on instructor-led training); training workflow (e.g., user notification, manager approval, wait-list management); the provision of on-line learning (e.g., computer-based training, reading & understanding), on-line assessment (management of Continuous

Professional Education (CPE)); collaborative learning (e.g., application sharing, discussion threads); and training resource management (e.g., instructors, facilities, equipment).

Some LMS providers include "performance management systems", which encompasses of employees' appraisals, competency management, skills-gap analysis, succession planning, and multi-rater assessments (i.e., 360 degree reviews). Modern techniques now employ competency-based learning to discover learning gaps and guide training material selection. For the commercial market, some Learning and Performance Management Systems include recruitment and reward functionality. A robust LMS should be able to do the following (Ellis, 2013):

- centralize and automate administration;
- use self-service and self-guided services;
- assemble and deliver learning content rapidly;
- consolidate training initiatives on a scalable web-based platform;
- support portability and standards; and
- personalize content and enable knowledge reuse.

A Course Management System "provides an instructor with a set of tools and a framework that allows the relatively easy creation of online course content and the subsequent teaching and management of that course including various interactions with students taking the course" (EDUCAUSE Evolving Technologies Committee, 2003:1), cited by Watson and Watson (2007:29). Examples of a Course Management System includes: Blackboard; Angel; Sakai; Oncourse; and MOODLE. However, Blackboard is a good example of the confusion that exists regarding these terms as it is commonly referred to as an LMS in the literature (Parr, 2004). The inappropriate use of LMS in the literature is perhaps most commonly associated with computer applications which we would identify as Course Management System. These systems are used primarily for online or blended learning by supporting the placement of course materials online, associating students with courses, tracking student performance, storing student submissions, and mediating communication between the students as well as their instructor(s). Some of these similar functionalities can be seen within LMSs as well, so it is understandable why confusion might exist. However, the systemic nature of an LMS does not limit its functionality to that of a Course Management System (Watson, 2007). A Course Management System is used as a synonym for LMS. Therefore, herein, we will use LMS.

By contrast, a Learning Content Management System (LCMS) is a related software technology that provides a multi-user environment where developers, authors, instructional designers, and subject matter experts may create, store, reuse, manage, and deliver digital e-learning content from a central object repository (stores every single version of file updates). LCMS focuses on the development, management and publishing of the content that will typically be delivered via an LMS. Users can both create and re-use e-learning content and reduce duplicated development efforts.

The next section presents the background information on various elements that form the basis to architect a Cloud computing environment for educational service consumption. It also presents the requirements of a elastic (Scalable applications: can upgrade easily and extend the usefulness of applications) educational Cloud services wrapper for legacy (traditional) applications that need to scale across multiple, geographically distributed sites owned by one or more Cloud based service providers.

2.5 Social Media and Cloud based Learning

Collaborative learning is distinguished from the traditional approach in which the instructor is the principal source of knowledge and skills. For example, the neologism or new concept "e-learning 1.0" refers to the direct transfer method in Computer-Based Learning and training systems. In contrast to the linear delivery of content, often directly from the instructor's material, Computer Supported Collaborative Learning (CSCL) uses blogs, wikis, and cloud-based document portals (such as Google Docs and Dropbox). As technological Web 2.0 advances, sharing information between multiple people in a network has become very convenient and there is also a risen in utilization.

One of the main reasons for it's usage states that it is "a breeding ground for creative and engaging educational endeavors" (Crane, 2009:2). Using Web 2.0 social tools in the classroom allows for students and teachers to work collaboratively, discuss ideas, and promote information. According to Sendall (2008), blogs, wikis, and social networking skills are significantly useful in the classroom. After initial instruction on using the tools, students also reported an increase in knowledge and comfort level for using Web 2.0 tools. The collaborative tools laid a platform for the students to pursue their future career goals and to be apt in today's workforce with the technological knowledge and skills attained through their education. This is like a stepping stone to climb the tower of success.

2.5.1 Education and Management of Resources with Clouds

Cloud computing is a relatively new concept, first introduced and generally credited to Amazon with its introduction of Amazon Elastic Compute Cloud (EC2) public Cloud services in 2006. Many proprietary that opened Cloud solutions and services continue to evolve although most are still utilizing the existing services which are re-categorized as Cloud services with standing examples including facebook 'Like' services, Google+ and the Google Calendar services (IBM, 2012).

> Our Definition of Cloud Computing: a relatively innovative, novel concept (with reference to the two selected institutions of study),

> "A Cloud can be defined as a disjointed series of computational resources significantly sharing the features of Grid / Web services, Peer-to-Peer (P2P) computing systems, Client Server Architecture, Distributed systems and other Web 3.0 characteristics making it a unique user experience every time, Streamlining Application / Web Interfaces (Frontend) and projecting data independence (Backend) to end-users (Amaldas *et al.*, 2013a; 2013c)."

Cloud computing can be also defined as 'a type of parallel and distributed system consisting of a collection of inter-connected and virtualized computers that are dynamically provisioned, and presented as one or more unified computing resources based on service-level agreements established through negotiation between the service provider and consumers' (Shankaranarayanan, 2011).

Some of the examples for emerging Cloud computing infrastructures / platforms are Microsoft Azure (Chappell, 2008), Amazon EC2, Google App Engine, and Aneka (Shankaranarayanan & Amaldas, 2011). This capability of Clouds is especially useful for elastic (automatically scaling of) applications, such as web hosting, content delivery and social networking sites. One of the key aspects that make a Cloud computing infrastructure different from a Grid computing infrastructure is that of the massive deployment of virtualization tools and technologies. Thence, as against Grids, Clouds contain an extra layer of virtualization that acts as an execution, management, and hosting environment for application services. These services can also be hosted on a P2P network topology if need be. Thereupon, traditional application provisioning models that assign individual application elements to computing nodes do not accurately represent the computational abstraction, which is commonly associated with Cloud resources (Shankaranarayanan, 2011), e.g., considering a Cloud host that has a single processing core. There is a requirement of concurrently instantiating two Virtual Machines (VMs) on that host. Although in practice VMs are contextually (physical and secondary memory space) isolated, still they need to share the processing cores and system bus. Hence, the amount of hardware resources available to each VM is constrained by the total processing power and system bandwidth available within the host. This critical factor must be considered during the VM provisioning process, to avoid creation of a VM that demands more processing power than is available within the host (Shankaranarayanan, 2011).

There are many ways of categorizing Cloud Computing, for example, IBM defines Cloud computing as solutions that enable Information Technology (IT) to be delivered as a service to end users. In a marketing sense, this is based on the market dynamics of demand and supply which involves corporates investing more into Cloud application services and bandwidth in contrast to investing in compute resources locally. Managing computing resources is an expensive process and Cloud services offer the convenience of improving the Total Cost of Ownership (TCO) for service providers and service consumers alike by extending its services over the internet transparently. Cloud services are broken down by IBM into four very simplistic service oriented methodologies: Software as a Service; Storage as a Service; Platform as a Service; and Infrastructure as a Service (IBM, 2012). These services are similar in nature to Web/Grid Services, Storage, etc to compute data for users and manage resources in an organization.

2.5.1.1 Software as a Service (SaaS)

SaaS was one of the first concepts of Cloud computing allowing application hosting by a Cloud service provider so that the application can be accessed through the web or a mobile portal (tablet or smart phone). This process typically requires the application developer to integrate existing applications and services using a Cloud kit, a software Application Programming Interface (API) used for deployment of services such as a Web services using a specific Cloud infrastructure or to design a new application for the Cloud. The applications might be commercial or developed by academics and the open source community (*ibid*).

2.5.1.2 Storage as a Service (STaaS)

Most applications require some form of persistent data storage. As such, most Cloud service providers include storage as an attraction for its end-users to typically join their Clouds and pay per usage of services consumed usually on subscription basis. Applications can be stored using either structured (database) and semi-structured datasets (files and large objects usually in binary format). This allows these portals to access SaaS applications that are to be stateless and therefore much more simplified in their storage and management mechanisms (*ibid*).

2.5.1.3 Platform as a Service (PaaS)

Public computing involves the sharing of compute resources with very little flexibility towards software accessibility. When we teach computer security, we want the students to be able to directly interface with the hardware and deploy changes to the kernel to test different security routines. One way to make the students utilize Virtual Machines (VMs) such as, VirtualBox or VMWare. But these virtualization softwares do have their limitations; performance is one of them. Since we need to allow students to experiment and learn in a secured environment without affecting the host operating system, one option is to use a Cloud based virtualization solution where VMs can be hosted as a Cloud service, with particular features like General-Purpose Graphics Processing Unit (GP-GPU) resources for Open Computing Language (OpenCL) and Open Graphics Library (OpenGL) scientific computation and visualization; introduction of new communication protocols and storage stacks, etc., to name a few. Rather than building a new lab for the students to use (closed / controlled environments), we can provide a PaaS in real time to our students so that they can test their OpenCL / OpenGL applications or new security routines for Linux kernel development without bothering about the overhead complexities. Amazon EC2 is one of the first examples of a working PaaS (*op. cit.*) based on a pay per service subscription model of utilizing High Performance Computing resources.

2.5.1.4 Infrastructure as a Service (IaaS)

The most generic mechanisms of Cloud services is IaaS, wherein the Cloud services offer networking, storage, computing resources, and ICT services. Typically, IaaS includes SaaS, STaaS and PaaS as well as IT and networking combined as a service package (*op. cit.*).

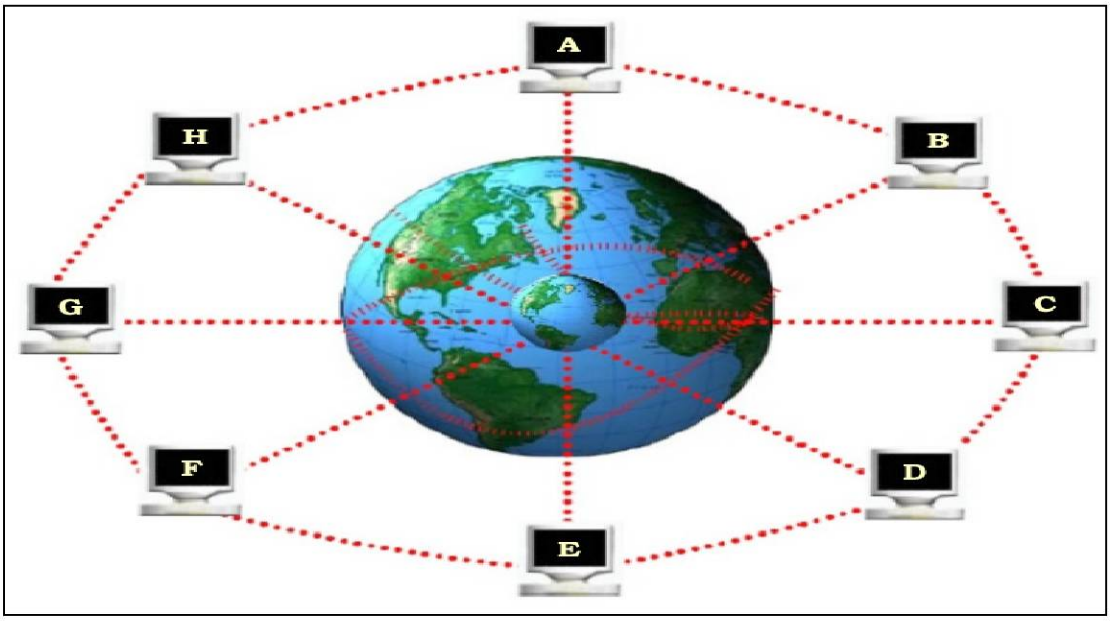
2.6 Understanding Previous Research

High Performance Computing (HPC)

The birth of HPC took place due to the resource constraints posed by symmetric computing nodes. Over the past decade, distributed computing and its host of technological advancements such as P2P, Multi-Agents, Grids and now Cloud based Management of resources has affected the way we use computers in one form or the other. Technology is inherently difficult to manage because it is constantly evolving, often in ways that cannot be predicted. This continuous change in the technological domain can be termed as "Dynamic

Exponentiality" as defined by the researcher. Technology management requires policy implementation and best practices that leverage technologies to be built, maintained, and enhanced towards the competitive advantage of the firms utilizing proprietary knowledge and tacit knowledge (know-how) (Amaldas *et al.*, 2013b).

Figure 2.4: Cloud Paradigm: A Hypothetical Internet-Work of Networks



Source: Amaldas et al., 2013a

Since technology is such a indispensable force, the field of technology management has emerged to address in a particular fashion how companies should approach the adoption of technology in business strategies and operations with respect to ICT resources. Using high performance compute resources such as Cloud services or Grids are becoming common place for ICT reliant organizations, businesses, departments and laboratories to maintain the exponential evolution of data and information generated by end-users. Any system deployed with respect to information management are fabricated to include a minimal threshold or upper limit to bear with information overloading and high compute demand. But even server farms and the most expensive supercomputing centers need some form of scheduling mechanisms to improve upon fault tolerance.

Probably the most important factor that has driven the design of distributed systems is the local needs of the end user. The primary and most critical application of an end user would be to have a system or environment where he/she can work without the exertion to understand the complexities of the node in use. Although many models have been invented and made the user experience as transparent as possible, we feel that a user should be aware that he/she is connected to a service oriented network and is constantly updated about the resources and services available based on the end users requirements. The Internet as of today, is one of the most pervasive networks in existence. This connectivity at a very nominal cost gives designers of large systems to utilize this feature to streamline the design of their systems more effectively. It enables the designers of the systems to visualize their projects in a decentralized manner. As the cost of computing and computer hardware decreases, the complexity of the tasks of the end-user is proliferating. Moreover, the user is not willing to invest in new and expensive hardware to achieve this increased usability. Therefore, system designers have to opt for techniques which can achieve this surged complexity by harnessing the power of all low-end systems effectively. This concept forms the foundation of any distributed system.

Another HPC mechanism is the “Peer-to-Peer (P2P)” concept of Distributed Computing for sharing resources in a manner of ‘give and take policy’. P2P computing is a subset of distributed computing. The technology was an off-spring of bountiful divergent technologies and has become famous after the success of distributed computing. A peer is a single entity or node that shares its resources with other peers or nodes directly or indirectly connected to it. Each peer offers a variety of resources and services to its peers in its domain or network topology. The topology is usually unknown as a peer can be connected from any network. P2P has had a lot of attention in the last few years. The origins of P2P technology are more anarchistic than grids and agents. Early P2P systems were primarily made to enable users to share, often illegal files easily and in public. Early systems had numerous scalability problems or were not pure P2P systems. The pure P2P approach suffers from some noticeable disadvantages. Any node can introduce malevolent data in the system, which can crash the business process. The data in the network is also inconsistent. As there is no monitoring server, security and configuration become key issues (Saini, 2013). There is no central server to detect the presence/absence of peers to take necessary action when a peer fails. Consequently, there are more serious research and product development efforts on

P2P technologies. Suns JXTA (JXTA, 2013 and P2PJXTA, 2013) effort is one exceptional area in P2P computing today. In the open source community, P2P also seemed to have matured and issues with respect to scalability have also been addressed in some systems, e.g. (P2PJXTA, 2013). P2P systems also have a elementary goal of employing distributed resources and providing services to the participating nodes. Today, the services has primarily been in the areas of file sharing but as Suns JXTA shows, P2P is not limited to just that. Sun Microsystems JXTA (JXTA, 2013) and P2PJXTA (P2PJXTA, 2013) shows that P2P actually has many similarities with Grids, Clouds and Multi-agent based systems. Usually, two or more peers are simultaneously connected to each other with data or resource sharing taking place amongst the peers connected. A good example of a P2P network file sharing application would be Utorrent, a file sharing application that lets users install its P2P software and share files across a wide area network such as the Internet. Peers often depend on each other for assimilating information, computing resources, forwarding requests, etc. which are prerequisites for the functioning of the system as a whole and for the benefit of all peers interacting directly with each other.

Resembling P2P computing, Grid technology has gotten a lot of attention from these academics (Foster & Kesselman, 1999; 2004; Berman *et al.,* 2003) and commercial (Ahmar, 2004) environments. The academic community is seeking superior measures to tackle HPC problems; and the commercial industries' interests lies in more client usage of commodity hardware to reduce operational costs or replace expensive specialized computing resources. Grids in many ways represent technologies formed from earlier ideas (Ahmar, 2004) of meta-computing but have gone beyond that area of study. The main source of information on grids is the Global Grid Forum (GGF, 2004). Their main reference platform is the Globus Toolkit with Alternatives being the Legion project (Legion, 2013) which is more agent-like and Condor (Condor, 2013) which has its roots in harnessing unused Computer Processing Unit (CPU) cycles in Clusters. Grid technology is already available from several commercial vendors such as: HP, Intel, Sun, IBM and Oracle, all having divergent HPC products available currently for end-user computing. Cloud computing is a generic framework involving borrowed concepts and ideologies from the previous technologies such as Grids and P2P networks.

In the last two decades, parallel and distributed systems, P2P, High performance Grids (Foster & Kesselman, 2004; 1999) and now Cloud computing have evolved as the default infrastructure for delivering ubiquitous services for compute and data intensive scientific applications. To support the research, development, and testing of new Grid components, policies, and middleware, several Grid simulators, such as: GridSim (Shankaranarayanan, 2011); SimGrid (Legrand, 2003); OptorSim (Bell, 2002); and GangSim (Dumitrescu, 2005), have been proposed and developed in the past. SimGrid is a generic framework for simulation of distributed applications on Grid platforms. On one hand, GangSim is a Grid simulation toolkit that provides support for modelling of Grid-based virtual organizations and resources. On the other hand, GridSim is an event-driven simulation toolkit for heterogeneous Grid resources. It supports comprehensive modeling of grid entities, users, machines, and network, including network traffic. The major limitations of most of the abstract fabrics discussed is the development of these platforms which were centered around specific applications limiting their structural usage. In this research, a novel load balancer is proposed for a innovative generic framework, namely, the CA-Cloud which was created towards improving educational services in an academic context.

2.7 Understanding Multi-Agent Based Systems

Artificial Intelligence gives life to programs in the form of adding virtual intelligence as a factor in agents and multi-agent based systems. Electronic agents are well-suited for computationally intensive, repetitive and time bound resource intensive tasks involving multi-agent based HPC systems. The agent research community has focused on technologies such as developing autonomous agents and techniques for collaborative computing among agents. Very little research has been done to justify the usage, collaboration and utilization of intelligent agents in high performance Cloud computing that has been very recently utilized for computationally intensive applications and services in an educational context such as the LMS. There are numerous definitions for agents and agent based systems; we will discuss a few here with relevance to Multi-agent based systems utilized in HPC platforms. Franklin and Graesser (Foner, 2013) defines agents as "An autonomous agent is a system situated within and a part of an environment that senses that environment and acts on it, over time, in pursuit of its own agenda and so as to effect what it senses in the future." (Foner, 2013) states that an agent "requires aspects of periodic action, spontaneous execution, and initiative; in that the agent must be able to take pre-emptive or independent actions that will eventually benefit the user." Agents have been extensively (Agentlink, 2006) studied wherein many projects have been designed and incorporated on agents and multi-agent technologies. An agent is in essence an autonomous piece of code and the data that can, within limits of each agent based system, move freely between participating nodes to harness resources or provide services. An agent is said to be autonomous when it defines its own rule set based on a set number of goal(s) depending on its environment. When defining the goal with respect to HPC systems, the target of any agent is to provide transparent services based on the availability of resources and services pertaining to its environment. The assumption is that the agent knows or tends to learn everything about its system based on its past experiences (Agentlink, 2006).

IBM defines agents as suitably noted for following an agenda or schedule that is efficiently executed based on an environmental experience gained by an agent(s). It is this ability to intelligently execute user oriented or goal oriented objectives that agents make themselves far superior to normal programs or comparatively non-agents. As denoted by Stan Franklin (1996), agents are classified based on their properties such as reactive, autonomous, temporally, goal oriented, communicative, socially able, learning, adaptive, mobile, flexible, characteristic properties that they adhere. Similar properties can be observed during the consumption of Web services which are bounded by: reactive; autonomous; temporally (relating to spatial boundaries); communicative; and goal oriented agent. Such agents are classified in the form of multi-agents complying to dissimilar properties that are utilized to achieve contrasting objectives based on their perspective environments, explicitly here, the HPC environment. Voluminous researchers have tried to sort agents as being intelligent entities. Taking us human beings into consideration, intelligence is nothing but a source of past actions or experiences. It is with this effect that further actions are inculcated based on present or past experiences. When comparing agents with ordinary programs such as load balancing or message passing systems, there is no intelligence factor evolved in such programs. This is because these programs are following a set of heuristics based on syntactic schema that provides processing capabilities only to the programs in operation. Likewise, agents can exhibit such characteristics based on the environment in which they are imposed upon. The intelligence factor is formed based on the experience of the agent with respect to its environment. “Just like a human mind, the experience of an agent determines the level of complexity, involved in the decision making process.” From this, we can envision that when the brain of a human being reaches a level of complexity, it becomes next to impossible for the brain to think in a cohesive and simplistic manner. Moreover, in Multi-agents, a goal is set and to achieve it, a singular program will only follow a series of step-by-step instructions followed by if-then-else decision-making tree. Incorporating the knowledge achieved from experience factors or past values to the existing decision making loop, some interesting discovery of intelligence blooms which is again limited to the agent's actions and it's environment.

2.7.1 Coalition Terminology and Multi-Agent Interactions

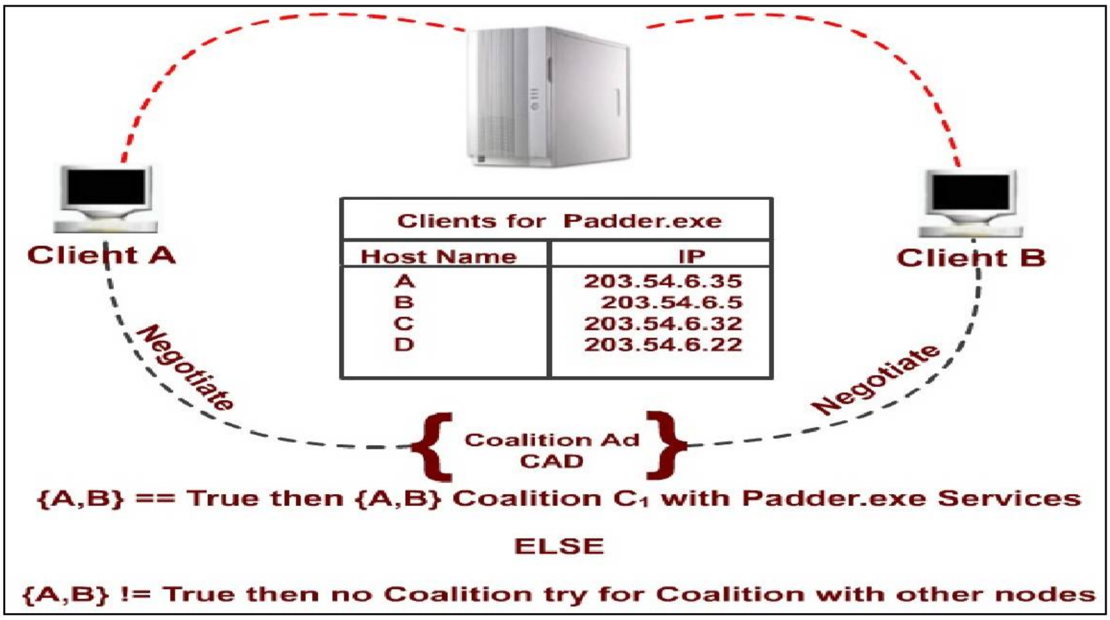
The term ‘coalition’ is a synonym for grouping. Agents form teams or coalitions based on some form of common goal or interest. A good example of coalition formation would be the domain of “politics” where each political party considers its position and then tries to form a coalition to achieve its objectives, specifically such as political powers like forming of a ministry or government body. Here, the mission of each party or agent group is to come to power using coalition. The same example can be applied for sub-coalition or sub team formation. Each party is represented by a group of individuals who are autonomous, i.e., they join the party on their own free will, based on a mutual interest policy. Although, each person has his or her own ambition in life, the constitutional aspiration that brings them together is a common intention in achieving a political objective such as being a Member of the Parliament, a Minister, etc. Henceforth, every individual forms a circle or coalition to become members of the party termed as a sub-group or sub-coalition. The circle in turn is based on turn of events forming a coalition based on mutual interests with other parties or subgroups to form a coalition. The example provides a good overview of how agents should form coalition based on mutual interests and common ambition.

2.7.1.1 Coalition Formation in Agents

Coalition formation can be defined as "When forming a coalition, a rule based methodology is to be applied on the Mutual or self interested agents which acts as the foundation for the subscription or removal of agents." Agents tend to be autonomous; this autonomicity attribute of an agent makes it unique from normal programs or services. As shown in the Figure 2.4, a set of nodes are working in a common domain space close to each other. Each node is represented by an agent, e.g., A, B, C, D, E, F, G, H. Coalition formation takes place between the agents based on mutual interests, commonality of set targets, goals of the agents and target based reasoning. The commonality goal factor could be anything from resources, services, brokerage, pay-offs, interests, etc., (Shankaranarayanan, 2011).

Coalition has its roots from game theory where players or agents form

Figure 2.5: Coalition Formation in Agents



Source: Formulated by Researcher, 2013

groups and plot a strategy for winning a game. In general, with respect to agent based systems and game theory, coalition formation occurs on the fly where agents tend to form groups to achieve a common objective such as job processing or maximizing their utility value. Here, with regards to Cloud computing, we en route and define two new concepts called, static coalition and dynamic coalition in multi-agent based Cloud computing systems. Our fundamental premise is that coalition mechanisms add value in the context of agent-based distributed systems, for the following reasons:

- Coalition of peers can reduce the communication overhead involved in executing complex tasks and services which require the use of multiple peers.

- Coalition of peers can enable high quality matching between the requirements of tasks services and the infrastructure that is made available to execute these millstones. Comparatively, an appropriate coalition formation mechanism can bring together a collection of peers with similar platforms and Quality of Service (QoS) characteristics that are best suited for a given task.

- Coalition formation mechanisms can be used to optimize complex tradeoffs between the objectives of maximizing the utility of the service requester(s) and the service providers, e.g., a service requester could be maximizing it's pay-off for the given task by being an intermediary service provider that outsources it's job to third party agents, thence, maximizing its individual utility value.

- Coalition formation mechanisms can economically hike the system throughput as a whole. After some negotiation among agents, duties will be allocated to appropriate coalitions who can execute them with minimal costs and time constraints. Henceforth, agents seem to be better off given the task at hand. A good example of this would be the formation of coalition among agents in a local Linux cluster where the maximum pay-off is achievable with minimal communication overheads.

The following rules are only a hypothetical methodology that could be incorporated in agents. It is not necessary for all the points to be satisfied in order to form a coalition as one or more points should satisfy the criteria of the formation of the potential coalition.

"Utility represents the motivations or values upheld by the agents. A utility function for a given agent assigns a value for every possible outcome of the task executed with the property that a higher value / pay-off implies the outcome."

"Pay-offs are the values representing the services of agents. Pay-offs may represent profit, quantity, 'Utility' or other continuous measures (cardinal pay-offs), or may simply rank the desirability of outcomes (ordinal pay-offs)."

Pay-off value: An expected value after a task is completed or fulfilled.

Utility value: A value add on which is gained as the expected rate from the average pay-offs obtained as estimated and formulated by the agent.

Fairness: A term used with respect to Agents, meaning, the pay-off value or quantified rate which is equally allocated based on the tasks executed by individual autonomous peers in pay-offs.

Rules for the Formation of Coalitions

1. Utility or self interests that are goal oriented, e.g., pay-offs, resources, services, etc.
2. Commonality of resources and services: operating systems, hardware and software resources, etc.
3. Self-interest based on goals or utility values that are directly proportional to pay-offs.
4. Closest neighbors (or) shortest path of nodes are based on turn around time, domain (or) local topology.
5. QoS and reliability factors.
6. Trust and Beliefs.

2.7.2 How is Coalition Formed among agents?

Usually coalition is formed in agents based on the utility value. When applying agent based coalition concepts with respect to Cloud computing, the commonality as a factor is taken into consideration. As shown in Figure 2.5, it is understood that clients A and B are part of a common domain and they register their locations using the directory services or Agent based Peer Manager (APM) service as seen previously in CA-Cloud Computing Architecture. On registering, they come to know about their existence and a Coalition Advertisement Token (CAT) is sent by either one of them based on commonality of services. In this instance, the commonality between A and B is the services offered by both of them. The APM tends to become a broker for A and B which brings together the formation of the potential coalition of the two nodes based on commonality and mutual interests. At this point, the understanding is that some form of agent communication language such as Knowledge Query and Manipulation Language (KQML, 1997) is used for negotiation, communication and formation of the coalition which is a work in progress concerning our research (Finin, *et al.*, 1997). Just like subscription to a magazine, an agent or group of agents registering with the APM needs to form or join a Coalition based on subscription. Rules of subscription could differ from coalition to coalition based on mutual agreement and leadership by the agents.

Intelligent Computing with Agents

"Intelligence" makes the difference... Intelligence can be defined as a source of information attained from past actions or experiences based on the environment and its attributes. "Intelligent Agents are software entities that carry out some set of operations on behalf of a user or another program with some degree of independence or autonomy, and in doing so, employ some knowledge or representation of the user's goals or desires", (Franklin, 1996).

Understanding Trust in Agents

Agents tend to come across each other as they may choose to interact and negotiate over the jobs specified. During this interaction, there is an associated degree of risk, which is inherent. The interaction could involve parties who have little or no prior experience of performing transactions with one another; therefore, the potential outcome cannot be foreseen. The use of trust in such scenarios, where uncertainty is prevalent, can help assess the associated risk involved for the interaction to take place (Marsh, 1994). According to Griffiths *et al.,* (2003), trust T in an agent called sed on Marsh m (Marsh, 1994) and the work of (*ibid*), is represented using a value in the interval between 0 and 1: T[0,1]. As this value approaches 0, the agent becomes increasingly distrusting and conversely, as it approaches 1 the agent has complete trust or blind trust. The value represents the view of an individual agent and cannot be directly compared with that of other agents due to its subjectivity. Trust is initially set to a value according to the agent's action. This disposition determines both the initial value that trust takes and how trust is altered after an interaction with another agent occurs. When the initial trust is represented by a low value, the agent can be considered to be pessimistic, whilst, conversely higher values represent optimism. As denoted by (*op. cit.*), we can trust agents only based on their actions and reactions that take place during job processing. Trust is a mutual exchange of knowing and using agents repeatedly based on the previous actions of the entrusted agent. In human beings, it is also very similar as trust is formed based on a commonality of interests and familiarity experienced with the duration of time. When an agent spends substantial amount of time with another trusted agent, it helps to built the agent's reputation of trustworthiness.

2.7.3 Classifying Agents

Agents can be classified along the lines of their usability characteristics. Some of the agents discussed below are based on the properties adhered by the agents employed in the CA-Cloud computing system.

User Agents

The goal of the user agents is to exploit the available resources, while meeting the requirements of the user and adhering to acceptable trust limits. User agents respond to requests for a particular resource usage. For example, a user could make a inquiry to access a remote service that is situated in a remote location. The user agent will then need to find an appropriate resource along with the right for authentication.

Resource Agents

The agents which offer remote resources set goals that ensure resources under their management that are utilized to their maximum capacity, while, monitoring and executing under their own trust limits. The resource agents not only process current requests but they are also able to reserve resources for future usage, e.g., a user might wish to access an information resource instantly and may also want to reserve the usage of a database for storing the results at a later time.

Negotiating Agents

Both user agents and resource agents have their own trusting dispositions and may trust other agents differently from their peers. Before the user and the resource agents can cooperate, the requirements of both have to be analyzed and met. This is achieved by a mediating negotiation agent which takes the requirements of a user agent and finds a suitable match for collaboration. Each user agent has it's own negotiation agent who performs all the mediation for them, e.g., a user agent may wish to find a suitable supercomputer for it's user. However, there could be many available matching resources with different constraints and costs. The negotiating agent would then match the user requirements with the availability and characteristics of appropriate resources.

Mobile Agents

A mobile agent has a habit to travel along a network and collect information with respect to it's goals set. A mobile agent tends to migrate from one node to the other, usually searching for files, resources, other agents, etc. Mobile agents are also said to be 'adhoc' in nature as these agents have individual goal sets and try to be as independent or autonomous as possible. The biggest disadvantage of these agents is pertaining to their characteristics that they uphold. Since mobile adhoc agents copies from each node and replicates itself. Due to this nature, it creates a misconception that the information is malicious; the system views it as a virus and destroys it. A good example of this would be a search agent that is searching for resources that gets blocked by firewalls and port scanners as they are mistaken for viruses and Trojan worms.

2.7.4 Importance of Team Formation in Clouds

Task allocation, resource allocation, team formation or coalition formation, static or dynamic organization, and optimal groupings all provide different perspectives on the same basic problem, and provides a variety of techniques for assigning roles to agents for individual tasks. We analyze a simple experimental distributed multi-agent environment with a set of user-agents having different service capabilities, in which educational services are introduced at regular intervals. Most of the tasks require more than one agent's services and resources towards completion of the task. Agents can either form short-term ("dynamic") teams for the duration of a single task or long-term ("stable") or static teams to work together for longer periods of time (Rathod, 2004). We investigate different strategies by comparing agent performances empirically, concluding that even without an explicit element of trust, static teams are more successful than dynamic teams.

2.7.5 Static (Long Term) Team Formation

There has been some work on long-term teams in the computational organization theory literature. Axtell (1999) presents a micro-economic model in which heterogeneous agents with different preferences for effort and leisure form teams or groups. Agents can leave these teams (dependent) and start one of their own (independent) when they think it is beneficial for them. The incentive for agents to be in a group and to contribute to the team is the production of output which is divided equally amongst agents, even though, the effort of each of the individual group members differ. However, as the team size germinates, agents have meager incentive to apply effort as their share in the output becomes relatively insensitive to their input. This gives rise to free-riding agents who do not contribute any effort, which in turn induces hardworking agents to leave the group. The dynamics and distribution of team sizes, productivity and income are studied empirically.

Nonetheless, in Axtell's framework, there is no model of tasks to be performed and it consists of a very simple method for distribution of pay-off to team members. By contrast, Rathod's (2004) contract-based model allocates profit sharing of agents based on both membership and contribution to tasks, balancing the need for stability with a recognition that some agents are more valuable to the team than others. Additionally, the model provides a richer environment in which the aim is to complete all the tasks introduced into the system at regular intervals enforcing team leaders to compete for member agents. They present several strategies for team formation with varied inclinations for taking risks while bidding the tasks. They also study systems that include agents having distinct strategies and compare the performance of diverse agents in the competitive scenario. Our approach is based on applying game theoretic optimization and team formation (Coalition) algorithms in the domain of Cloud based education. Due to the dynamic nature of Cloud computing systems, all interactions inside a team are made locally transparent. In order to maintain team integrity, a mechanism or protocol is required to eliminate inconsistency in the decision making within a team when introduced to a dynamic distributed environment such as a Cloud. In this research, we apply team formation concepts to the CA-Cloud Computing Architecture to improve the throughput of Educational applications by optimizing on Quality of Service (QoS) issues such as latency (the transfer time between two computers), application scalability (elasticity for expansion), scheduling and fault tolerance. We apply trust mechanisms to enable agents to keep a coalition consistent during and after job processing targeting user-agents to enable automated restructuring of the coalition.

2.7.6 Dynamic (Short Term) Team Formation

Chavez *et al.,* (1997), models the challenge of assigning processes to machines as a resource allocation problem where machine agents are treated as resources and the aim is to find an assignment of resources for processes. Tambe and his team have looked at the problem of team formation in a complex, dynamic multiagent domain that includes uncertainty, incomplete information and the possibility of agent failure (Tambe, 1997a; Tambe, 1997b; Tambe, 1998; Sandholm, 2002). By contrast, Gerkey and Mataric (2003) defines the problem of task allocation as assigning tasks to agents while taking QoS constraints into consideration. Recently, researchers have modeled the team formation problem as a Distributed Constraint Satisfaction Problem (DCSP). However, DCSP fails to capture the rapidly changing environment in a dynamic multi-agent system; to address this situation; the notion of dynamic DCSP (Niemela, 1999) was introduced. Modi *et al.,* (2001) have proposed a dynamic DCSP approach to resource allocation using the Asynchronous Weak Commitment (AWC) algorithm. In this approach, the set of constraints (roles to be filled for each task) to be satisfied are allowed to be dynamic. Their algorithm addresses a subset of dynamic DCSPs in which only the local constraints are allowed to be dynamic. Researchers have also used market-based approaches relied on methods from the field of economics (Yokoo, 2000; 1998).

In voting, the solution is determined from inputs taken from all the agents.

Different auction mechanisms, such as sequential auctions (Boutilier, 1999) and simultaneous auctions (Greenwald, 2003), have also been applied to this problem. Sandholm (2002) discusses methods for determining optimal winners in combinatorial auctions where agents can bid for more than one item; and their valuations are varied for distinct combination of items. Contract nets (Dang, 2005) have also been used to allocate tasks to contractor agents who bid for these tasks. The contractor can recruit other agents to complete the task and pay them for their services. Wellman, Gerkey and Mataric (2003), surveyed and analyzed methods for creating market-oriented multi-agent systems (Wellman & Wurman, 1998; Wellman *et al.*, 2003). The market approach defines costs of performing tasks and revenue earned by agents. This gives self-interested agents an incentive to complete the tasks, increasing their revenue and in turn, benefiting the system. Wellman & Wurman (1998) also emphasizes the necessity of market aware agents in a multi-agent world and explains how price systems' facilitates decentralized decision making. Huberman and Hogg (1995) presented a model of interactions amongst agents and their dynamical effects on the structure and performance of the community.

2.8 Scheduling Algorithms

High performance Cloud computing recently has had problems with respect to scaling to a large set of remote nodes over geographically dispersed cluster of resources usually due to the exponential increase and complexity in the data retrieved. Load balancing is a serious aspect of effectively ensuring optimum resource availability and system stability. Agent based Coalition formation techniques are a well known area in the field of Game theory closely followed by the Artificial Intelligence (AI) community. This research attempts to tie coalition formation concepts with respect to Cloud based virtualized load balancing specifically for a Multi-agent based High Performance Cloud Architecture. Coalition formation strategies are applied to effectively minimize message passing (state information updates) and optimize on load balancing under various usage scenarios formulated specifically for the academic community. MOT involves managing of ICT infrastructure, technologies, resources and end users which are incorporated here within an educational context. The primary bottleneck faced by Cloud based load balancing is that it is constrained by numerous QoS factors. Optimizing on the service provision and consumption involves utilizing numerous QoS constraints, such as: system resources; latency; bandwidth; maintaining dynamic state information updates; resource failure; pre-emption of processes; location information; etc. Hence, in this research, we propose a new generic scheduling or load balancing algorithm termed the CA-Balancer that incorporates coalition formation methodologies towards improving overheads in Cloud Architectures.

Load balancing has been the primary area of research for decades in the areas of distributed high performance Grids and Cloud computing services.

Just like the real estate industry the three most important aspects of Load balancing are "Location, Location and ... Location". The primary problems with existing load balancing schemes is the inability to achieve an optimal solution towards a transparent, scalable and fault tolerant system that will try to have minimal message passing and is open to dynamic load changes with respect to heterogeneous resources deployed over a Grid or Cloud Architecture. The introduction of virtualization enabled Cloud computing in data centers and server farms has been heralded as "transformational" and "disruptive" and "game changing", (MacVittie, 2013). From an operational perspective, like transformational innovation in other industries, disruption is not about how the core solution is leveraged or applied but how it impacts operations and the broader ecosystem, rather than the individual task with reference to accepting the solution. The transformation of the vehicle industry, for example, towards alternative fuel-sourced vehicles is disruptive and introduces drastic changes to supply chain of the industry (*ibid*). But it doesn't change the way we drive a car; it still works on the same principles and skills learned by an individual. Analogous to an automobile industry where disruptive technologies were introduced to an existing driver of a vehicle can be related to an end-user in the ICT sector where new concepts and usability scenarios still need retraining. Load balancing virtualized applications can be categorized with respect to disruptive innovation based applications involving age old concepts of load balancing applied to Cloud computing systems virtually. While the core principles of load balancing applications consists of basic distributed systems, much of the additional concerns that arise from the use of virtualization needs to be resolved experiencing exponentiality. The CA-Balancer is a pursuit undertaken to resolve such scenarios in a Cloud based virtualization context embarked in this research.

The CA-Balancer (also denoting the researcher's first and last name) is an extension of the previous research model A^3*p*viLoad (Shankar, 2001b) which primarily focuses on dynamic load balancing under a set of varying conditions or parameters. The ideas behind this study is to apply coalition formation strategies from a game theoretic optimization point of view towards optimizing scheduling algorithms with respect to virtualization of Cloud based computing services. A simulation study was undertaken to prove the integrity and novelty of the algorithms developed and was compared and contrasted with traditionally proven algorithms such as Eager *et al.*, (1986) and Mitzenmacher's (1997) methodologies. The CA-Balancer load-balancing algorithm tries to optimize on scalability issues and limit the number of messages passed around the CA-Cloud system, a Cloud Architecture previously researched (Amaldas *et al.*, 2013a). CA-Balancer effectively utilizes scheduling of remote jobs over a decentralized P2P network topology such as the Cloud Architecture deployed over the Internet. The following sections discuss in detail about: the various coalition schemes that can be formulated; new load balancing algorithms; load balancing policies; simulation studies; and results.

The main contributions of this research are to: (i) Design and develop an optimal load balancing scheme for the CA-Cloud Holistic Software Architecture; (ii) Simulating loaded scenarios in an educational services context with respect to utilizing the CA-Cloud computing environment and performance testing of existing Cloud services; and (iii) Develop a Multi-agent Cloud Virtualization Balancer that utilizes Power server mechanics for simulating and solving loaded conditions using Coalition in Clouds.

The remainder of this section is organized as follows: first, a general description about Load balancing and Cloud computing, existing models, and their layered design are presented; second, a brief overview of existing state-of-the-art in distributed (grids, Clouds) system simulation, load balancing algorithms and modeling of processes; third, represents the comprehensive details related to the Architecture of the CA-Balancer load balancing scheme by enumerating the overall design components and a set of simulations that were conducted for quantifying the performance of CA-Balancer in a mini-Cloud environment (Amaldas *et al.*, 2013a).

2.9 Previous Research and Classical Algorithms

This section presents the background information on various elements that forms the basis for architecting a Cloud computing system. It also presents the requirements of elastic or scalable applications that need to scale across multiple, geographically distributed data centers that are owned by one or more Cloud service providers. Load sharing in distributed computing systems such as Clouds has been an extensively researched field of study over the last four decades (Ahlgren *et al.*, 2011). Various schemes and algorithms with varying levels of successes have been tried, to fulfill the objectives of load sharing. These goals includes the even allocation of excess load among the nodes in a distributed system and the utilization of idle resources. Application-level scheduling, a variant of load sharing at the abstraction-level of user-initiated applications, involves the scheduling of applications at various nodes in a distributed system, regardless of the location of the initiation of the application, so as to satisfy the load sharing objectives. This sub-area of load sharing has also been researched widely. Our aim in this research is to design and implement a load sharing scheme which balances the load of individual nodes and reduces the mean turnaround time of a process (application) from its initial genesis to its termination while providing the user a transparent and seamless view of the system as a service provider. With this objective in mind, we have studied a variety of previous strategies; designed and developed a new schematic, named, the CA-Balancer. A comparative simulation of various legacy programs proves the viability of our load sharing model, with an implementation of the CA-Balancer in a mini-Cloud test-bed, namely, the CA-Cloud Architecture. In our approach, we have considered a Coalition based Event-driven, Decentralized strategy termed the CA-Balancer that balances the loads of individual nodes (Agents in this case) of a mini-Cloud system according to their status and the occurrence of certain processes. The simulation results and the implementation schematics support our views that CA-Balancer could be easily extended to any Architecture by being a viable scheme for load sharing in distributed Cloud computing spaces irrespective of the geographical distance (Amaldas *et al.*, 2013a).

The first aspect that has been the principal motivation behind the design of Cloud computing systems and its services is the massive strides that have been taken in the area of microelectronics and the diminishing costs of computing. The costs of fabricating hardware has been consistently declining over the past decade. This has resulted in the investments of software rather than the procurement of hardware as the former can be upgraded easily. Corporations would rather spend resources on developing a new software than to purchase new and expensive hardware for general purpose computing using Commodity–Off–The–Shelf (COTS) products and services paving the hardware towards a rapid pace of obsolescence. Nevertheless, it would be more economically viable or sensible to implement a system on current or procuring cheaper hardware depending on the subscribed model of computing. This resulted in corporations having numerous low-end machines which they expected to perform some high-end tasks; Clouds are ideally suited for such deployments based on a pay per service model of computing.

The second aspect that has heralded the popularity of Cloud computing is the widespread use of computer networks and the diminishing cost of setting up a network. In this millennium, the Internet is one of the most pervasive networks in existence. Such connectivity at a very nominal cost provides designers of massive systems the option to take advantage of the diversified features to streamline the design and fabrication of their Cloud platforms more optimally. It enables the designers of the Cloud the ability to visualize their projects in a decentralized manner. Scalable architectures are based on the fundamental principles of rapid communication between the various computational resources availability. A high speed network provides the same type of connectivity as that of a ubiquitous electricity (energy from unknown sources) being available at all instances irrespective of time and geographical space.

The third and probably the most integral factor that has driven the design of Cloud computing are the expectations and needs of the user(s). As the costs of computing elements started to steadily decline, it triggers an exponential rise in complexities of the tasks executed by the end-users. This adds to the unwillingness of the end-users to invest in new and expensive hardware to improve their user experiences. Therefore, system designers have to incorporate techniques which can achieve this waxing intricacies by harnessing the power of all the low end systems effectively.

This concept forms the foundation of any distributed system or Cloud computing mechanism transparently. To add to the level of complexity, all organizations are built in a decentralized manner. For instance, a financial institution would like to maintain it's customers' database accounts where it was created and would not like to adopt a centralized server to store all it's data. A Cloud Architecture would be a 'welcome' addition to a financial institution domain but security could be a concern here. This escalating need for decentralization is a key motivation behind the design of Clouds (an aging concept taken from the distributed HPC or Grid domain), especially to handle distributed database systems over de-centralized geographical spaces. As with any organization, the economics of setting up new systems are often a daunting and a cost-ineffective approach to building and maintaining unique ICT infrastructures wherein Cloud based Architectures seems to be an alternative to a more cost effective manner of harnessing huge scale computing power and remote data independence.

2.9.1 Education and Management with Clouds

Load balancing or sharing (Muthucumaru, 2000; Luling, 1991) is a scheduling problem that deals with spreading computationally intensive tasks over a system (such as CA-Cloud). This is a scheduling mechanism that is currently being tackled in the CA-Cloud Architecture. Some researchers even claim that the single most crucial reason for the unavailability of large-scale commercial Cloud systems' are the lack of an effective load sharing scheme (Amjad, 2004). The goal of load balancing or sharing is to take some computationally intensive tasks and port them to processors or nodes where there is a lesser processor load. The difference between load balancing and load sharing is that the former involves preempting running processes and migrating them, while the latter refers to, migrating non-preemptive processes, i.e. once the processes have commenced execution, they are not stopped until the execution is completed.

2.9.1.1 Importance of Load Balancing in Clouds

Load balancing algorithms are still an optimum aspect of distributed systems design such as Grids and Clouds as this determines how the process is subdivided into varied segments for faster execution. Although speed in terms of Gigahertz (GHz) and even Pentahertz (PHz) has been achieved, a saturation point is inevitable, bearing in mind the packing density of a silicon chip. Thus, the need for Multi-core design, a concept taken from parallel and distributed system was adopted. This limitation in speed, forces us to find better methods of processing, namely, distributed systems, grids and service oriented mechanisms such as Cloud based computing. But existing parallelism algorithms tends to be challenging as the process by itself has to be analyzed in the first place and then special parallel algorithms are needed for effective load distribution.

Applying the wrong load balancing algorithm can have a detrimental effect on the overall performance and scalability of the Cloud let alone its Cloud services and related legacy applications. Virtual or physical servers can be chosen based on numerous algorithms such as Round Robin, Least Connection Algorithm and the likes of Fastest Response Time Algorithm tends to result in a really unequal distribution of loads due to the heterogeneity of HPC Cloud environments. Hence, tested algorithms that are chosen for load balancing might only work for known application with proven optimal scheduling and not fit for dynamic reconfiguration of introducing unknown services which calls for a cloud-based load balancing service. As the rising complexities of these algorithms becomes exponential, the processes are now being parallelized at the system level where a decoder circuitry is used for decoding instructions before they are fed into the instruction pipeline. The parallel code replacements are made at the low level which makes parallelizing more effective and the overall complexities are transparent to the user. The biggest advantage of distributed systems such as Clouds are their notable characteristics of being very scalable, virtualizable and instantaneously providing viable solution to computationally intensive processing of tasks. Applications in graphics processing areas and game programming also pose very challenging problems especially when it comes to: rendering images or videos; and running a series of experiments with AI bots learning from their environment; are two good examples of utilizing computational resources dynamically. The idea of parallel and distributed systems was to divide this load into many sub modules which leads to smaller loads on individual systems. This makes the system capable of handling these modules with ease. Although the idea seems pretty simple, the level of complexities rises based on the problems and the level of exponentiality expressed in the datasets used.

The problem of load sharing has been dealt with extensively and has been the topic of many research endeavours (Baumgartner & Wah, 1991; Mullender & Nehmer, 1987; Ni *et al.*, 1985; Hyunok & Soonhoi, 1996 ; Paulo, 1996; Fabrizio, 2000; Sih, 1993; Johnathan, 1988). In this section, we will review some of the work that has gone into the development of load balancing schemes over the past decade or so. Before we go into the details of the various methodologies, we will explore some general class of algorithms (Tanenbaum, 1992). Most distributed algorithms can be categorized on the basis of these classes. The first basis of classification is the point of control where algorithms can be grouped as centralized or decentralized. A centralized algorithm will be one where the state information is maintained on a central server. This server will make all the decisions regarding the migration of processes and maintaining state information updates. There are arguments that this is not purely distributed since there is still dependence on a central server. However, it can be argued that this scheme does actual processing in a distributed manner with the state information updated centrally. These algorithms could suffer from a single point of failure and the performance of this scheme might deteriorate under heavy load conditions. The other approach to the same problem is decentralized approach whereby the advantage is that there is no single point of failure; it has the potential to offer a more reliable service than a centralized algorithm. However, the problem in a decentralized scheme is the ability to maintain system status in an efficient manner. A careless system design could cause the network to become overloaded with data containing state information which could result in the performance of the system going down.

At the point of initiation, scheduling algorithms can be classified as sender and receiver initiated. A sender-initiated algorithm basically relies on the sender initiating the migration procedure. This implies that the nodes that need to offload processes also have to search for a less loaded system. A receiver-initiated algorithm is one where the nodes that are lightly loaded are the ones which search for processes to migrate. The algorithm which we are proposing, is a combination of both these methodologies. The design of the algorithm will be discussed in the later chapters. There are many specific examples of related work in scheduling (load sharing) that have been undertaken in the past. Priority based scheduling, e.g., provides sub-optimal solutions for a set of homogeneous nodes allocated with prioritized jobs. Examples of these types of algorithms includes (Hwang *et al.*, 1989), Round Robin, etc,. Cluster-based Algorithms which map task clusters or coalitions onto the same node reduces communication overhead which is also gaining popularity in some research circles such as (Hwang *et al.*, 1989; El-Rewini & Lewis, 1990; Gerasoulis & Yang, 1992; Pande *et al.*, 1994; Pande, 1995;

Sarkar, 1989). We can also make use of the idle time of nodes to duplicate jobs, i.e. duplication-based scheduling (Samantha, 2000; Ahmed, 1994). In the following paragraphs, we will discuss some past work that has been done in the area of distributed scheduling over the past decade.

2.10 Comparing Existing Algorithms

One of the premier studies in the area of load balancing algorithms with a point of view on complexity was conducted by Eager *et al.*, (1986). Eager tried to study the complexity versus performance trade-offs in load sharing algorithms. Eager proposed three algorithms: The first algorithm, simply states that an overloaded machine should probe a machine at random, and then, send the process. If that new processor is also overloaded, then, that machine will send the process somewhere else until the process gets executed. This process of polling continues until the task at hand is executed. This algorithm is a very simple one to implement. A known drawback of this algorithm is that the process would be bouncing around from system to system for a long period of time before it actually gets executed.

The second algorithm that was proposed by Eager *et al.*, (1986), indicates that when a machine was picked at random, a probe will be sent to it to confirm its presence. Now, the machine that received this probe would respond with a signal informing the host system if it is overloaded or not. In case of an overloaded system, polling for systems which can process the tasks will be probed.

The third algorithm probes a 'k' set of machines and waits for them to respond with their load statuses. The machine with the lowest load is then selected for processing. This algorithm gave the best set of results. It was observed during this experiment that Algorithm three, performed better under the simulation but the complexity of implementation was so high that Algorithm two, was preferred. This experiment brought to light an interesting fact that simplicity is another very crucial aspect of the design of any algorithm.

Mitzenmacher (2000), proposed a new Algorithm which used some of the basic concepts of Eager's Algorithm. He proposed that using a Bulletin Board System (BBS), there could be a periodic update. His scheme for migration involved probing some machines, in order to get back the load status. The process is then migrated to the best of the responding machines. In the process of this experiment, it was found that the best response is obtained only when two machines are randomly probed. We have also tried to utilize this result in the simulation in order to validate the model. One of the drawbacks of this scheme is that it relies on a periodic update signal. This could introduce the problem of out of date information; it also needs to maintain global status information amongst the agents in the CA-Cloud system. Another study in the area of distributed load balancing was given by Mor Harchol-Balter (2000). This study focused on Task Assignment by Guessing Sizes (TAGS). This was a theoretical study that was conducted to understand the effects of loading web servers. In this study, the researcher proposed a scheme with respect to multi-level feedback queuing in a uniprocessor system. The difference here was that various levels of the queue existed in different nodes. Therefore, every time a process was executed at one queue and it was unable to complete its processing, it was restarted on the next lower level queue. Mor Harchol-Balter (2000) contended that this approach was better than pre-empting the process as the cost of pre-emption would not justify the possible benefits it might bring Mor Harchol-Balter (2000) to the system. This scheme was also studied using our simulation model. It was easier to bind the queuing model to some time slots which would give an optimal performance. A general purpose load sharing algorithm does not have the luxury of this knowledge. The knowledge characteristics of a process before execution is called 'priori' information. The method discussed above tries to avoid the use of priori information. The goal of our Algorithm is to exploit prior information as it can lead to a very optimal system based on the known set of applications.

2.11 Limitations observed in Current Systems

1. Optimal resource allocation strategies need to be incorporated for job processing due to the highly dynamic nature of resource requirements of a job, namely: load; CPU; and latency.

2. When looking at scalability issues over a Cloud as compared to a Grid, remote computational nodes do not share a file system and pose problems related to: fault-tolerance; state-information updates; latencies; and overloading of remote nodes.

3. Fault tolerance is a major issue that needs to be addressed in current Cloud computing models. The re-submission of jobs with respect to timeout or failure detection is based on the intelligence of the scheduling mechanisms deployed which are usually not AI.

4. Static sets of nodes are assumed as the algorithms do not provide mechanisms for adding dynamic sets of nodes and resources on the fly.

5. All remote nodes are assumed to be running the local grid daemon (E.g. Globus) which is platform dependent most of the time.

6. Latency and bandwidth issues are not considered during scheduling and remote execution of tasks.

7. Re-submission of failed jobs or nodes has not been accounted.

8. Fault tolerance needs to be incorporated in order to save the job state and restart the job at the most optimally available Cloud service group.

9. Restricted to the size of the dataset (database) being distributed across remote nodes limits size of node set.

10. Coarse grained load-balancing is achieved through dataset segmentation involving heavy overhead due to dataset fragmentation.

11. Centralized failure of head node or initiator nodes. No automated mechanisms for discovering optimal nodes and their respective resources.

12. Intelligent job scheduling mechanisms are needed for re-submission of jobs and process migration when failure detection takes place.

The major gaps and constraints towards system's level as well as application level task orientation has been evaluated and highlighted. We are primarily interested in two key problematic areas, namely, scalability and resource allocation issues that are prevalent in current educational applications (services) and Cloud services enabled platforms. In order to improve the throughput of these legacy tools, we are looking at agent based coalition mechanisms towards improving scalability by taking into considerations static and dynamic changes to the QoS characteristics of a Dynamic Cloud Environment; and thereby enhancing the efficiency of resource allocation and achieving better fault tolerance by applying trust mechanisms specifically towards legacy applications under study. In order to test our mechanisms and hypotheses, there is a need to develop a sandbox 'mini-Cloud' test bed to test the feasibility of the approaches and to look at utilizing remote resources in the form of services employing the power server method of computing.

2.12 Chapter Summary

In this Chapter, a detailed outlook of various service oriented mechanisms applied in education were reviewed; and numerous gaps were observed in the current literature. The following chapters will discuss and highlight the adoption of MOT related technologies with the focal point on understanding the need for adopting MOT as a standard in educational systems with respect to business schools; it's potentials and policy implications in the selected study sites evaluated in the research. A scalable, CA-Cloud Computing Architecture is proposed for service provisioning in an educational context with respect to service consumption in the two selected institutions with respect to business schools.

Chapter 3

Methodology and Findings

Methodological issues and empirical evaluations are discussed in this chapter. The chapter consists of two main sections which are related to each other during the findings and discussions of the methods applied.

3.1 Introduction

Social research includes countless number of methodologies that can be employed along the lines of experimental research, survey research, ethnography, phenomenological research, grounded theory, heuristic inquiry, action research, discourse analysis, feminist standpoint research, and many others (Crotty, 1998:5). However, research in the educational domain tend to make use of a selection of common methodologies, namely, Experiments, Surveys, Case studies, Grounded theory, Ethnography and Action research, each suiting specific studies and its associated data sets [1] [2]

3.2 Design of Study

The study design encompasses both quantitative and qualitative approaches to solving a known research problem utilizing the CHRIST technology management processes as described in Chapter 1. For the quantitative approach, the survey descriptive design is used. Descriptive research, also known as statistical research, describes data and characteristics about the population or phenomenon being studied. Descriptive research answers the questions who, what, where, when, why and how... by identifying exploration, description and explanation as the three purposes of social science research (Babbie, 1989). Descriptive research classifies phenomena by providing an illustration of a variable that is to be observed using statistical determiners to perceive the distribution, pole and the data tendency. Two sets of instruments were used here: 1) The student response instruments for the implementation and usage of MOT as a framework; and (2) Instruments for tenured academics and contractual teaching staffs. The quantitative variables measured in this

[1] Amaldas *et al.* 2013d). An Empirical Analysis of Faculty Performance and Perspectives in Japanese Business Schools. *International Journal of Management & Information Technology (IJMIT)*, *4*(1), 179-189. Impact factor: 0.91. `http://cirworld.com/index.php/ijmit/article/view/411606`.

[2] Amaldas *et al.* (2012d). Faculty and Students Perceptions of TILO: A Case Study of a Vietnamese Business School. *The International Journal of Ethics, Leadership & Business Management*, *8*, 56-66. ISSN 2301-3052.

study are demographic backgrounds, motivation levels, satisfaction levels, roles, personal factors and environmental factors which influence the respondents' motivation and satisfaction levels. The qualitative design is used to observe the data from the open ended questions point of view determined through the interview process. This design will provide detailed information related to the studied phenomenon and is very suitable to obtain the real-world scenarios related to the variables determined. Merriam (1998), writes that external validity "is concerned with the extent to which the findings of one study can be applied to other situations". Unambiguously, the qualitative design will be used to achieve the concept building and comprehension (Merriam, 1997) which are very much needed to make evaluations and to give recommendations related to the motivational and satisfaction levels of students and faculty.

3.3 Research Design (Students)

This study measured the effectiveness of blended learning courses deployed across two International Universities in the Asia Pacific Region, namely, Japan and Vietnam. Research methodology employed a quantitative, pre-MOT test and post-MOT test control group design. Use of intact classrooms, where students are not individually assigned to groups, denotes a Quasi-experimental research design; this is a form of experimental research without randomization used (for both qualitative and quantitative approaches) extensively in the social sciences and psychology (McDermott & Sarvela, 1997). In this study, students' course grades were measured along with course satisfaction surveys and lecturer evaluation. A pre-test and a post-test control group design is one of the strongest methodological research designs, assuring that significant differences discovered between and among groups can be attributed to the intervention (McDermott & Sarvela, 1997). Adapting to this research design, threats to internal and external validity are controlled and generalization to other similar settings is possible (Neutens & Rubinson, 2002).

3.3.1 Revisiting the Research Question(s)

To meet with the purpose of this study, the following research questions and hypotheses were evaluated (Student Respondents only) for statistical significance as previously discussed in Chapter 1.

- *To what extent does current systems satisfy the needs of the end user (in our case the students)?*
- *Do student ratings of instruction reflect a higher class satisfaction score in the hybrid learning environment when compared to the traditional face-to-face learning?*

"Is there a significant difference in student performance when introduced to Traditional and Hybrid Learning environment with respect

to their Ethnicity (Ho_1), Age (Ho_2) and Gender (Ho_3)"?.

The hypotheses (Alternate Ho_1 – Ho_3) tests the three variables listed for statistical significance with regards to the adoption of MOT based motivation and training with respect to students in the selected two Institutions (Japan and Vietnam). Please note that blended or Hybrid learning terminology is interchangeably used throughout the thesis by the researcher.

3.3.2 Study Participants

Participants (n = 250) included students enrolled in the traditional business courses (n = 250) followed by the hybrid businesses courses (n = 98) were evaluated after re-training using MOT principles during the year (2012 - 2013) at three satellite campuses (Both in Vietnam and Japan). Student and faculty motivation, satisfaction levels and learning outcomes were continuously monitored using an electronic assessment system (CES) and a Cloud based LMS (CA-Cloud) management system was developed by the researcher for evaluating pre-MOT and post-MOT training phases with respect to both faculty and students.

One part of the traditional business course, was to serve as the control group, while the other randomly selected group was chosen as the intervention group. Each student was self-selected to be in the hybrid or traditional business course. The business courses were mandatory as part of the Core Curriculum for all undergraduate and postgraduate business schools. Study procedures were reviewed and approved through written consent which was obtained prior to data collection from all the respondents.

3.3.2.1 Hybrid (Intervention) vs. Traditional Course (Control) Structures

The blended course design for the business related courses consisted of two parallel layers that were performed together: the in-class portion focused on activity learning and the on-line portion aimed at the delivery of content materials organized into a series of learning modules along with interactions using the developed CA-Cloud Architecture.

The in-class portion of the hybrid course met once a week and was limited to a maximum of 40 students per session. Each in-class meeting included a brief lecture, no more then 10 minutes, plus 40 minutes of in-class "active learning" activities: discussions, rich pictures (data perception), role playing, debates, worksheets, group projects, and group presentations. Class activities were designed to create an environment that fostered critical thinking, problem solving and the development of self-regulation abilities with personal reflections and action plans. The instructor served as the guide to learning and not as a disseminator of knowledge (testing the areas of self study and progress).

The on-line portion of the hybrid course focused on content delivery, course management and extension of the in-class discussions to the web.

The on-line component consisted of PowerPoint presentations with a corresponding note sheet, homework assignment, project development each week. Materials were presented using the CA-Cloud system. The traditional course format included four face-to-face lectures given per week which was assisted by the use of PowerPoint slides. Class size of the traditional courses were larger, averaging 60 to 300 students depending on the course curriculum and intake. This limited the amount and type of "active learning" activities done in class. The instructor served as disseminator of knowledge in a lecture format, delivering the information and answering questions asked by the students. The same scope and sequence was followed by both the traditional and hybrid courses. The traditional course did not have access to the same on-line course materials as the hybrid course.

3.3.3 Instruments used in Data Collection

Demographic information was collected to obtain descriptive characteristics for students in the intervention and control groups. A pretest examination was given to all study participants to assess course content prior to the presentation of any course materials. The pretest examination contained 20 randomly selected multiple choice questions setup by the researcher to observe the current Intelligence Quotient (IQ) levels of the students throughout the semester. A post-MOT examination process composed of the same questions as the pre-MOT test was given at the completion of the course. The additional measurements of course achievements that were collected included individual student's scores from three semesters along with the overall course grade. Participants completed a Course Evaluation Survey (CES) using a 5-point scale with the following variables: Strongly Satisfied (5), Satisfied (4), Neutral (3), Dissatisfied (2), and Strongly Dissatisfied (1). The CES is administered to help both academic and teaching staff to obtain feedback about their courses and contribute to the improvement of student learning outcomes. The participants in both groups completed this portion of the survey upon completion of the course after the post-MOT test examination. Finally, the-end-of-semester Course Evaluations were uniformly distributed across all disciplines and departments at the both the selected institutions and were compared. The course evaluation forms also used a five-point Likert scale: Strongly Satisfied (1), Satisfied (2), Neutral (3), Dissatisfied (4), and Strongly Dissatisfied (5).

3.3.4 Data Analysis

Descriptive statistics and frequencies were compiled to give the means and percentages for demographic data. Independent t-tests for each of the variables were computed to measure the significant differences. Aggregate totals for surveys and the Course evaluations allowed for the comparison of overall satisfaction scores to be computed below. One-way ANOVA allowed for comparison among and between groups.

Blended and traditional courses were compared for acquisition of knowledge and mastery of material content. Descriptive statistics (mean and standard deviation) were reported for pre-MOT test, post-MOT test, written examinations and final course grades. Independent T-tests determined statistical significant differences between groups.

All statistical tests were performed using p <0.05 and 0.01 as the level of significance. All data were analyzed using the statistical software package SPSS, version 21.0 (IBM, 2013).

3.3.5 Limitations of the Study

Limitations of the study included threats to internal and external validity. Not all participants were present on the days that the course satisfaction and teacher evaluation surveys were given. Although the total number of participants was 400, only 250 completed the course satisfaction survey and completed the teacher evaluation (62.5%) with selected datasets being omitted for irrelevance and vagueness. According to McDermott and Sarvela (1997), 50% or more return rate on survey research is acceptable; the researcher could not predict how students who did not fill out the survey felt about not doing it.

This research reports the findings from two universities (Institution A in Japan and Institution B in Vietnam) and results may not be applicable in all places, though using a control group does increase generalization

(Neutens & Rubinson, 2002). Limitations of this study were numerous, although expected in studies conducted in non-laboratory conditions where the researcher cannot control all the variables. These limitations do impact the results of this study. Face-to-face aspects of the traditional and hybrid courses studied were different and findings revealed that students preferred hybrid learning courses which may be due to the fact that they preferred the active face-to-face learning in this course, and not necessarily the fact that it was blended.

Statistically, the researchers could not partial this effect out from their data, therefore, results can be open for interpretation. In addition, the graduate assistants and faculty who taught the business courses included in this study had varied teaching experiences which may have influenced the results, although random selection of blended and control groups sought to control this threat to internal validity.

3.3.6 Results from the Selected Sites (Students)

Respondent Profile

Respondents in the study represented the population spanning the two selected institutions (Institution A - Japan and Institution B - Vietnam) with frequencies and percentages of demographics reflective of the business school profile as seen in Table 3.1 on page 139. Demographic evaluation and data was retrieved from completed course satisfaction surveys which represented

107 (42.8%) students in the traditional lecture based business courses and 143 (57.2%) students in the hybrid courses which included the MOT based training of faculty and students with the proposed CA-Cloud architecture. Participants were divided among males (n=98, 39.2%) and females (n=152, 60.8%) gathered across three semesters (trimester per annul) at both sites. Grade level distributions (see Table 3.6 on page 146) reflected more on international students comprising of more than 49.6% of the total sample when compared to the Japanese (16.8%) and Vietnamese (33.6%) of the total sample across the three semesters. The business courses were geared up towards international students and this sample reflects the typical student intakes for business courses offered at both the sites.

Table 3.1: Demographics: Traditional (n=107) & Hybrid Students (n=143)

Pre and Post-MOT	Traditional (n)%	Hybrid (n)%	Total (n)%
Age (years) (n=250)			
18 - 19	3 (12.4)	28 (19.5)	31 (12.4)
20 - 21	62 (52.8)	70 (48.9)	132 (52.8)
22 - 23	31 (26.8)	36 (25.17)	67 (26.8)
>= 24 Years	11 (8.0)	9 (6.2)	20 (8.0)
Gender (n=250)			
Male	89 (39.2)	9 (6.2)	98 (39.2)
Female	18 (60.8)	134 (93.7)	152 (60.8)
Ethnicity (n=250)			
Japanese	17 (16.8)	25 (17.4)	42 (16.8)
Vietnamese	45 (33.6)	39 (27.2)	84 (33.6)
International	45 (49.6)	79 (55.2)	124 (49.6)

Source: Calculated by the Researcher, 2013

Table 3.2: Independent T-Tests & One-Way ANOVA: Traditional vs. Hybrid for Overall Course Performance(n=250)

Pre-MOT & Post-MOT Variation	Traditional Mean (SD) Japan	Hybrid Mean (SD) Japan	Traditional Mean (SD) Vietnam	Hybrid Mean (SD) Vietnam	df	F-Value	P-Value
Pre-MOT & Post-MOT Results	2.05 (0.794)	2.13 (0.812)	1.64 (0.481	2.24 (0.812	238	0.991	0.011*
Ethnicity	2.26 (0.718)	2.38 (0.767)	1.50 (0.502)	3.10 (0.203)	248	2.2	0.001*
Institution A/B	1.58 (0.496)	1.43 (0.497)	1.57 (0.496)	2.53 (0.234)	228	0.171	0.221
Grades	3.24 (1.212)	3.20 (1.259)	3.21 (1.324)	1.21 (1.242)	232	0.061	0.0001*
Gender	1.17 (0.376)	1.94 (0.244)	3.23 (1.146)	2.23 (1.121)	170	30.51	0.002*
Age	2.47 (0.718)	2.18 (0.819)	3.22 (1.237)	1.22 (1.223)	241	0.089	0.001*

Source: Calculated by the Researcher, 2013

Among the respondents, 67.2% (n=117) indicate the ethnic backgrounds of the students classified as Japanese, 16.8% (n=42), Vietnamese, 33.6% (n=84) and the rest were International students, 49.6% (n=124) including: Afro-Americans; Americans; Indians; Chinese; and others. The above mix of sample data collected includes: Japanese; Vietnamese; and International students spanning the two selected Institutions. This indicates that there is huge demand for business courses in the selected institutions for international students; and these long term sojourners (students temporarily residing in a country) are able to share their cultural backgrounds and experiences with there local peers namely the Vietnamese and the Japanese respectively. Demographics between hybrid and traditional courses mirrored each other very well enable the pervasive influences of MOT principles into practice.

3.3.7 Pre/Post-MOT Comparisons - Overall Student Achievement

Hybrid and traditional courses were compared for the acquisition of knowledge business students and their views on MOT based training awareness. Descriptive statistics (mean and standard deviation) were reported for pre-MOT tests and post-MOT test results which included written examinations, mid-terms and assignments for inclusion as a final course grade (refer to table 3.1 on page 139).

Table 3.3: Mean & SD for Students Satisfaction: Traditional vs. Hybrid (n=250)

Course Satisfaction Survey	Traditional Mean (SD)	Hybrid Mean (SD)
The learning goals/objectives in this course are clear to me.	2.68 (1.113)	2.71 (1.067)
The teacher is extremely good at explaining my questions.	2.91 (1.024)	2.90 (0.929)
The teacher normally gives me useful feedback on my progress throughout the course.	2.75 (1.091)	2.78 (1.051)
Tasks given in assessments require me to demonstrate the skills learnt for this course.	2.85 (1.148)	2.69 (1.022)
The teaching staff motivates me to do my best work in this course.	2.82 (1.242)	2.69 (1.141)
The learning resources for this course are very useful to me for Career development and course completion.	2.61 (1.227)	2.82 (1.142)
The web-based materials are assisting me: text, rich pictures, diagrams, animations and quiz/feedback documents, etc., are adequate for this course.	2.88 (1.147)	2.74 (1.105)
There is an effective use of other computer-based teaching materials: specialized software, computer simulations and other software programs used at home or in a computer lab.	3.02 (0.981)	2.97 (1.037)
The facilities including TBL/CBL, classroom facilities, lecture theaters, studios, labs, online learning, Powerpoint, research, videos, etc., are adequate for this course.	2.80 (1.136)	2.73 (1.082)
In this course, there a good balance between theory and practice.	2.94 (1.106)	3.03 (1.051)
I can see how I will be able to use what I am learning in this course in my future career.	2.70 (1.283)	2.80 (1.184)
The teacher make a positive effort to understand the difficulties I might be having with my work load.	2.64 (1.151)	2.78 (1.090)
The teacher put in a lot of time into giving comments on my assessments continuously.	2.98 (0.990)	2.99 (0.993)
I am overall satisfied with the quality of this course.	2.57 (1.142)	2.78 (1.051)
I would like to use Technology initiated tools like Face book during the course.	3.09 (1.209)	3.11 (1.169)
During the course, I would like to use Technology initiated tools like Twitter.	3.07 (1.355)	3.08 (1.366)
Throughout the course, I would like to use Technology initiated tools like Online Chat to do group study.	3.42 (1.141)	3.50 (1.168)
I would like to use Learning Management Systems to do group study and Review of the course notes.	3.02 (1.189)	2.90 (1.146)

*1 = Strongly Satisfied; 2 = Satisfied; 3 = Neutral; 4 = Dissatisfied; and 5 = Strongly Dissatisfied

Source: Calculated by the Researcher, 2013

The mean scores for pre-MOT test results (Japan: 3.24 hybrid, 3.20 traditional & Vietnam: 3.21 hybrid, 1.21 traditional) and post-MOT test results (Japan: 2.13 hybrid, 2.05 traditional & Vietnam: 2.24 hybrid, 1.64 traditional) indicating minimal differences between and within groups, and reflecting minimum content knowledge with respect to pre-MOT and post-MOT testing. Written examinations demonstrated the highest difference towards knowledge acquisition with mean grades ranging from 74.55 to 92.10 (out of 100). The hybrid students had a higher average mean for mid-term, assignments and the Final Course Grade. Independent T-Tests were calculated to determine significant differences between the traditional and hybrid learners (students) as seen in table 3.2 on page 140. Significant differences were noted in the pre-MOT test scores, post-MOT test scores, pre-MOT and post-MOT score differences and the final grades obtained. Hybrid students significantly outscored traditional students in the final examinations observed in the post-MOT phase after retraining was done for both students and faculty, while the reverse was true for the pre-MOT phase. Final course grades were significantly higher for hybrid students than traditional students, with the former mean score of 1.94 and the later of 1.17 ($p = 0.0001$). This difference could be due to differences in teaching and learning were in hybrid business courses had more time spent by these learners in using the CA-Cloud system compared with the traditional learners who were evaluated strictly on examination grades and face to face interactions only.

Student Course Satisfaction and Lecturer Evaluations were used to compare student course satisfaction, at the completion of the business course. All respondents completed a satisfaction survey which consisted of 16 questions wherein, 12 were rated higher for the hybrid course design (Table 3.3 on page 142). A composite score was calculated, and again the overall mean was higher for the Hybrid courses (1.94) than traditional business courses (1.17).

Table 3.4: Independent T-Tests - Course Satisfaction (Traditional vs. Hybrid, n=250)

Pre-MOT & Post-MOT Variation	Overall Satisfaction Mean	df	T-Value	P-Value
Traditional	1.17	248	3.464	0.0001*
Hybrid	1.94			

* Note: $p < 0.05$

Source: Calculated by the Researcher, 2013

Significant differences for total mean scores are reported in Table 3.4 on page 144. The total scores between the Hybrid courses (1.94) than traditional business courses (1.17) were significantly different ($p < 0.0001$) indicating that Hybrid learners judged the quality of education to be higher than traditional students.

Table 3.5: Mean & SD - Course Satisfaction (Traditional vs. Hybrid, n=250)

Course Satisfaction	Overall Satisfaction (Mean)	df	F-Value	P-Value
Age (years) (n=250)				
Traditional	2.47	1	383.33	0.000*
Blended	2.18			
Gender (n=250)				
Traditional	1.17	1	8.251	0.004*
Blended	1.94			
Ethnicity (n=250)				
Traditional	2.26	1	1.475	0.226
Blended	2.38			

* Note: $p <= 0.05$

Source: Calculated by the Researcher, 2013

Table 3.6: Pre-MOT & Post-MOT Grade Distribution

Satisfaction Survey	Satisfaction Ratio	Mean	SD	F-Value	P-Value
The learning objectives in this course are clear to me.	Traditional	2.68	1.121	1.063	0.009*
	Blended	3.05	1.296		
Assessment tasks in this course require me to demonstrate what I am learning from inside and outside the class.	Traditional	2.94	1.017	2.448	0.108
	Blended	3.12	1.166		
I am learning what I expected to in this course.	Traditional	2.68	1.069	1.095	0.003*
	Blended	3.08	1.242		
The amount of work required in this course is about right.	Traditional	2.80	1.128	0.059	0.126
	Blended	2.98	1.242		
This course is well organized.	Traditional	2.80	1.262	0.011	0.063
	Blended	3.06	1.304		
The teaching staff in this course motivate me and are extremely good at explaining things.	Traditional	2.56	1.215	1.938	0.0003*
	Blended	3.13	1.358		
I enjoy doing the work for this course.	Traditional	2.82	1.148	4.009	0.091
	Blended	3.03	1.355		
I find the learning resources for this course useful.	Traditional	2.95	1.004	6.068	0.008*
	Blended	3.29	1.173		
The teaching staff normally give me helpful feedback.	Traditional	2.70	1.151	1.137	0.031*
	Blended	3.00	1.322		
The web-based (LMS) materials in this course are very useful.	Traditional	2.92	1.083	2.797	0.002*
	Blended	3.34	1.187		
This course contributes to my confidence in tackling with the effective use of computer-based training.	Traditional	2.71	1.213	4.164	0.03*
	Blended	3.01	1.399		
Overall, I am satisfied with the quality of this course.	Traditional	2.69	1.136	1.711	0.01*
	Blended	3.05	1.291		
There is a good balance between theory and practice.	Traditional	2.97	1.004	7.019	0.01*
	Blended	3.29	1.174		
I feel I can actively participate in my classes and through the web.	Traditional	2.59	1.165	0	0.002*
	Blended	3.04	1.305		

Source: Calculated by the Researcher, 2013

Additionally, the overall quality of educational satisfaction levels were compared by demographical values computed in Table 3.5 on page 145. Indicators in Table 3.5 on page 145 show that only the demographics in which students were significantly more satisfied were with the hybrid approach of learning the courses. Demographic groupings that reported no difference in satisfaction between the different course structures included ethnicity, classifications of students 18-19 and above, 22 years and above, and a handful of minority students. Students that were significantly more satisfied with the blended course included males ($p = 0.002$), females ($p = 0.001$), Gender ($p = 0.001$, $p = 0.015$) and age groups 18-24 ($p = 0.0001$).

3.3.8 Course Evaluations

As part of the business faculty protocol, standardized course evaluation surveys (CES and traditional paper based surveys) were administered at the end of each semester (spanning three semesters) for each of the course at both sites (Institution A - Japan and Institution B - Vietnam). Overall means and standard deviations are reported for each question, divided between blended and traditional course designs Table 3.6 on page 146. Composite lecturer scores are the aggregated total of the individual questions. Students in the blended course consistently rated the lecturer and course higher. The questions included in the tables are a subset of the total questionnaire, and chosen on the basis of information obtained on faculty within the department who are required to include this data in their annual staff appraisal review.

Tests for statistical differences were conducted on individual questions as well as the composite scores Table 3.6 on page 146. Interestingly, hybrid students rated the course significantly higher than the traditional students (p=0.01) and felt the course focused more on course objectives (0.009). Also, blended students felt that the teacher encouraged class participation and discussion (p=0.003), was more available to students (p=0.031), was more helpful to students (0.0003), and was more interested in the materials available on the CA-Cloud LMS system (p=0.002). Noteworthy, there was no difference between students interested in the course prior to taking the course, yet afterwards blended students were significantly more interested in content/material of the course (p=0.043) due to proper segregation and availability of resource and course notes online.

The following are some comments from students in Japan, before the MOT Training was deployed (Pre-MOT Phase).

> *"I'm a Japanese student, this course is really difficult to understand the course and Power-point slides. Tests also difficult for me."*
>
> *"The slides go so fast that I could not write them down."*
>
> *"The Professor is good at speaking English, I feel her passion but she needs to finish the lecture on time!!!"*
>
> *"Mid-term test was too hard. Quarter system is too short to learn*

everything. Please give us an easier final test."

"I can understand what the Professor said but if she speaks clearer, it's better."

"In this course, Professor's pronunciation is difficult to understand. Many students agree with my opinion. To keep the students high motivations to study, I recommend her to pronounce English clearer so that the class will try to listen to the lecture. To tell the truth, can't understand your English. The class is very interesting and very valuable."

"I hope Professor provides Power-point slides "before" the class (on computer instructional materials file). It will help to concentrate on class if students have Power-point slides."

Likewise, the following are some comments from students in Vietnam, across two satellite campuses before the MOT Training was deployed (Pre-MOT Phase):

"Everything is good; Though something should be done to make the lesson less boring."

"The best aspects of this course is that the lecturer who always motivates us to work in every single class. By that, students can clearly understand the objectives of lessons no matter whether they are active or non-active students."

"I see clearly that my teacher puts a lot of the effort in order to explain to the students."

"The presentations give the students the chance to practice their learning skills as well as presentation skills."

"It is also a chance for the students to get familiar with each other before doing the report."

"The knowledge delivered in the course is about right and helpful in analyzing the real world problems. I enjoyed the presentations and other assignments."

"The teacher provided useful explanations with examples to each theory. The quizzes helped me to understand the theories better."

The following excerpt denotes the absolute frustrations of a student who feels his time and money had been wasted due to the negligence of the policy makers and the academic teaching staff in-charge of delivering the course.

"(1) About this course: I feel that this course is a waste of time and money. It is boring and not practical. This course should be in a MBA program where people have already taken the role of leaders for years, and not for a fresh undergraduate who has almost no experience in the Workplace. (2) The lecturer is trying hard, but, to me, the lack of teaching skills and understanding about the academic environment prevented the lecturer from succeeding. The lectures are

extremely boring and we were sleepy all the time because we did not understand a single thing and sometimes, I also felt the lecturer explained it wrongly, e.g., when the lecturer talked about Quantitative and Qualitative Research, the lecturer explained it in a wrong way, no one understood. it's unlucky for the lecturer that I was studying the Research" course and I knew that the lecturer was wrong. There are some problems with how the lecturer marks our assignments as well. Our group got 57% (PA) on the presentations and the other two groups got HD. I don't think we deserve the PA when the other group is not far better than us. This is the first time in this institution that I got a PA for presentation. Regarding the final report, we tried to collect a lot of the previous course reports that were marked DI or HD to learn about the suitable structure and get a better mark to make up for the presentation. However, the lecturer denied them all and forced us to use something we use in high school: Introduction, Body and Conclusion. In the Body part, the lecturer also forced us to write all about the implementation of the theories without describing the problems or explaining the theories. I don't really know. The other lecturers gives us high marks when we state the theories, explain it carefully and then apply. How the heck can I write a 2,300 word report without explaining the theories? Why is the lecturer so different from other lecturers? Another thing is that in the process of *writing the report and after the report, the lecturer kept on pointing at some parts in our report and said that the lecturer will give us zero mark for that, i meant it. The lecturer was teaching a "leading for Business change" course, the lecturer talked a lot of things about motivating people and all the lecturer has done was discouraging students? These things happened with all the groups, we were very irritated trying to satisfy the lecturer's lack of knowledge. Finally, I want to say that if this institution is in short of teachers, don't open the course. It's far better than letting us being affected by a "not appropriate" teacher. I paid 23 Million VND for the course and what I got was no knowledge, no skills, irritation, waste of time and effort and finally, a PA that will affect my overall GPA. I should say that this is the worst course that I have ever taken in this institution in Vietnam, Very disappointed!"*

"I'm looking for a lecturer that can motivate and understand students rather than students during the classes / assignments. I can see the lecturer trying his best but my lecturer's method seems to fail miserably. Our group did not enjoy the class and rather did self-study than spend the time in attending lecturers. Overall, I just think the teaching method is not appropriate. The assessments were fine but I'd prefer mid-term examination rather than final examination."

As student ways and means of knowledge acquisition transform, leaning more towards technology for rapid information dissemination and self-paced intrinsic attainment, educational structures and instructors must adapt as well. The challenge of this new educational modalities (characteristics discovered in adolescents who learn best through each of the four distinct ways: auditory, visual, kinesthetic, tactile) lies in how to effectively teach without compromising content or losing touch with the student. This study looked at blended sections and traditional sections of general business courses to determine how to balance student needs with pedagogical soundness. Promising data emerged to challenge instructors' traditional approach to teaching general business courses at the university level.

Discover the

3.4 Evaluating Faculty Motivation and Training

3.4.1 Formulating the Hypotheses (Faculty)

Any research into adoption of teaching mechanisms and measures is a tedious job; for it must take into account numerous complex elements, such as: the interpersonal relationship; the conventional ethical norms of the institution; the existing management hierarchy; the policy system; common practices; and many more. The hypotheses were formulated based on our first research question *'Does the adoption of MOT as a framework have any ef-*

fect on the motivation levels of international academics in management related departments?' as follows:

> *"Is there a significant difference in MOT based motivation and training awareness amongst the academics with respect to their Gender(Ho_1), Skillset(Ho_2), Age(Ho_3), Class Handling(Ho_4), Teaching Experience(Ho_5) and Intrinsic and Extrinsic Work Motivational Factors(Ho_6)?"*

The hypotheses (Ho_1 - Ho_6) tests the six variables listed above for statistical significance with regards to the adoption of MOT based motivation and training with respect to staff of the selected institutions (Japan and Vietnam).

3.5 Instruments used in the Study (Faculty)

The instruments of study consists of the Motivation Instrument and the Role of International academics in the adoption and usage of MOT and related technologies. The Motivation Instrument and the roles of international academics are discussed: demographic information, age, experience, position, salary and awards received and intrinsic and extrinsic motivation levels related to summarizing the roles of the respondents are provided. Both of these parts will form the cumulative score to view the performance of the selected respondents. The undertaken research is the type that involves at least two areas: the academics (or teachers) and the adoption of best teaching practices. Having considered all possible aspects of the research, Interviews and

Surveys are selected as the possible instruments for data collection. Statistical verification is done using "Multiple sources of evidence" as a point of reference here which is considered as the most suitable approach for the validation of data with regards to this 'fieldwork' study. It has been decided that Interpretivism is the theoretical perspective that lies behind the methodology chosen here. Constructionism is the epistemological view that overwhelms the entire research based on the philosophy that "meanings are constructed by human beings as they engage with the world they are interpreting with" (adapted from Crotty, 1998: 43). Epistemology will be discussed in the forthcoming Chapter.

Estimating the Sample Size

The respondents for the study include all tenured and contracted international teaching staff selected from the study site. The appropriate sample size for a population-based survey is determined largely by three factors: (a) the estimated prevalence of the variable of interest, motivation levels with respect to MOT as a framework in this instance; (b) the desired level of confidence; and (c) the acceptable margin of error. For a survey design based on a simple random sample, the sample size required can be calculated according to the following formula:

$$n = t^2 \times p\ (1 - p) / m^2$$

Where:

- n = the required sample size;
- t = confidence level at 95% (standard value of 1.96);
- p = estimated prevalence of MOT adoption in the projected area;
- m = margin of error at 5% (standard value of 0.05).

It has been estimated that roughly 20% (0.2) of the teaching staff have some idea of utilizing MOT framework and its related ICT technologies (inclusive of digital infrastructure access and digital technology usage) to enhance teaching observed from the selected respondents. This figure has been taken from previous studies by the researcher during the assessment of staff internally (academic audit). Hereafter, the ideal sample size determined would be approximately 246 respondents. After considering the correction factor that is, n = n / (1 + n / N), the number calculated is 250. The choice of sample is made using the stratified random sampling method where the external validity of the study is high and the data generalization can be attained. The number of surveys were around 400 and after careful consideration, 250 samples were chosen at the selected sites for both faculty and students towards data collection.

3.6 Methodology

Many research methods such as observation, interviewing, conversation analysis, document analysis or life history can all be employed towards data gathering. However in this research, there is a stronger inclination towards qualitative methods than that of quantitative ones as the research is intended to explore as much of the subjects' view points as possible. In fact, a number of methods have been adopted to collect the data and information, specifically: observation; document analysis; interviewing; and questionnaire answering. The comments made in the report are partly based on the observations and empirical experiences gained by the researchers in academic teaching. The analysis on the literature and the legislative documents are available at three levels: the policy level; administrative legislatures; and the university. The rest of the data comes from the research surveys conducted during the term as an academic in the institutions using the techniques of interviews and questionnaires. The design aims to collect information for the investigation towards the adoption of MOT in teaching and curriculum development as well as implementation of recommended policies. The similarities are noticeable in the content where the selection of participants is made randomly within each faculty based on their inclination to divulge information to aid the study. Moreover, all faculties in the university have their representatives to participate in the survey, so that an overall picture of 'MOT adoption' can be realized.

There are two major groups participating in the survey: Tenured Staff and Contractual Staff, currently working in all major faculties: Information Management, Management Studies, Accounting & Finance and Strategic Management & Organization. English Language and Linguistics faculty was excluded because of the totally different Human Resource Management (HRM) principles regulated and employed by the University. The backgrounds of the two groups of respondent's are explicitly: tenured and contractual staff. Tenured teaching staff is found to be in the ages ranging between 35 and 59. They have been working at the university for at least 10 years. All tenured staff are either the Heads of their departments or the Program Heads. Half of them have doctorates and the rest are postgraduate degree holders. Some of them are concurrently undertaking higher positions in the university's management hierarchy, to be precise: Deans of different faculties, Vice Presidents and the President of the University. The position of the tenured staff in the management gives an implication that their response to the interview and their comments certainly reflect highly on the credibility and accuracy of the data collected.

Contractual teaching staff is found to be in the ages ranging between their mid or late thirties. Their working time length at the university is relatively short, ranging between a few months to 3 years. Most of them have a Bachelor's degree and half of them are attending a Master course towards fulfilling contractual obligations and teaching requirements. By policy, PhD students are not offered any teaching position in the selected Japanese institution as a norm and are utilized mostly as teaching aid or assistants. They are allocated specific roles and tasks to be executed and are always monitored by tenured or higher ranking managers.

The survey has been conducted in several stages. First, the media department was contacted to access the list of possible academic staff and their respective contact details from both institutions (Japan and Vietnam). Then, appointments with the available tenured staff and the contractual staff were made individually. At the appointment, the survey took place in two steps: (1) The participant's agreement to undertake the interview is confirmed as the first step; (2) The interview took place on the spot, that is, the section of the office or the staff room where the questionnaire was delivered and collected upon completion. The response in the interview was taken down on a sheet of paper with pre-set questions by the interviewer. The interviewee could have a copy made available to them upon their request. Finally, the information collected was processed and analyzed at various levels.

Around 250 participants of the two groups were initially expected to be the respondents in the survey. There were many barriers towards the collection and completion of the data collection. The participants were most likely agreeable to participate after lecture hours for the research. At other times, they were busy either giving lectures, doing projects elsewhere or doing other academic duties. It was, in fact, very difficult for the researcher to get in touch with those academics in the list who were both available and willing to participate in the survey but was personally constrained by the workload. Moreover, each interview lasted at least 15 minutes where sometimes numerous interviewees refused to give their consent initially, which may imply possible negative comments on the current teaching practices. In summary, the methodology and various methods employed in the study have been presented in detail along with the justification. The subjects of the field study have also been introduced as planned and the research procedure has been clearly described.

3.7 Preliminary Findings

After the surveys and interviews were conducted, the following observations were made pertaining to the institutions under study. The names of these institutions are not being disclosed here due to contractual obligations when undertaking this research. Next for simplicity, the tertiary institutions (an International University in Japan and Vietnam respectively), henceforth, will be referred to as Institution A and Institution B. Every year a specific budget is allocated for teaching and learning processes, increasing the hope that a better educational system can be benefited by all students in Institution A in the respective business departments. The survey instrument was pretested by the faculties at the researcher's request from Institution A selected for the study. Based on this, a number of questions were reworded to improve clarity and to ensure that respondents' interpretation of the questions were consistent with the researcher's intent (Refer to Survey in Appendix B).

The final survey instrument was distributed electronically to 250 faculty members at both the sites. The rationale for focusing on the business schools is that these schools are at the forefront of management education, therefore, these institutions would be among the ones to be recognized towards the need for incorporating MOT and related technologies into their curriculum.

To obtain a data set representative of a cross-section of business disciplines, proportionate stratified samples were used based on faculties disciplines identified through their web-pages from the selected Institutions. A wide performance gap was observed between the students and staff at these departments due to the lack of quality in the basic facilities of learning and the related teaching services which were observed to be unsatisfactory. This was due to the lack of course material updates; lack of teacher training and moderation; rigid rules and management problems; peer pressure and other issues. Hence, many academics admit that they are deficient when it comes to skills in teaching due to lack of support materials, limited guidance and staff training given. This situation should encourage policy makers to give more diligent attention in providing educational technologies (MOT related as it is the case here), relative training and services to academics. It is intended that this will give direct influence through examination results and career opportunities. Besides directly providing MOT as a framework, staff and administrators are also responsible for constantly updating themselves with the latest trends and Skill-set. In relation to this, the responsibilities and tasks that are needed to complete all tasks by administrators and their network of academic staff were perceived as being hectic with heavy workloads. Without the support of internal management and continuous motivation, whether intrinsically or extrinsically within the department, it is difficult to achieve the goals. In addition to this, there were various issues that challenged the credibility and mental endurance of the administrators such as: complaints of academics on the lack of opportunities of being exposed to the training's of teaching support materials; and the lack of demand from departments towards teaching support materials that were produced by their peers, associated heads or managers as indicated in some of the interviews below. Only a selection of interviews was made available as a point of reference in this study. The respondents (faculties at Institution A and B) felt that MOT based research and development will enhance their teaching in the following ways:

> *"I feel that I am inculcating new methods in teaching and learning through integrating the Technology Management in Business courses. Students feel that I need to move with the latest trends in technology."*

> *"Students are more creative in their thinking when using technology based learning as they love to chat with their friends while doing their work."*

> *"Majority of the students felt that they need not waste too much of*

time in copying from the white board: currently, time is spent more in explaining the lecture materials which make me a dynamic teacher.”

“Each student studies in a different manner and are not the same in any given institution. We have to find out the level of knowledge and understanding of each class of students so that we can cater to their needs in a better fashion.”

The respondents felt that Institution A’s confidence in teachers enhancing their MOT based teaching in the following manner:

“I am happy that this tertiary institution gives us the freedom to prepare our own teaching materials and evaluation methods for each course which enables us in promoting technology based learning as it helps us to keep with the present trends of both domestic and foreign universities especially when we use WebCT in our 7 weeks of teaching.”

“Senior lecturers are encouraged by the university to share their experience of teaching which tends to lay a platform for the new academics. This is a major motivation for most of us teaching as we feel the university recognizes our efforts to improve the image of the university.”

“Traditional teaching makes students go to sleep and lose interest. Students must be motivated, so I use MOT based teaching which

indirectly motivates any teacher to teach new strategies to achieve better learning outcomes."

"As a teacher, I used to think passive learning is good enough but after the exchange of ideas with my colleagues, I understand that active learning is vital for the student learning outcomes. It has changed my perception of 'best learning practices' as an instructor."

"It is extremely important to integrate different teaching methods and techniques to achieve learning outcomes of students. Integrating videos, power-point, online quizzes... helps to make classroom learning more interesting for students."

The negative aspect respondents felt that MOT based training might make them less popular among students especially in losing control as a teacher:

"I use different strategies, methods and approaches to teach but some of my colleagues are afraid to use the same techniques although I am willing to teach them. They feel that 'spoon-feeding' is more like having the characteristics of a 'mother-goose'. Senior staff members tend to feel that they might have to learn the techniques and feel that will take too much of their time. They think it is a waste of effort and too many changes in their style of teaching are not good."

"If I forget to use the MOT based teaching methods, i.e. using the blackboard. students might think low of me. As it is. they think I am too old to be a teacher. They tend to like young teachers better."

"Although the new trend is student-centred learning, I personally feel that traditional approach of teaching has benefited me as a student when I studied. Now, people's thoughts has changed; we say that it should not be a teacher-centred approach but I have not changed my way of teaching and students are still happy with me as their teacher. They trust and believe and even feel happy to be controlled by me. This directly goes against the fact that the institution's focal point is ignored."

"Students tend to ask 'why teacher A helps us by giving similar examination questions to practice before the examination but why you want us work extremely hard to achieve the same A+ grade'. Students tend to compare one teacher to another which is unhealthy in any institution. As sometimes new teachers are compared with senior teachers like us which makes us very uncomfortable."

The respondents felt that MOT based teaching and learning experience will bring utmost change in students with regards to their study culture:

"Students must be given clear learning outcomes and goals in the beginning of each course. As it gives them confidence and also a

guide as to what will be expected in the seven weeks to come."

"I save lots of time in marking their work online especially since it is all Multiple Choice Questions (MCQ) rather than giving out paper based structured questions."

"I help to save the environment and earth with MOT based teaching: I also encouraged other academics to 'go green' so as to create a paper-less society."

"Technology based learning makes me proud as I am helping to make the environment a better place rather than printing or photocopying pages for students."

"The department's revenue has been reduced immensely due to the introduction of digital technologies; it also helps me to keep my fingers beautiful and out of pain as paper tends to cut my fingers when I handle too many examination scripts due to large class sizes."

"Students should not only focus on achieving higher grades but should be really innovative in gaining insights into subjects like Management of Digital Technology course which involves minor programming that they can practice online."

"Students are able to view their homework and quizzes online instantaneously which will encourage them to prepare for their exami-

nations better; they tend to be more independent doing their studies and compete with fellow peers in class."

The respondents felt that MOT based e-learning or virtual classroom experience brings students and teachers closer to each other:

"Students tend to feel that their English is bad and do not voice out their opinions and thoughts in class. The use of MOT based training helps students to do better as they are indirectly encouraged to chat with one another in a virtual classroom rather than being put down for their grammatical mistakes or laughed at by their peers in classroom based learning."

"Students tend to welcome the idea of having virtual classroom as they can be at any place during the time of the classroom session."

"Teachers can work at their desk and teach at the same time which makes teachers like me more relaxed during virtual classroom rather than physically standing during the normal classroom sessions."

"When I introduced virtual classroom in the second week like my colleague, students tend to 'let their hair down' and talk freely to me which never happened before I started to use MOT techniques such as e-learning."

"We always talk about creative thinking in classroom but most teachers without their knowledge indirectly tend to 'spoon feed' their stu-

dents. Students are happy but they tend to become narrow-minded which involves their focus only on the given syllabus and examinations. Students should 'think outside the box' which aids them in their future work culture."

"Traditional teaching approach is applicable in terms of disciplining the students but when introduced too much, it tends to restrict 'creative thinking' where students tend to 'bottle-up' their ideas."

3.7.1 Institution A (Japanese Institution)

In the study undertaken, Institution A comprised of 250 respondents (114 permanent international teaching staff and 136 contractual teaching staff as our respondents out of the 400 teaching staff evaluated). Faculty play an important role in internationalizing the curriculum and bringing international university degree programs and related content to students in the selected departments. MOT promotion, specifically with the development of DI was actively followed in the founding years. Despite the wide presence of MOT infrastructure and its relevant DT, the curriculum did not reflect much use of it initially until the initiation of this pilot study.

According to the academics, the MOT educational partnership can take a variety of forms, but their major concern is to initiate the transition from text, structure, and classroom based learning towards an e-learning system utilized worldwide. As pointed out in the methodology section of the chapter, the list of questions has already been field-tested by other researchers in Japan. The analysis of the field data was done to illuminate the reasons for the lack of MOT acceptance and usage among staff and students. For analyzing the data, the 't-test' and one way ANOVA statistical measures were used for evaluating the gathered data and theoretical hypotheses as discussed in the next section.

3.7.2 Hypotheses Testing Institution A (Japanese Institution)

The formulated hypotheses (Ho_1 to Ho_6) were tested for MOT based Motivation and Training Awareness of Academics based on the following variables: Gender and Educational Qualification, Age, Class Handling, Teaching Experience and Intrinsic and Extrinsic Work Motivational Factors.

To test the Hypothesis Ho_1 and Ho_2 based on the testing variables: Gender and Educational Qualification (skill-set) the Means, Standard Deviations (SD) and p-values were calculated. From Table 3.8 on page 170, the P-value was calculated as 0.006 which was found to be a significant difference between male and female academics in MOT based motivation and training awareness at 0.05 levels of significance. Hence, the null hypothesis is rejected.

From Table 3.8 on page 170 based on testing variable Skill-set, the p-value was calculated as 0.317 which was found to be insignificant. Hence no significant difference between ICT and Social Science academics with respect to MOT based motivation and training awareness at 0.05 level of significance.

Table 3.7: Cross-Tabulation of Faculty Motivations in Institution A (Japan)

(a.) Faculty Type and Frequencies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	International Faculty	114	45.6	45.6	45.6
	Contractual Staff	136	54.4	54.4	100.0
	Total	250	100.0	100.0	

(b.) Motivation Frequencies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High	157	62.8	62.8	62.8
	Low	93	37.2	37.2	100.0
	Total	250	100.0	100.0	

(c.) Motivation of Faculty, Type, High/Low Crosstabulation

Faculty Type			Motivation			Total
			Intrinsic	Extrinsic	N/A	
International Faculty	Motivation	High	20	33	19	72
		Low	11	19	12	42
	Total		31	52	31	114
Contractual Staff	Motivation	High	22	45	18	85
		Low	8	30	13	51
	Total		30	75	31	136
Total	Motivation	High	42	78	37	157
		Low	19	49	25	93
	Total		61	127	62	250

Source: Formulated by the Researcher, 2013

Table 3.8: Mean, SD, & T-values - Variables Tested for Institution A (Japan)

Grouping Variable	Groups	N	Mean	SD	F-Value	P-Value at 0.05
Testing for Variable: Gender & Skillset						
Gender	Male	121	1.38	0.48	0.797	0.006 *
	Female	129	1.36	0.48		
Skillset	ICT	116	1.35	0.48	0.574	0.317
	Social Science	134	1.39	0.48		
Testing for Variable: Age						
Age	25 - 30	52	1.40	0.49	0.771	0.037 *
	30 - 35	91	1.40	0.49		
	35 - 40	78	1.35	0.47		
	Above 40 Years	29	1.31	0.47		
Testing for Variable: Class Handling						
Subjects	Information Management	41	1.32	0.47	0.464	0.037 *
	Management Studies	80	1.34	0.48		
	Accounting & Finance	86	1.38	0.48		
	Strategic Management & Operations	43	1.47	0.50		
Testing for Variable: Teaching Experience						
Years	Up to 5	47	1.3	0.462	0.299	1.231
	6 - 10	76	1.34	0.47		
	11 - 15	97	1.44	0.5		
	Above 15 Years	30	1.33	0.48		
Testing for Variable: Intrinsic and Extrinsic Work Motivational Factors						
Motivational Levels	Intrinsic	61	1.31	0.467	0.52	0.005 *
	Extrinsic	127	1.39	0.49		
	N/A	62	1.04	0.49		

Source: Formulated by the Researcher, 2013

Consequently, the null hypothesis Ho_2 is accepted.

To test hypothesis Ho_3 (Variable Age), one way ANOVA was used for evaluation. The P-value was found to be 0.037 which is significant at 0.05 levels of significance. It indicates that there is a significant difference amongst the academics when MOT based motivation and training awareness is concerned with respect to their age. It indicates academics within the age groups of 25–30 and 30–35 years of age (m = 1.40) have greater MOT based motivation and training awareness compared to other age groups of academics: academics greater than 40 years (m = 1.35) and 35–40 years (m = 1.35). The P-value (0.037) was found to be significant. Therefore, the null hypothesis Ho_3 is rejected.

The reason for academics (between 25–35 years) are having greater MOT based motivation and training awareness is because they attend special educational workshops, service-training, refresher and orientation courses conducted by third party trainers and institutional level linkages which facilitates their field experiences to gain wider MOT adoption. It is also debatable that these academics belong to a Generation X (Catalyst, 2012) series classification which makes them more inclined towards MOT training and susceptible to technology adoption than their predecessors.

To test hypothesis Ho_4 based on Class Handling, one way ANOVA was used as shown in Table 3.8 on page 170. The P-value of 0.0037 which is found to be significant at 0.05 levels. It indicates that there is a significant difference among the academics involved in MOT based motivation and training awareness with reference to their class handling. It indicates that the Strategic Management & Operations class handling academics (m = 1.47) have greater MOT based motivation and training awareness when compared with other class handling academics, specifically, Management Studies (m = 1.32), Accounting and Finance (m = 1.38) and Information Management (m = 1.32), with the F-value (0.464) which is found to be significant. As a result, the null hypothesis Ho_4 is rejected.

To test hypothesis Ho_5 based on Teaching Experiences, one way ANOVA was used. The P-value is found to be 1.231 which is insignificant at 0.05 levels. In conclusion, there is no significant difference in MOT based motivation and training awareness of academics with respect to teaching experience. Thus, the null hypothesis Ho_5 is accepted.

Similarly, to test hypothesis Ho_6 based on Intrinsic and Extrinsic Work Motivational Factors, one way ANOVA was used. The Mean, SD and F-value are given in Table 3.7 on page 170. The P-value of 0.005 is found to be significant at 0.01 levels. It indicates that there is a significant difference among the academics having MOT based motivation and training awareness with regards to Intrinsic and Extrinsic work motivational factors. It indicates that intrinsically motivated academics (m = 1.31) have lesser MOT based motivation and training awareness compared to extrinsically motivated academics (m = 1.39) and N/A (m = 1.04) staff. The F-value of 0.52 is found to be significant and thus, the null hypothesis Ho_6 is rejected.

Hence from the computed values of significance from Table 3.8 on page 170 it can be assumed that there is a significant difference with respect to MOT based motivation and training with relevance to academics in the Japanese institution with respect to their Gender, Age, Subject Handling and Levels of Motivations towards MOT adoption and technological usage.

3.7.3 Institution B (Vietnamese Institution)

In the study undertaken, Institution B comprised of 250 respondents (157 permanent international teaching staff and 93 contractual teaching staff as our respondents out of the 1500 teaching staff across two satellite campuses which includes English teachers) playing an important role in internationalizing the curriculum and bringing international university degree programs and related content to students (with more than 3,000 students into degree programs and some 2,000 into Academic English classes) in the selected departments (Refer to Survey in Appendix B).

The analysis of the field data was done to illuminate the reasons for the lack of MOT acceptance and usage among staff and students. For analyzing the data, the 't-test' and one way ANOVA statistical measures were used for evaluating the gathered data and theoretical hypotheses as discussed in the next section.

Table 3.9: Cross-tabulation of Faculty Motivations for Institution B (Vietnam)

(a.) Faculty Type and Frequencies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	International Faculty	154	60.6	61.6	61.6
	Contractual Staff	96	37.8	38.4	100.0
	Total	250	98.4	100.0	
Missing	System	4	1.6		
Total		254	100.0		

(b.) Motivation Frequencies

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	High	165	65.0	66.0	66.0
	Low	85	33.5	34.0	100.0
	Total	250	98.4	100.0	
Missing	System	4	1.6		
Total		254	100.0		

(c.) Motivationof Faculty. Type. High/Low Crosstabulation

Faculty Type			Motivation			Total
			Intrinsic	Extrinsic	N/A	
International Faculty	MotivationType	High	25	60	17	102
		Low	9	29	14	52
	Total		34	89	31	154
Contractual Staff	MotivationType	High	16	29	18	63
		Low	13	13	7	33
	Total		29	42	25	96
Total	MotivationType	High	41	89	35	165
		Low	22	42	21	85
	Total		63	131	56	250

Source: Formulated by the Researcher, 2013

3.7.4 Hypotheses Testing Institution B (Vietnam Institution)

The formulated hypotheses (Ho_1 to Ho_6) described above was tested for MOT based Motivation and Training Awareness of Academics based on the following variables: Gender and Educational Qualification, Age, Class Handling, Teaching Experience and Intrinsic and Extrinsic Work Motivational Factors.

To test the Hypothesis Ho_1 and Ho_2 based on Gender and Educational Qualification: Mean, Standard Deviation (SD) and t-value were calculated. From Table 3.9 on page 174, the P-value was calculated as 0.0075 and was found to be significant with respect to male and female academics. Therefore, Gender is found to have a significant difference in MOT based motivation and training awareness at 0.05 of significance level indicating a rejection of the

Table 3.10: Mean, SD, & T-values - Variables Tested for Institution B (Vietnam)

Grouping Variable	Groups	N	Mean	SD	F- Value	P Value at 0.05
Testing for Variable: Gender & Skillset						
Gender	Male	111	2.09	0.72	5.951	0.0075 *
	Female	139	1.88	0.65		
Skillset	ICT	122	1.30	0.45	2.144	0.072 *
	Accounting & Finance	128	1.38	0.48		
Testing for Variable: Age						
Age	25 - 30	36	1.53	0.5	3.413	0.009 *
	30 - 35	108	1.32	0.47		
	35 - 40	75	1.24	0.43		
	Above 40 Years	31	1.42	0.5		
Testing for Variable: Class Handling						
Subjects	Information Management	40	1.43	0.5	1.398	0.022 *
	Management Studies	73	1.27	0.44		
	Accounting & Finance	94	1.38	0.48		
	Strategic Management	43	1.28	0.45		
Testing for Variable: Teaching Experience						
Years	Up to 5	43	1.37	0.48	0.697	0.277
	6 - 10	84	1.29	0.45		
	11 - 15	83	1.39	0.49		
	Above 15 Years	40	1.33	0.47		
Testing for Variable: Intrinsic and Extrinsic Work Motivational Factors						
Motivational Levels	Intrinsic	63	1.35	0.48	0.762	0.021 *
	Extrinsic	131	1.32	0.46		
	N/A	56	1.13	0.48		

Source: Formulated by the Researcher, 2013

null hypothesis.

From Table 3.10 on page 175 based on Skill-set, the P-value was calculated as 0.072 which was found to be significant. This indicates a difference between ICT and Accounting & Finance academics towards MOT based motivation and training awareness at 0.05 level of significance. Consequently, the null hypothesis Ho_2 is accepted. One reason for this could be that ICT academics were more inclined to IT usage and adoption than Accounting faculty.

To test hypothesis Ho_3, one way ANOVA was used. The P-value of 0.009 was found to be significant at 0.05 levels. It denotes that there is a significant difference amongst the academics in comparison with MOT based motivation and training awareness with respect to their age. It indicates academics between 25 – 30 years of age (m = 1.53) have greater MOT based motivation and training awareness compared to other age groups of academics: academics with 30 -âĂŞ 35 years (m = 1.32); 35 – 40 years (m = 1.24) and above 40 years (m = 1.42). The F-value (3.413) is found to be significant. Therefore, the null hypothesis Ho_3 is rejected.

The need for academics (ranging 25 – 30 years) towards greater MOT based motivation and training awareness is due to the fact that they attended educational workshops, service-training, refresher and orientation courses conducted by third party corporate trainers and institutional level connections which provides their field experience to gain wider MOT adoption.

To test hypothesis Ho_4 based on Class Handling, one way ANOVA was used as shown in Table 3.9 on page 174. The P-value of 0.022 is found to be significant at 0.05 levels. It indicates that there is a significant difference among the academics involved in MOT based motivation and training awareness with reference to their class handling. It indicates that the Information Management class handling academics (m = 1.43) have greater MOT based motivation and training awareness when compared with other class handling academics, explicitly, Strategic Management (m = 1.28), Accounting & Finance (m = 1.38) and Management Studies (m = 1.27), the F-value (1.398) is found to be significant. As a result, the null hypothesis Ho_4 is rejected.

To test hypothesis Ho_5 based on Teaching Experiences, one way ANOVA was used. The P-value is found to be 0.277 which is insignificant at 0.05

levels. In conclusion, there is no significant difference in MOT based motivation and training awareness of academics with respect to teaching experience here similar to the Japanese case discussed previously. In this way, the null hypothesis Ho_5 is accepted.

Similarly, to test hypothesis Ho_6 based on Intrinsic and Extrinsic Work Motivational Factors, one way ANOVA was used. The Mean, SD and P-value are given in Table 3.10 on page 175. The P-value of 0.021 is found to be significant at 0.05 levels. It indicates that there is a significant difference among the academics having MOT based motivation and training awareness with regards to Intrinsic and Extrinsic work motivational factors. It indicates that intrinsically motivated academics (m = 1.35) have greater MOT based motivation and training awareness when compared to extrinsically motivated academics (m = 1.32) and N/A other (m = 1.13) staff. F-value of 0.762 is found to be significant and thus, the null hypothesis Ho_6 is rejected.

Hence from the computed values of significance from Table 3.8 on page 170 it can be assumed that there is a significant difference with respect to MOT based motivation and training with relevance to academics in the Vietnamese institutions with respect to their Gender, Age, Skill-set, Subject Handling and Levels of Motivations towards MOT adoption and technological usage.

3.8 Chapter Summary

In this chapter the research primarily involved a mixed mode approach of methodology connecting Qualitative and Quantitative methods of data collection; Preliminary data was collected spanning Japanese and Vietnamese institutions in the Asia Pacific during the researcher's involvement as an academic utilizing the MOT Framework towards Learner centric and Teacher centric classroom learning. The levels of MOT adoption in these institutions were observed in classroom environments by interviewing both faculty and students (as evaluated next using our proposed architecture CA-Cloud); Policies were evaluated and recommended towards the standardization of MOT best practices encouraging adoption in the institutions spanning developed and developing countries with relation to MOT based education.

Chapter 4

CA-Cloud Architecture

This chapter discusses the findings, implications and policy recommendations elaborated after describing the methods used in acquiring the required primary and secondary sources of data collection observed in the methodology chapter.

4.1 Introduction

4.1.1 The Architectural Schematic

High Performance Cloud (HPC) computing is revolutionizing the way in which end user computing is simplified and mass computing resources are utilized to execute programs faster with or without the knowledge of the end user. Due to network traffic and limited bandwidth, Cloud computing still has a long way to go to achieve global acceptance and become a regular commodity such as that of the Internet. Service oriented mechanisms and the concepts of net metering such as Amazons EC2 have given major players such as Microsoft to rethink application deployment and usage. IRAs have also played a critical role in the development and transition to Web 3.0 standards. In this milieu, the major objectives of any Cloud architecture is to minimize the idleness of systems and related resources across networks and migrating tasks across a variety of network topologies. The proposed architecture is an extension of our previous research work A^{3p}viGrid (Amaldas *et al.*, 2013c). An extensible and scalable Cloud services layer is built around the Operating System such as Windows, MacOs and LINUX using a power server to make this architecturally a platform independent service mechanism[1]

Cloud computing over the past decade has become an item of acceptance and is fast becoming a medium, for processing resource intensive applications like Rendering (frame by frame) and Animations as a consumable service. CA-Cloud is an extensible and scalable architecture which incorporates the use of team based "Mini-Cloud" formations as a test bed to migrate different types of processes and to develop a Semi-transparent end user session. Distributed systems such as Clouds provides middleware support for existing Operating Systems and uses a load sharing scheme (Armbrust *et al.* 2010) to effectively

[1]Some parts of this section has been adapted from Amaldas *et al.* (2013c). CA-Cloud - An MOT based High Performance Framework for Sharing Educational Resources. *The International Journal of The GRID*, *4*, 50-72. ISSN 2301-329X.

utilize and share common resources such as file storage and parallel execution of processes. A number of clusters are positioned at strategic locations inside the campus and are connected using High Speed Gigabit networks (Wired or connection based transactions). Each Cluster (Distributed) Server has a Wireless Hub that connects local mobile devices such as Laptops and Personal Digital Assistants (PDAs) which are allocated with Internet Protocol (IP) addresses dynamically using either Dynamic Host Configuration Protocol (DHCP) or ZeroConf type II configurations.

4.1.2 Overview of Current Technologies

Communication over different types of networks becomes effective only when the overall latency of the data transmissions are effective. If the transmission or transfer rate is higher, then, process migration is not effective and the process is best suitable for local processing. Most of the current Cloud infrastructures face more or less a similar bottleneck. Hence, it becomes cumbersome to build a global Cloud infrastructure that can effectively use distributed computing as a base to migrate processes from different parts of the globe for effective distributed computing and parallel executions of program threads. The idea behind the CA-Cloud architecture is to use a combination of wired and wireless commodities to effectively offer service components to the students and faculty of both Institution A and B. Instead of approaching a theoretic global infrastructure, the CA-Cloud utilizes a local approach that is more cost effective and would drastically bring down the idle time of systems operating at the selected institution. Another problem faced by most researchers is the use of Cloud service and its related infrastructure. Most Cloud systems either serve a specific purpose like that of a scientific or research project which utilizes resources for tasks such as number crunching; the use of a distributed file systems with parallel execution of programs over a distributed shared memory scheme, etc. The goal of any system is to provide up-time of close to a hundred percent and also execute processes at the fastest possible time. Furthermore, the complexities of writing parallel programs adds to the burden of the programmer who has to write applications specific to the deployed platform and utilize remote resources which poses a unique management problem with respect to MOT. In the next section, we will discuss about the various problems faced in designing a Cloud system followed by virtualization services.

4.1.3 Design of an Experimental Cloud Platform

A new sand box Cloud enabled MOT based architectural framework termed the "Coalition Agents Cloud (CA-Cloud)" computing architecture is proposed in this research. CA also indicates the researchers' first and last names, whereby, protecting the rights to the research work. It works on the principle of the power server method of computing. Service discovery is based on the needs of the agent transmitting some form of state information updates or discovery messages to a known set of nodes. The following are some of the effective design objectives that a system designer should follow in order to deploy an effective Cloud architecture using a university or company infrastructure.

(A) Better Throughput

One of the primary reasons behind any new approach is that there should be some improvement in performance. This improvement in performance should be large enough to justify shifting from the current system. In a distributed Cloud computing system, the challenge lies in utilizing all the idle resources of the machines on campus in an effective manner in such a way that all tasks gets done in less time. In the implementation of a distributed Cloud computing system, the potential stumbling blocks are the latency that is introduced by the network. Maintaining current state information about the system is another problem which has to be addressed by system designers. Too many updates could flood a network with unwanted state information and similarly, too few an update could result in obsolete data which could make the system unstable and worse, unusable.

(B) Resource Sharing

The term resource here can means anything from a hardware device, memory, Central Processing Unit (CPU) cycles, data processing or storage. An effective distributed Cloud computing system should try to utilize these resources in an optimum manner. The task here again is the ability to maintain all the state information to be as current as possible. CA-Cloud maintains a global table state that is common to all systems. Hence, state information is always updated and based on the state information, the scheduler migrates processes accordingly.

(C) Scalability

This is a very important parameter about how well a system can scale up or down. This effectively means that a system should be able to adapt to various kinds of parameters. Systems should be able to enter and leave the system without any barriers. At the same time, the performance of the system should not suffer as a result of this dynamism.

(D) Heterogeneity

As networks have become widespread, large kinds of special purpose systems are on these networks. The idea behind CA-Cloud is to effectively utilize resources from a variety of platforms and maintain a common resource pool. In a modern context, any Cloud computing system should be able to handle the complexities that arises from dealing with such systems on different kinds of Architectures, Platforms and Applications.

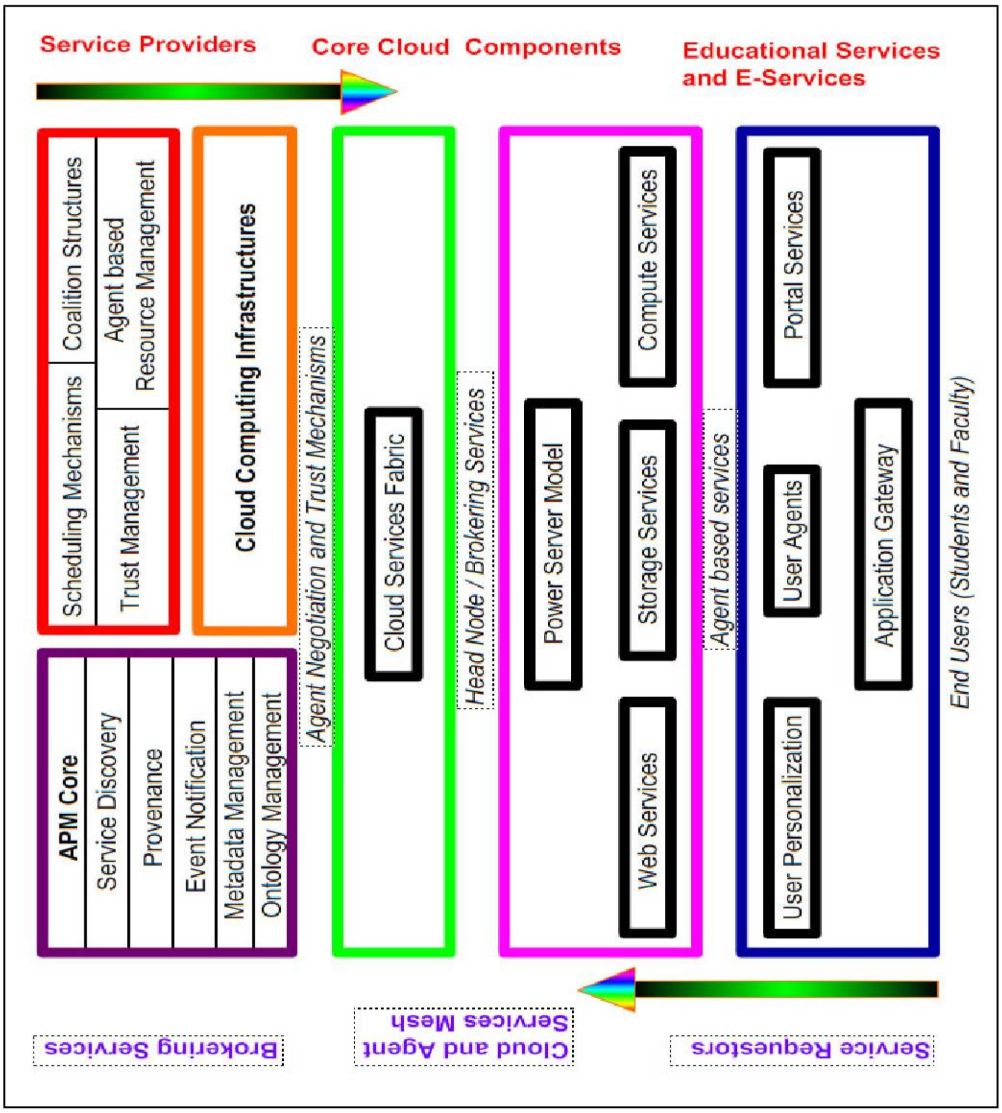
(E) Fault Tolerance

The implementation of fault tolerance in a system will reflect on the increased availability of the system. This implies that the system is not dependent on any one system's functioning. A typical problem area here would be the storage of files on a remote server. Each time a user session is in progress, the requested files has to be available to the user. The vulnerability of the system would be loss of information stored. To deal with this, we are looking at the concept of smart storage where two or more systems will have a track of each other and thus, effective data servicing is made possible. Replication or mirroring of data has to be done smartly without redundancy. The system as a whole can function even after some systems have failed. This reflects in increased reliability of the system. These are some of the basic objectives of what should be the design factors that go into the design of the CA-Cloud. These factors however are only general guidelines and they are applicable to various system designers as parameters to good architectural design. For instance, if a designer knows that the number of systems in his system will never exceed a certain small number, he can overlook the scalability feature and try to optimize on the relevant features.

4.1.4 The Proposed Architecture

The CA-Cloud works on the principle of the power server model of computing. Each of the clients runs the CA-Cloud server which is a simplistic http web server running services based on common scripting languages such as Perl, Hypertext Pre-Processor (PHP) or Common Gateway Interface (CGI). The client side coding model enables the developer to develop services using the CGI and can use any of the languages that support CGI scripting. For the sake of simplicity and rapid development of services, we have used Perl as the default language of choice due to its availability and portability to most platforms. Discussed below are the different components that enable the functioning of the CA-Cloud Architecture.

Figure 4.1: CA-Cloud Architecture



Source: Amaldas et al., *2013c*

4.1.5 Components of CA-Cloud Architecture

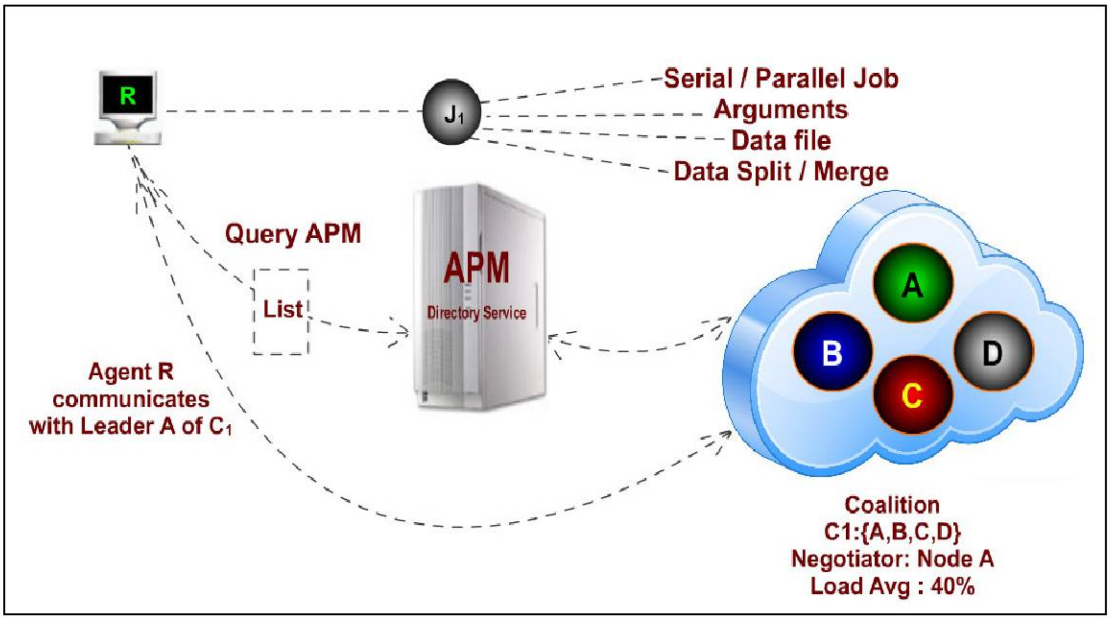
(A) Service Discovery

Any peer (Agent in this case) needs to transmit some form of state information updates or discovery messages to a known set of nodes or agents. The basic requirements of discovering a remote peer is by identifying the peer by its unique id, explicitly, the IP address or domain name or both and its services offered. The CA-Cloud uses a decentralized directory structure to enable peers to register and de-register agents and their respective services. A good example of this would be Web Services Definition Language (WSDL) which uses Universal Description, Discovery and Integration (UDDI) for publishing web services. The CA-Cloud system relies on a similar service, namely, the Agent based Peer Manager (APM) where each peer hosts a set of service agents running a specific service. Each peer is also given a unique id with respect to the APM registration service which identifies the polling agent (peer). The unique id ensures that the agent remains distinctive to the APM even if its configuration and services changes (i.e., the IP address and location specific information changes).

(B) The Agent based Peer Manager (APM) Service

The primary aim of the APM is to store location and service information in the form of categorized listing. Similar to P2P file sharing applications such as

Figure 4.2: CA-Cloud Directory Structure - APM (Adapted from Amaldas *et al.*, 2011)



Source: Amaldas et al., *2013c*

Bittorrent which uses the .torrent style structure for seeding files, the APM stores location and services information in the form of servicename_location.APM file. Seeding is a process of connecting to a torrent when you have a complete file. There are two ways to do this: (1) By leaving your client open after the download completes. Once you have the entire file you become a seed and the BitTorrent client remains connected to the swarm, sending to other users until you close it. (2) By clicking on a torrent link (or opening a saved .torrent file) and selecting a filename of a file that has already completed. BitTorrent will check over the file and realize that it's already complete, and continue to connect to the tracker and serve as a seed).

Figure 4.3: Structure of Agent Based Peer Manager Directory Services

```
struct APMFile {
APM_Location();
Service_Name();
Service_Description();
Peer_information();
}

Example File: Results_RU.apm

# APM location: Ritsumeikan University, Japan

# Service Name: Results

# Service Description: Student Results Services

# Remote Results are Concatenated Back to Originator

# Peers   URL Port
192.168.1.10 http://192.168.1.10/results.cgi 85
192.168.1.11 http://192.168.1.11/results.cgi 85
192.168.1.12 http://192.168.1.12/results.cgi 85
192.168.1.13 http://192.168.1.13/results.cgi 85
192.168.1.14 http://192.168.1.14/results.cgi 85
192.168.1.15 http://192.168.1.15/results.cgi 85
192.168.1.16 http://192.168.1.16/results.cgi 85
192.168.1.17 http://192.168.1.17/results.cgi 85
192.168.1.18 http://192.168.1.18/results.cgi 85
192.168.1.19 http://192.168.1.19/results.cgi 85
-END
```

Source: Amaldas et al., *2013c*

(C) The Initialization Phase

- All peers are capable of being a head node by running the CA-Cloud Daemon.
- All the Agents download a list of peers based on the requirements of the user from the APM.
- Initially an ideal set of peers are initially computed for job processing.
- An optimal coalition or team is then formulated from the ideal list using the coalition formula and the most appropriate coalition list is finalized.
- Services defined by the user(s) are checked with APM for registration / de-registration.
- Job submission and scheduler agents are initialized for receiving remote jobs.

(D) Computing Ideal Set of Nodes

The most optimal set of nodes are computed by creating the ideal coalition using a series of QoS constructs that can be formed with a given set of peers if and only if the latency of the peers is minimal. By applying a latency test, the ideal set of nodes along with their QoS parameters are processed initially by the client. This is not a necessity that the client needs to compute the set of nodes. A user can obtain the set as a file which is read by the script as the ideal set. The most important step is to compute the optimized coalition list which determines the closest nodes needed for job processing.

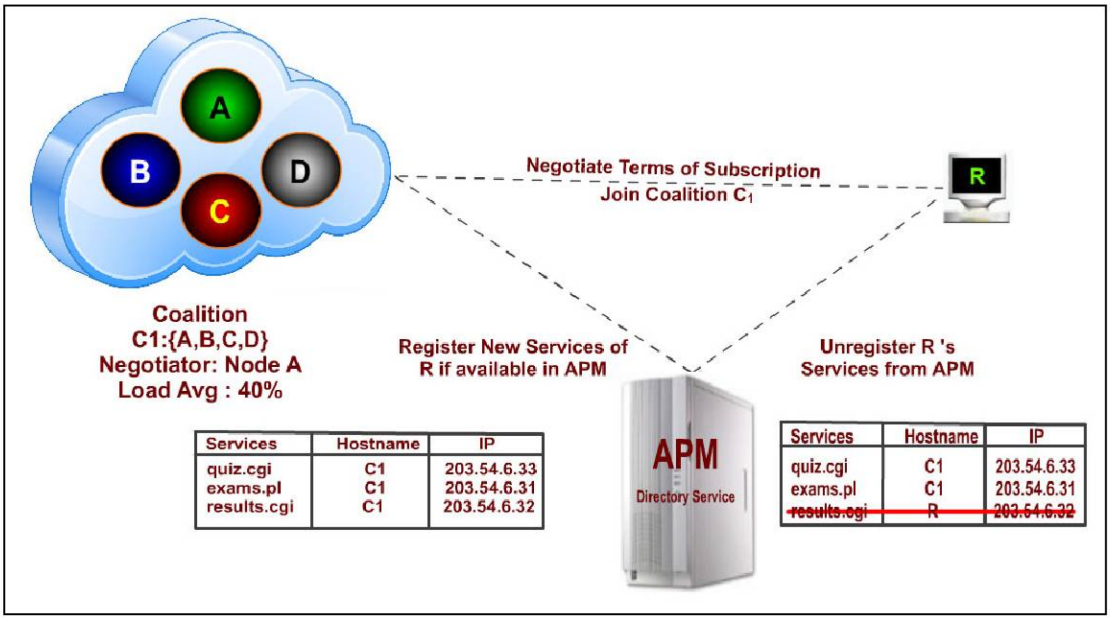
(E) Job Scheduler and Service Registration

The basic operation of any scheduler is to create an ideal job queue for job processing. The job scheduler takes care of job id creation, time of creation, etc. It is the duty of job scheduler to log the statuses of the jobs such as job history, success or failure of jobs, compute the trust based on job history, de-register services, etc.

Service Registration

A service is registered by calling the APM registration service which takes the IP address, hostname, location information, service name and service location/path. It is assumed that each node is represented by one or more agents and a common coalition formation construct is used based on a set of rules. The rules could be different for each agent based on its environment and self-interests. The commonality of service factor plays a vital role in the collaboration and formation of coalition amongst agents. Let us assume that R is a node represented by an agent. The commonality (results.cgi services) between the agent R and the coalition C_1 constitutes a previously formed coalition in nodes A, B, C, D leading to negotiation and registering of agent R in coalition C_1 based on utility factor. Here, the APM acts as a directory services agent that negotiates and stores information of individual peers and coalitions available in the immediate domain space. It is not necessary to have a centralized APM as each domain hosts a set of peers and each domain can apply an APM service and reflect changes similar to the domain name services concept of computing over the internet. Here, R finds interest in joining the coalition group C_1 where a negotiation takes place based on utility. The agents in coalition form a decision in the acceptance or rejection of R towards joining the coalition C_1 based on coalition interests.

Figure 4.4: New Agent Initiation and Registration in the APM



Source: Amaldas et al., *2013c*

Let U be the utility value for remote node R and coalition C_1. UR is the utility value for R. U(C_1 : (A,B,C,D)) is the utility value of the coalition C_1

where agents A, B, C, D each have individual utility values such as UA.

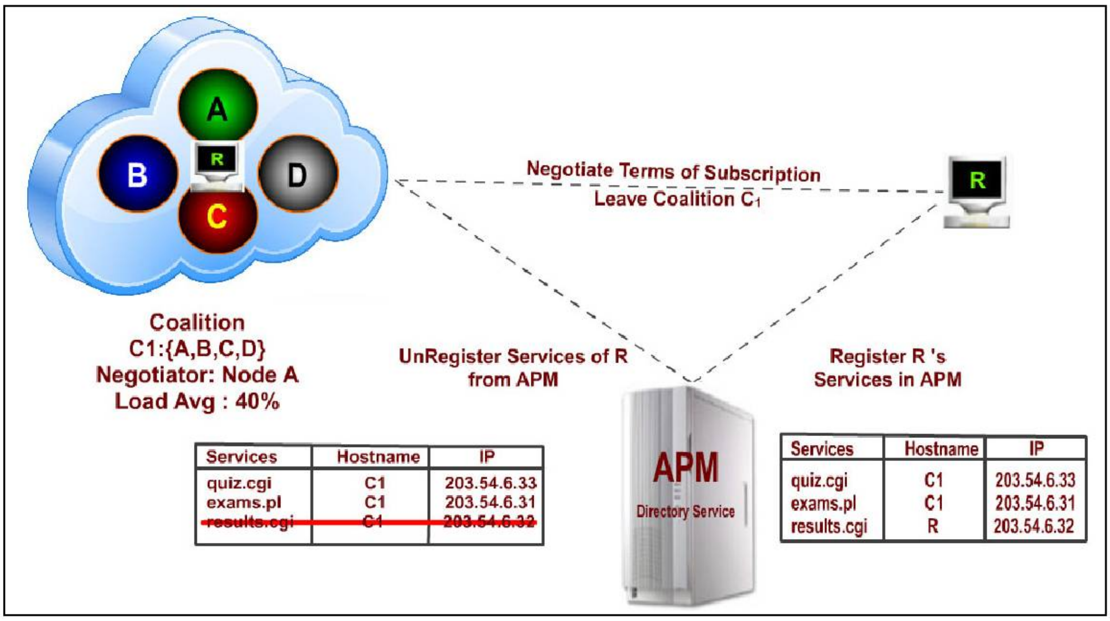
Here, the utility factor is defined as the more jobs obtained, the more utility value, namely, mutual interest or Common service consumption based on a give and take policy. Hence, a coalition is formed to increase the utility value of an agent or set of agents. Factors such as the increase in resources, payoffs and additional services plays a vital role in the decision factor of accepting or rejecting an agent within the coalition or Mini-Cloud. After negotiations, R tends to join the coalition group C_1. An "un-register" message is sent to the APM which updates the required tables for the removal of the services of the Agent R. Similarly, a register service becomes a possibility if new services are rendered based on the entry of the new peer R. C_1 registers new services that become available after Agent R joins the coalition and the APM updates its tables accordingly.

Service De-Registration

When an agent tends to leave a coalition due to unavailability, resource problems etc., a set of leaving rules are defined based on the subscription rules of the coalition group. Rules like group losses, individual losses, re-negotiation and higher payoffs for the stay of the agent, will have to be taken into account for the agent leaving the group. Agent R is leaving the group C_1 after negotiations. An un-register message service is called upon as specific services of R are affecting the coalition C_1 as a whole and the APM is updated accordingly.

Equivalently, the autonomous node or agent registers its services back to the APM which does an update to its directory.

Figure 4.5: Agent De-initiation and De-Registration in the APM After Task Completion

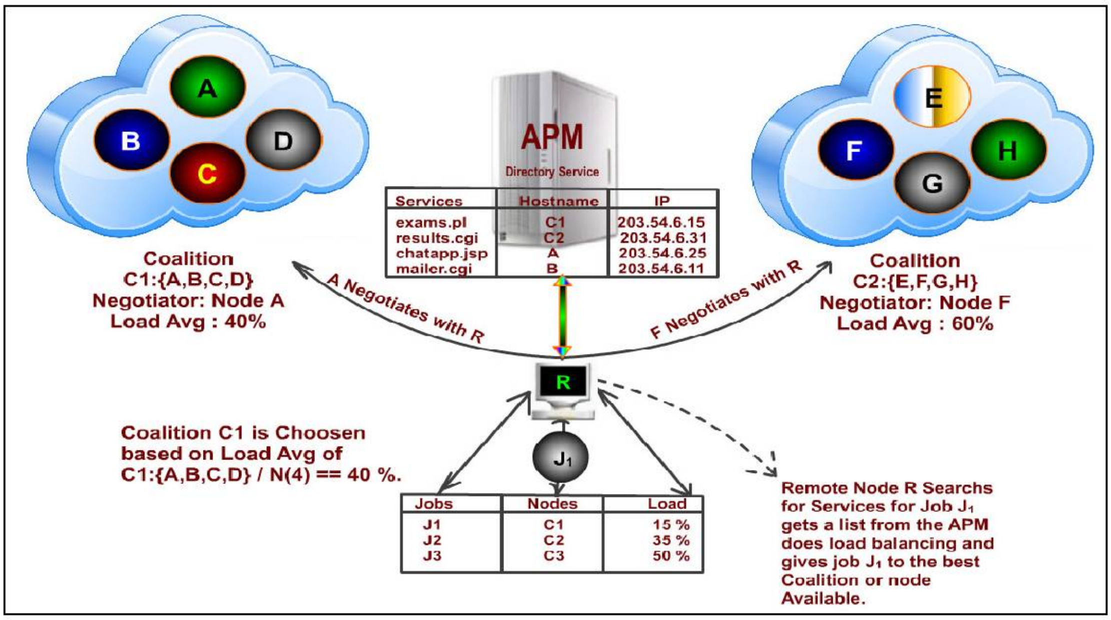


Source: Amaldas et al., *2013c*

(F) Agent based Coalition

A coalition, in the context of agent-based systems, is usually defined to be a group of agents that come together to solve a common task or achieve a common objective. Coalition has its roots from Game theory, where, player agents form groups and plot a strategy for winning a game. In general, with respect to Agent based Systems and Game Theory, coalition formation occurs on the fly where agents tend to form groups to achieve a common goal such as Job processing or maximizing their utility value. Here with respect to HPC Cloud computing, we en-route and define two new concepts called Static coalition and Dynamic coalition in agents. Two categories of coalitions are of interest here: Static and Dynamic.

Figure 4.6: Coalition Structural Integrity and MOT Enabled Resource Management Center



Source: Amaldas et al., *2013c*

Static coalitions are typically formed on the basis of more persistent common goals and tasks, and are less likely to change from problem to problem. Dynamic coalitions, on the other hand, are groupings that are formed to address the needs of a specific task or common objective. Once these tasks are completed, or the common objectives met, Dynamic coalitions tend to disband, and re-form in different ways. Here in the CA-Cloud Architecture, Static and Dynamic coalitions are formed based on the agent's decision making at the time of effective job processing and aggregation of available resources.

4.1.6 Computing Optimal Coalitions

An optimal coalition is obtained based on a distance formula which is computed as adapted from our previous research (Amaldas *et al.*, 2013c). Let us now see how templates can be computed using a set of QoS factors. Let us compute the requirements of the job, say, J_1. Let us take that job J_1 has Latency $\leq$ 40, Load $\leq$ 10 and CPU % $\leq$ 50 as its QoS factors. Let us take the QoS factors to be Q_1, Q_2, Q_3 and the distance needed to be computed for the job J_1 using a template T_i. It is assumed here that T_i satisfies the QoS factors $Q_1..Q_3$. The distance is calculated by using the following distance formula formulated:

Here, P_1 and P_2 are the predicate properties of the Job J_1 and Q_1, Q_2 and Q_3 are the real values R_1, R_2...R_n of the job. So, let us take that the storage requirements and load requirements of the job J_1 are satisfied which is denoted by T (True) and resource CPU % is not satisfied which is denoted by F (False). The predicate value for Template T_1 is Load = 50, storage = 20 and CPU % = 45 and the real value requirements of the job J_1 is denoted by Load $\leq$ 40, storage $\geq$ 10 and CPU % $\geq$ 50. Let W_1, W_2...W_n be the weights associated with the job J_1 and O is computed using the real values of job J_1. If the predicate value matches, it is denoted by a 0 or else by a 1. By applying these values to the distance formula, we can compute the distance for calculating the best coalition or agent available for the job J_1. The summation and end distance value is computing using T_i and J_i the real values and P_i and Q_i, which is again the predicate values, required by the job J_1. The predicate values are denoted by a true or false condition based on the matching of the template QoS factors to that of the Job J_1 (Amaldas *et al.*, 2011).

Therefore, if the outcome is a true, and true is represented as a 0 and computed, else no computation takes place. Similarly, a simple subtraction of the real value gives the minimum distance between the template and job properties. Let us now take the example given in the table above and try to find the distance manually for J_1 and the template T_1. Let us compute w to be the weight, which is equal to 1. Now for Q_1 factor, we compute the values in the distance formula obtaining a distance of 10. Similarly for Q_2, we get -5 and Q_3 we get -9. The sum of Q_1, Q_2 and Q_3 gives us the distance between the job J_1 properties and the predetermined template T_1, which is obtained as -4. Similarly, the number of templates created are based on the history of the Jobs and a definitive distance calculation helps to confirm which of the coalitions are eligible for job processing. By calculating the distance between each template and the QoS factors of the job, we can find out which of these are the best set of optimal coalitions or peers that are available to R for offloading job J_1. The optimal coalition ensures minimal fault tolerance and also tries to increase the throughput of the services offered (Amaldas *et al.*, 2013c).

A coalition based framework for Cloud based service consumption architecture was proposed in this research. To improve application and agent specific performance, customized Virtual execution environments (VMs) were created for each of the agents running the CA-Cloud service. An improvement in performance after initialization and execution of agents on the VMs was observed initially without any datasets. The use of scratch disks also proved useful in improving the execution time of some of the initial service oriented mini-Clouds. The scalability of the Mini-Cloud test bed was based on numerous dynamic QoS factors such as availability of resources, the operating environments of the agents, latency and bandwidth constraints, etc. Cloud applications included services that are directly available to end-users (students). We define end-users as the active entity that utilizes the SaaS applications over the Internet. These applications or Cloud based service may be supplied by the Cloud provider (SaaS providers) and accessed by end-users either via a subscription model or on a pay-per-use basis. Future research would be geared towards improving the framework for working with dynamic memory allocation and pre-emptive multitasking capabilities and actual usability in a university setting such as Institution A (Japan) and/or Institution B (Vietnam).

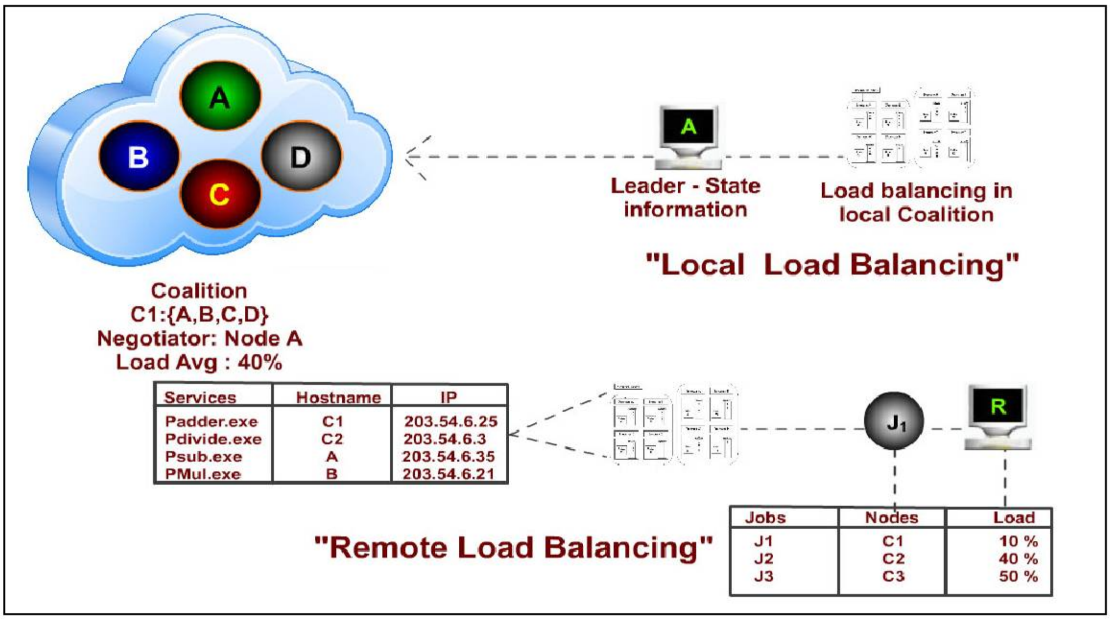
4.1.7 CA-Balancer Scheduling Mechanism and Results

Over the years, many scheduling infrastructures have been studied including the FCFS, Backfill, and EqualUtil strategies (Gerasoulis & Yang, 1992). Below, we present some of the general architectures that have been realized, forming the basis of the CA-Balancer scheme. These scheduling infrastructures rely on either a centralized, hierarchical, or decentralized architectural mechanics. Centralized scheduling algorithms involves the assigning of one specific node in the system as the scheduler. This node will maintain universal awareness (Luling, 1991) of all statuses (information updates) of all the other nodes in the system and map jobs to suitable nodes. However, it presents scalability problems and single point-of-failure issues. Hierarchical scheduling makes use of a layered structure of job scheduling wherein different levels of schedulers execute scheduling policies (which maybe different from each other) over their own relevant plane, i.e. they utilize meta-schedulers that schedule other coarse-grained jobs over a set of schedulers. These levels of meta-scheduling may keep extending. These are quite popular scheduling algorithms and many have evolved along the lines of cluster or Grid based scheduling (Eager *et al.*, 1986; El-Rewini & Lewis, 1990; Hyunok & Soonhoi, 1996; Pande *et al.*, 1994; Fabrizio, 2000). Their biggest advantage is that they can incorporate different local scheduling policies as well as higher levels of scheduling. However, they may also suffer from the same fault-tolerance issues as the centralized architecture discussed previously. Decentralized scheduling does not take any particular structure. Here, the nodes directly communicate with each other (or with a common job pool server) to share their loads. Many different attempts have been made in the past to develop an optimal scheduling scheme of this type (Gerasoulis & Yang, 1992). Our scheme (CA-Balancer) is also an attempt in this area involving dynamic scaling over virtualized agents in a given cloud setup. This type of an architecture presents many advantages to the user including reduced global system status information, reduced communication bottleneck, better scalability, no single point-of-failure, etc. There are many specific examples of related research work in scheduling that have been undertaken in the past. Priority based scheduling, for example, provides sub-optimal solutions for a set of homogeneous nodes which are allocated as a set of prioritized jobs. Examples of these types of algorithms include (Hwang *et al.*, 1989). Cluster based algorithms, which map task clouds onto the same node to reduce communication time, have also gained popularity in research circles recently taking its cue from distributed systems with examples including (Eager *et al.*, 1986; El-Rewini & Lewis, 1990; Hyunok & Soonhoi, 1996; Pande *et al.*, 1994; Fabrizio, 2000; Fabrizio, P. & Wu-Chun, F. 2000).

Some of the well-known grid and more recently Cloud scheduling models are part of research projects such as Apples and the Nimrod/G (Globus based broker). The Apples model is used largely for parallel applications. Each scheduler considers its process application resource requests and then matches it with the predicted load and availability of the system resources. The scheduler, or agent, as they are referred to keeps track of several resource statuses by using what is known as a Network Weather Service (NWS). The Nimrod/G system for example, uses a resource management and scheduling scheme for large-scale resource management. Here, resource allocation is accomplished by taking in parameterized requests. This scheme targets primarily scientific applications. Master-Worker (Mor Harchol-Balter, 2000) scheduling is another popular model used in HPC systems. However, it often suffers from many drawbacks including fault tolerance. Most of the above algorithms neglect the need for a solution to the single point-of-failure problem. They assume replication and mirroring of servers to be a sufficient solution to the problem. In our algorithm, fault tolerance to this problem is inherently built-in. In fact, to provide the fault-tolerance, CA-Balancer suffice with a sub-optimal solution as later explored in detail in the chapter.

For our model, we consider jobs (or processes) as applications that need to be run on a node. These jobs may consists of computationally intensive tasks which are mapped onto a node (machine). However for this model, once a task or a job is started on a machine, it runs to completion, i.e. there is no preemptive migration of tasks. The CA-Balancer model coherently combines both the selection and the scheduling strategies of a scheduling model (Gerasoulis & Yang, 1992). A crucial pre-requisite behind this scheme is that the load of a machine in the Cloud must be known and updated as needed.

Figure 4.7: CA-Balancer Schematic



Source: Amaldas et al., *2013c*

The machine load (Amaldas *et al.*, 2011), as we define it, is the machine load which is equal to the CPU utilization in percentage. We propose to keep a list of loads for every machine in a defined table. Now, each machine creates a table for itself (we call it the CA-table) that rates the machines according to their machine loads; it also includes the IP addresses of the machines that rank lower than it on the load table in an ascending order of the load (For example CPU utilization) on each machine at that particular instance in time. This amounts to the status information required in this scheme. Since the CA-Balancer is a purely distributed and decentralized strategy, no global system information for universal awareness (Luling,1991) is maintained. This is actually an advantage of the strategy wherein the criterion for the transfer of a job in the CA-Balancer scheme is determined by a threshold. Here, if the machine load L exceeds or equals the threshold level T, i.e., $L \geq T$, then the machine needs to offload jobs to other machines until the load again reduces below the threshold ($L < T$) after offloading or completing the execution of some of its other jobs. Since we have considered a non-preemptive mode of operation, if $L \geq T$, then, only new jobs generated on that node will be offloaded to other remote nodes. The situation $L < T$ will arise only when the node completes some of its already-running jobs.

Table 4.1: Random Inter-Arrival Time Distribution

Inter-Arrival Time (sec)	Probability	Cumulative Probability	Random Distribution
2.5	0.200	0.200	1-200
5.0	0.200	0.400	201-400
7.5	0.200	0.600	401-600
10.0	0.200	0.800	601-800
12.5	0.200	1.000	801-000

Source: Formulated by the Researcher, 2013

When the situation arises that $L \geq T$, then, selection of jobs to transfer is done according to which new jobs originate in the source machine. Again, these new jobs come under another threshold, S. According to this threshold, the overall workload requirements should exceed the threshold S for the job to be termed as "significant" and be selected for transfer to a remote processor. This threshold / trigger is provided to eliminate "zombie" processes which is prone to cause unnecessary congestion in the network. The CA-Balancer scheme is event-based and in particular, two prominent events that

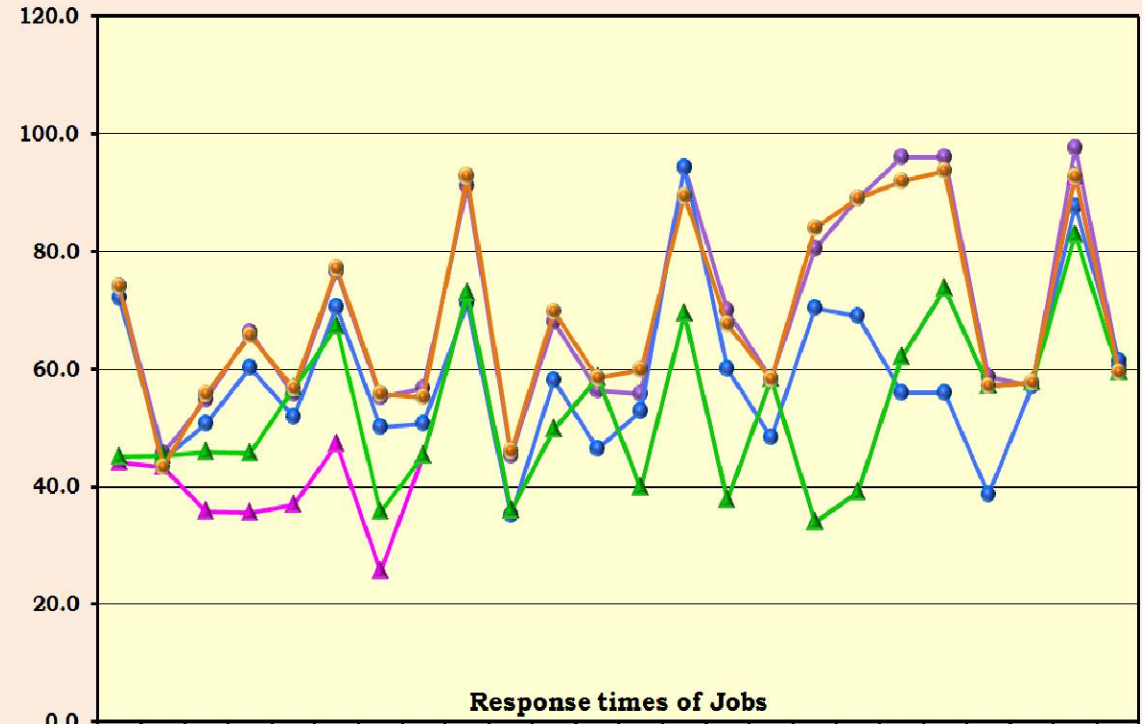
Table 4.2: Eager's Results with n = 2 Responding Target Machines

Sno	Gen Procr	Proc Size	I-A Time	Start Time	Ttime S-T	Proc Trans Time	Proc St	Proc End	Ttime T-S	End Time	Over all Resp Time	Mach 1	Mach 2
1	2	70	Null	0	0.3	2.1	2.4	73.8	0.3	74.1	74.1	5	0
2	7	40	12.5	12.5	0.3	1.2	14	58	0.2	58.2	45.7	4	5
3	7	50	7.5	20	0.4	2	22.4	74.4	0.4	74.8	54.8	1	4
4	6	60	10	30	0.1	0.6	30.7	96.1	0.1	96.2	66.2	0	4
5	0	50	5	35	0.4	2	37.4	90.4	0.4	90.8	55.8	5	2
6	4	70	7.5	42.5	0.1	0.7	43.3	118.9	0.1	119	76.5	3	7
7	1	50	12.5	55	0.1	0.5	55.6	110.1	0.1	110.2	55.2	5	2
8	5	50	5	60	0.1	0.5	60.6	116.6	0.1	116.7	56.7	7	6
9	6	80	5	65	0.4	3.2	68.6	155.8	0.4	156.2	91.2	3	1
10	4	40	5	70	0.2	0.8	71	115	0.2	115.2	45.2	0	6
11	7	60	2.5	72.5	0.4	2.4	75.3	140.1	0.4	140.5	68	0	6
12	5	50	7.5	80	0.2	1	81.2	136.2	0.2	136.4	56.4	4	0
13	4	50	10	90	0.4	2	92.4	145.4	0.4	145.8	55.8	2	0
14	7	80	2.5	92.5	0.3	2.4	95.2	186.4	0.3	186.7	94.2	6	3
15	4	60	5	97.5	0.2	1.2	98.9	167.3	0.2	167.5	70	1	0
16	7	50	5	102.5	0.2	1	103.7	160.7	0.1	160.8	58.3	1	3
17	6	70	10	112.5	0.3	2.1	114.9	192.6	0.3	192.9	80.4	0	2
18	7	80	2.5	115	0.1	0.8	115.9	203.9	0.1	204	89	4	2
19	6	80	5	120	0.4	3.2	123.6	215.6	0.4	216	96	3	4
20	0	80	12.5	132.5	0.4	3.2	136.1	228.1	0.4	228.5	96	3	2
21	3	50	7.5	140	0.1	0.5	140.6	198.6	0.1	198.7	58.7	7	1
22	3	50	7.5	147.5	0.1	0.5	148.1	204.6	0.1	204.7	57.2	2	5
23	6	80	2.5	150	0.4	3.2	153.6	247.2	0.4	247.6	97.6	3	1
24	3	50	2.5	152.5	0.2	1	153.7	212.7	0.2	212.9	60.4	6	2

Source: Formulated by the Researcher, 2012b; 2012c the scheme is based on the following scenario: Event A takes place when a job originates in the system (i.e. anywhere in the network of machines). Event B takes place when a job terminates in the system (either in its source machine or in a target machine). During the course of the execution of a job (or task) in a workstation, the load does not significantly rise or drop, i.e. fluctuate. We presume a very generic, decentralized topology; the only criterion being that each workstation has access over the network to all other workstations. CA-Balancer is a fully decentralized scheme; therefore, there is no central scheduling "authority" in the system. Each machine handles its own scheduling requirements, and each event individually is assessed accordingly (Amaldas *et al.*, 2013a).

Here, we present the results of our simulation study by analyzing the CA-Balancer algorithm with various QoS constraints. For comparison purposes, we employ Eager *et al.*, (1986; 1988), Algorithm 3, as illustrated above. The motivation behind this simulation was to study the performance of CA-Balancer as compared to a well-established technique like Eager's (1986). We establish the mean response time of both the schemes as our distinctive parameter to measure.

Figure 4.8: Comparative Analysis of the Simulation Heuristics of CA-Balancer with Eager & Mitzenmacher Scheme



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Eager's Algorithm	74.1	45.7	54.8	66.2	55.8	76.5	55.2	56.7	91.2	45.2	68.0	56.4	55.8	94.2	70.0	58.3	80.4	89.0	96.0	96.0	58.7	57.2	97.6	60.4
Mitzenmacher's Algorithm	72.1	44.7	50.8	60.2	51.8	70.5	50.2	50.7	71.2	35.2	58.0	46.4	52.8	94.2	60.0	48.3	70.4	69.0	56.0	56.0	38.7	57.2	87.6	61.4
CA-Cloud (Static Coalition)	44.1	43.3	35.8	35.6	36.8	47.2	25.7	45.2	72.8	36.0	49.8	58.4	39.8	69.4	37.6	58.3	33.9	39.0	62.0	73.6	57.2	57.7	92.8	59.4
CA-Cloud (Dynamic Coalition)	45.1	45.3	45.8	45.6	56.8	67.2	35.7	45.2	72.8	36.0	49.8	58.4	39.8	69.4	37.6	58.3	33.9	39.0	62.0	73.6	57.2	57.7	82.8	59.4
Coed Scheme	74.1	43.3	55.8	65.6	56.8	77.2	55.7	55.2	92.8	46.0	69.8	58.4	59.8	89.4	67.6	58.3	83.9	89.0	92.0	93.6	57.2	57.7	92.8	59.4

Source: Amaldas et al., 2013b; 2013c

Table 4.3: CA-Balancer Results with n = 2 Responding Target Machines

Sno	Gen Procr	Proc Size	I-A Time	Start Time	Ttime S-T	Proc Trans Time	Proc Start	Proc End	Ttime T-S	End Time	Over all Resp Time
1	2	70	Null	0	0.3	2.1	2.4	73.8	0.3	74.1	74.1
2	7	40	12.5	12.5	0.3	1.2	14	55.6	0.2	55.8	43.3
3	7	50	7.5	20	0.4	2	22.4	75.4	0.4	75.8	55.8
4	6	60	10	30	0.1	0.6	30.7	95.5	0.1	95.6	65.6
5	0	50	5	35	0.4	2	37.4	91.4	0.4	91.8	56.8
6	4	70	7.5	42.5	0.1	0.7	43.3	119.6	0.1	119.7	77.2
7	1	50	12.5	55	0.1	0.5	55.6	110.6	0.1	110.7	55.7
8	5	50	5	60	0.1	0.5	60.6	115.1	0.1	115.2	55.2
9	6	80	5	65	0.4	3.2	68.6	157.4	0.4	157.8	92.8
10	4	40	5	70	0.2	0.8	71	115.8	0.2	116	46
11	7	60	2.5	72.5	0.4	2.4	75.3	141.9	0.4	142.3	69.8
12	5	50	7.5	80	0.2	1	81.2	138.2	0.2	138.4	58.4
13	4	50	10	90	0.4	2	92.4	149.4	0.4	149.8	59.8
14	7	80	2.5	92.5	0.3	2.4	95.2	181.6	0.3	181.9	89.4
15	4	60	5	97.5	0.2	1.2	98.9	164.9	0.2	165.1	67.6
16	7	50	5	102.5	0.2	1	103.7	160.7	0.1	160.8	58.3
17	6	70	10	112.5	0.3	2.1	114.9	196.1	0.3	196.4	83.9
18	7	80	2.5	115	0.1	0.8	115.9	203.9	0.1	204	89
19	6	80	5	120	0.4	3.2	123.6	211.6	0.4	212	92
20	0	80	12.5	132.5	0.4	3.2	136.1	225.7	0.4	226.1	93.6
21	3	50	7.5	140	0.1	0.5	140.6	197.1	0.1	197.2	57.2
22	3	50	7.5	147.5	0.1	0.5	148.1	205.1	0.1	205.2	57.7
23	6	80	2.5	150	0.4	3.2	153.6	242.4	0.4	242.8	92.8
24	3	50	2.5	152.5	0.2	1	153.7	211.7	0.2	211.9	59.4

Source: Amaldas et al., 2013b; 2013c

In this simulation, for Eager's (1986) model, the source machine probes k potential target machines and based on their loads, it decides on the target machine to transfer the process to. We have also combined a certain aspect of Mitzenmacher's (2000) scheme assuming that simulation of processed where k = 2. This is because Mitzenmacher (*ibid*) argued that selection between two randomly chosen remote processors provides good efficiency in load balancing and hence in our simulation design, we have considered an eight processor system for the sake of simplicity.

We consider non-preemptive processes which have to be executed towards completion once started on a remote processor. We have simulated conditions like varying transmission times and varying process sizes in a multitasking environment in our model. Both the network transmission times and the (processes sizes remain the same as shown in Tables 4.1 on page 204 for all algorithms) are generated by a pseudo random number generator with the distribution functions as shown in Tables 4.2 on page 205 and 4.3 on page 208. The inter-process arrival time is not a Poisson distribution but it is rather a discrete distribution as shown in Table 4.3 on page 208. Here, we have considered the case of p = 8 process generators; all the machines can generate processes in the system. A simplifying assumption was made indicating that no processes are generated simultaneously in the system. Thus, the inter-arrival times listed are indicative of the times when the process enters the whole system. Another assumption about the scheduling algorithm is the increase in load which will be proportional to the actual process size. The process size is also indicative of process execution time when the process is run on an unloaded ideal benchmark machine. Thus, at any instance of time, due to multiprocessing requirements, the new execution time of a process that is about to start executing on a remote processor is given by the following equation:

```
New_exec_time = ideal_exec_time + (ideal_exec_time * CPU\% of node)
```

Each of the algorithms were simulated according to their basic design. For simulation purposes, in the CA-Balancer scheme, only the best target machine responded for each source machine's request. Eager's (1986) Algorithm 3 stayed unaltered, with k = 2. When the manual simulation was done (with 24 iterations), Tables 2 and 4 shows the simulation results; all time units are in seconds; a graph of the overall response times as compared with the process sizes was drawn between the two schemes; and the ideal execution times and the trends were observed accordingly. As the loaded condition of the system began to grow (considering a dynamic multitasking environment such as a Cloud), the CA-Balancer scheme performed better then existing mechanisms, providing faster overall response times as indicated in the results tables. From the results here, we get a slight performance improvement of about 0.5% (with respect to the mean response time) in favor of CA-Balancer. Thus, we see that the CA-Balancer algorithm performs just as well as Eager's (1986) scheme, as applied in the contexts of Cloud computing using a virtualized Multi-agent environment.

$$P_{opt} = [{}_{i=1}\Sigma^{n}\ (i)\{\text{where load on } i <= \text{load on } x\}]\ /\ [{}_{i=1}\Sigma^{n}\ (i)]$$

Here,

P: probability for an optimal solution;

i: any processor in the system;

n: total number of processors in the system;

x: source processor.

Process analysis is the concept of analyzing the current statuses of all the nodes in the system and finding out if the originator of the process can provide sufficient resources to execute the process locally. As the value of n keeps rising, the probability of an optimal allocation reduces, leading to the decline in performance level of Eager's (1986) scheme. If the requirements are not met by the local machine or by the best remote machine, a better machine in the network is given the process. That is, the process is migrated after the process has been analyzed. The issues like parallel execution of code are not taken into account here as the overhead is substantial. The complexity is to find whether the process can be parallelized; and if it is possible, apply decision parameters required for migration of the various threads. This poses another problem where all the results have to be collected in a sequential manner and the overall result should be obtained in a desirable format. Moreover, fault tolerance is a must when incorporating parallel algorithms where there should be no packet loss as it will lead to undesirable results and bring the entire network to a standstill. Hence, a non-parallel process migration approach has been implemented in CA-Balancer scheme. Although these features have both advantages and disadvantages, we wanted to reduce the complexity of the system thereby adding simplicity. The scheme has been implemented in a multi-agent environment incorporating operating system independence and each component of the scheme has been modularized into various segments that add to the readability and also functionality of the code. The basis of CA-Balancer lies in a dual sender-receiver-initiated methodology. It is a more sophisticated version of the Cloud using standard sender or receiver initiated schemes (for example, the drafting algorithm studied in (Gerard, 1981) and applied in (Ni *et al.*, 1985) in relation to process migration) used in general distributed HPC systems. Eager's schemes (Eager *et al.*, 1986) are sender-initiated, i.e. the loaded machines probe others in the system asking for permission to offload their processes on them. Standard receiver initiated schemes rely on the idea of an idle workstation that probes others in the system asking for work. The drafting algorithm in (Gerard, 1981 & Ni *et al.*, 1985) relies on pre-emptive process migration to off-load processes to machines which are in the Low state. The main difference between drafting and CA-Balancer lies in their fundamental features. Drafting is a purely receiver-initiated model while CA-Balancer relies on direct sender-receiver participation (Coalition in Agents as is the case here). In drafting, the processors in Low state (relatively idle workstations) probe the ones in High state asking for work. CA-Balancer does not focus on the search for idle machines. It relies only on better performance machines with discrete load parameters, and not relative states (Low, Normal, High) which can cause fluctuations and improper load sharing for machines on the border line of the relative states at particular instances of time. Another feature of drafting that reduces its effective efficiency when compared with CA-Balancer is that the load value of the sender is extended (piggybacking) by every broadcasting message in the system. This involves more network traffic and thereby more congestion. CA-Balancer reduces the broadcasting requirements to a minimum and ensures greater efficiency. All machines keep track of global system status in drafting, which is not the case in CA-Balancer. Furthermore, the sophistication in our model allows for many new salient features to become inherent in the architecture of the scheme.

4.1.8 Overview of the CA-Broker Schematic

Applying economic incentives in the domain of High performance Grids and Cloud based services are not a new area research with respect to consumption of compute resources. Amazon Elastic Compute Cloud (Amazon EC2) is a good example of applying economic concepts such as Pay-per-service or pay-per-use model of computing. Technology is inherently difficult to manage especially at incorporating economic resources in service oriented architectures because it is constantly changing in an unpredictable manner. Technology management requires policy implementation and best practices that leverage technologies to be built, maintained, and enhanced towards the competitive advantage of the firms utilizing proprietary knowledge and know-how. We take a look at applying brokering concepts to a Multi-agent based

Cloud computing system using Coalition mechanisms and trust based modeling of calculating utility factor in agents. Hence in this research, we propose a new generic brokering scheme termed the 'CA-Broker' that incorporates coalition formation methodologies towards incorporating communication and trust mechanisms in agents using a Cloud based Architectural schematic termed the CA-Cloud[1]

Although hardware prices have been drastically slash down, the motivation behind economic brokering is the sharing and utilization of resources effectively. The key to applying an efficient economic brokering system is to form a mutual benefit or commonality based on trust issues are taken into consideration during system design. Like most architectures such as Globus (2013) and Nimrod-G (Shankaranarayanan & Amaldas, 2011), the CA-Cloud utilizes a brokering scheme that incorporates a fairness algorithm such as Shapely's fairness value algorithm (Gale & Shapley (1962); Dubins & Freedman, 1981). An efficient brokering scheme tends to provide a clear path to formation of trust among interacting agents of their respective domains or coalitions. Negotiations take place in local or remote agents, where in a proper brokering system, it would help to apply fairness value to jobs processed by implying a utility value. An economic brokering system can be achieved here by incorporating the concept of brokerage in the APM which acts as the nego-

[1]Some parts of this section has been adapted from Amaldas *et al.*, (2013a). CA-Broker âĂŞ A Cloud based Brokering Mechanism for Multi-Agent Intelligent Computing. *The International Journal of The GRID*, *4*, 09-33. ISSN 2301-329X.

tiator and the service discovery of the peers acts as a mutual payment scheme based on the negotiation between agents in the various remote peers having a commonality of services. The utility value here would be economic incentives and the agents in the coalition negotiate with the leader based on the job to have fairness in pay-offs. The fairness value could be achieved by using methods such as shapely value (Gale & Shapley (1962); Dubins & Freedman, 1981) based on fairness in pay-off.

The CA-Broker is a core component of the CA-Cloud architecture previously researched. The APM is a agent based directory service that is used to store location and service information in the form of categorized listing.

In this chapter, we investigated different strategies of brokering by comparing agent performances empirically, concluding that even without an explicit element of trust in static and dynamic coalition settings, multi-agent systems improve the economic aspects of cloud computing systems in the cloud services being offered.

4.1.9 Economic Brokering in Clouds

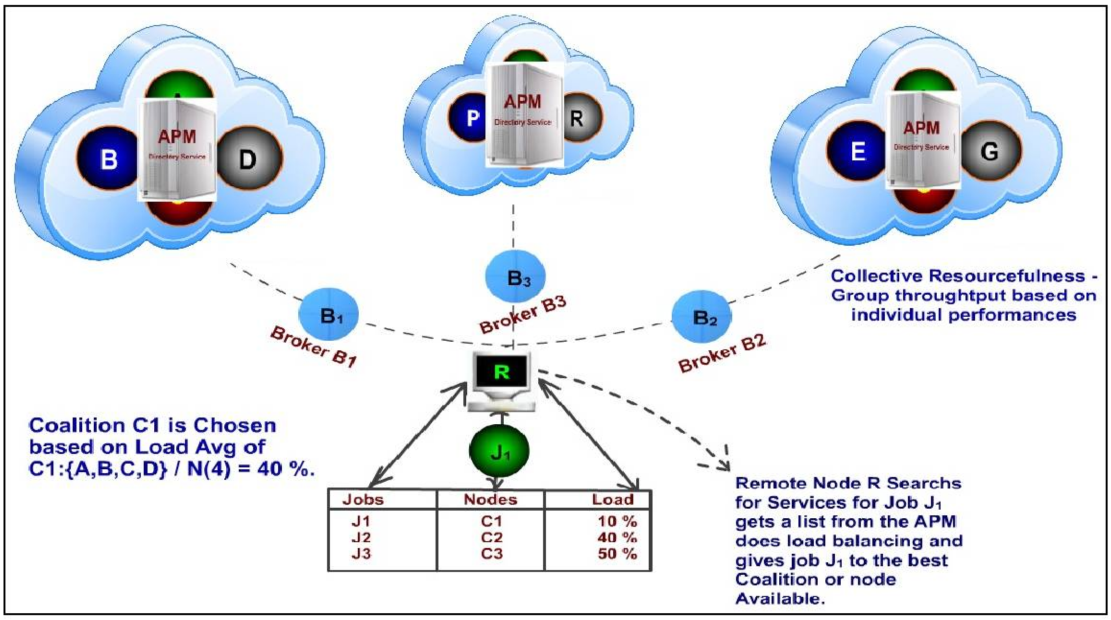
Economic brokering systems have become a common place especially with the vast advances made in the areas of cryptography and secure computing where services are offered based on a pay-off value such as credit or mutual exchange of resources and services available. Agents play a vital role in negotiating and initiating usability of services based on trustworthy of the nodes. Various peers as discussed in the architectural scheme: CA-Cloud which are represented by agents that form a variety of groups for coordinated computing. The primary idea of applying Coalition techniques to Cloud computing is the utility value gained by every autonomous agent representing their respective peers. There has been a phenomenal growth in the development, deployment and usability of Electronic market places on the Information superhighway. Secure networks play a vital role in the way services and payment schemes are utilized for Business to Business (B2B) markets. Attacks made by Hackers and Crackers on these networks have increased the consciousness for the need to increase security and bring out the positive spending power of the user at a click of the finger. Economics has played an important part in developing service orient infrastructures that brings out different pay-off schemes for the services offered, e.g., free sites like `ebay.com` offer auctioning bids and free posting of articles to be sold. The pay-off here could be a brokerage for the services offered. On one hand, eBay tries to maximize its capital by advertisements being displayed during the user experience on-site. Brokering on the other hand, is a process of middleman work. A good example would be the share market, where shares are nowadays traded electronically. Here, in the context of managing ICT resources and Cloud services, a broker is a end-user, an agent or an organization that sets up an account electronically and monitors every transaction being brokered. For example, if a Cloud service is sold or bought through a subscription account, a brokerage value is deducted from the total pay-off. Thence, a brokering system tends to offer economic services to the end-user or user agent(s).

4.1.9.1 Economic Brokering and Fairness in Pay-off

A brokering system becomes a sort of point of discovery of services available from an agent(s) or organization. With respect to the CA-Cloud Architectural scheme, services available from individual peers are maintained in the APM directory services that offer searching for services and common peers that benefit from each other. The APM by itself acts as a Broker or Brokering system that tends to offer cloud services towards searching of services and its respective agent groups. Henceforth, a brokering system forms a bridge between the consumer and producer or in this case, service requesters and service providers. As shown in the Figure 4.9 on page 218, R is a node that has generated a New Job J_1 for processing. R contacts the APM; and then, after applying CA-Balancer Load balancing scheme, R decides to give the Job J_1 to A.

Applying the concept of Economic Brokerage, in general, we can depict from Figure 4.9 on page 218 that Peer A has been elected as the leader of the coalition C_1 which consists of autonomous peers A, B, C and D as part of the team formation. The elected leader Peer A represents the Coalition C_1 on behalf of all its nodes; takes decisions based on the increase in utility value of the coalition as a whole. As shown in Figure 4.9 on page 218, we can see

Figure 4.9: CA-Brokering Schematic



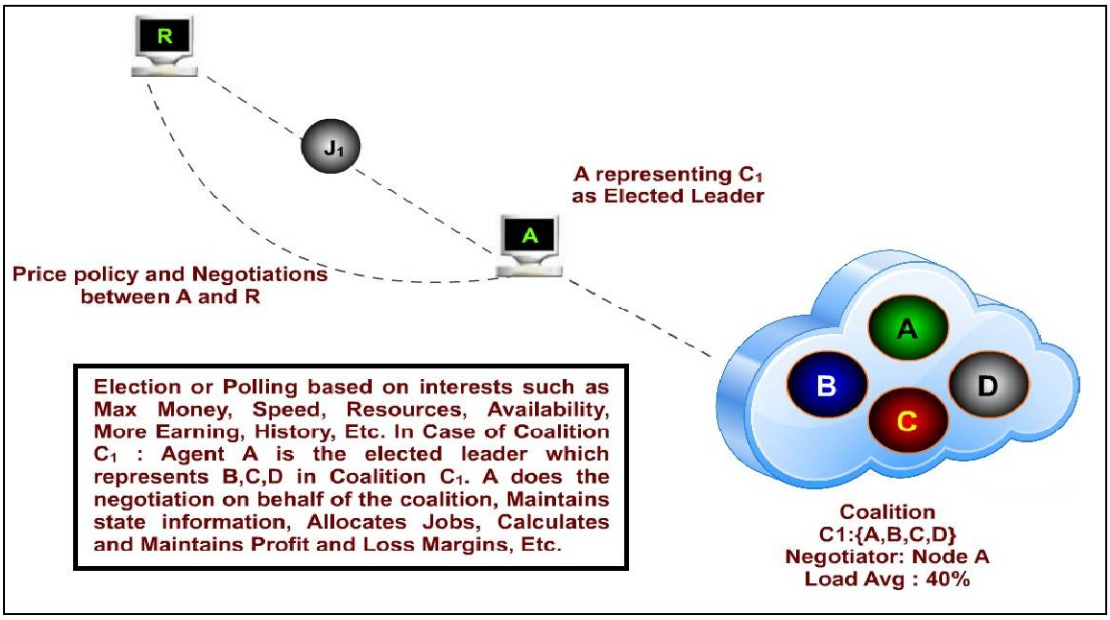
Source: Amaldas et al., 2013a

that the coalition has a load average of 40 percent which is listed in R during decision making. R and A are represented by their respective agents and the agent uses a form of communication language (KQML, 1997 for instance) that enables the negotiation and initiation of job processing, specifically here, Job J_1. Here, the directory services model APM, tends to be the broker between the service requester, explicitly, R[J_1] and the service provider namely Coalition C_1 represented by its leader A. The broker is responsible for the pay-off value it receives only after successful execution of the task allocated by the coalition. Once successful execution takes place, the agent is awarded trust points which indicates the level of trust the coalition has on the selected agent based on its previous job processing actions. Every system is assumed to have a number of agents having different goals. It can also be understood that every agent is autonomous and pertaining to its objectives will represent and act on behalf of its environment and targets set by its end-user. APM directory services acts as a service discovery model that minimizes the need to maintain a resource discovery based on polling every single node for its individual services. Every APM Directory service is only limited to its respective domain of Agents connecting and authenticating with it. In other words, we can apply the notion of using APMs based on its region or geographic location state information. As shown in Figure 4.9 on page 218, each of the three APMs represents a region or local Mini-Cloud domain. As we know, the services offered by the peers listed in the APM are very specific or limited to the Cloud under usage. Hence, to generalize the approach, the system can be compared to existing P2P network technology where several hundreds or thousands of these peers connect to their respective regional Cloud servers for authentication and searches are coordinated with various Clouds running these services. Let us take R to be an agent that generates the Job J_1 in a very specific Mini-Cloud as a service. Now R makes a search request based on the requirements of the Job J_1 with respect to its local domain APM. Next, the APM directory service tends to search and prepare a list of peers that can offer the required services of J_1 else fails indefinitely. What happens if the required services are unavailable? With this question in mind, the general schematic shown in Figure 4.9 on page 218, was devised. A coordinated search request is sent across various APMs available on the Internet which then returns with the results of the services available pertaining to the requirements of the search string or services requested. So, simply the system can be defined as a search engine that coordinates searches and if feasible with respect to turnaround time and pay-off negotiations, remote jobs are processed accordingly. A brokering agent determines the search, negotiates and tries to fix a economic brokering value with remote agents. As shown in the Figure 4.9 on page 218, B_1, B_2 and B_3 are brokering agents sent to find services that are available under remote APMs. Upon finding the services, the pay-off value is determined after negotiations; information is also sent to the peer that generated the job and initiated the search. This is done because each APM is represented by local policies and pay-off values according to the terms of the Administrator or User Agent. Hence, a service offered can have different pay-off values with reference to the service provider.

How Serial and Parallel tasks tend to affect Brokering and Pay-off?

First of all, it is unnecessary for peers to form the coalition based on the parallel nature of the Job. It can form Coalition with parallel processing or serial processing jobs based on the aims of the agents representing the peers and the utility value expected. The major problem is the fairness in pay-off achieved by the agents, viz., assuming that the pay-off value has an economic incentive to it. As shown in Figure 4.10 on page 221, J_1 has a value of 100 dollars for processing the Job. Now, if coalition C_1 consisting of the peers A, B, C and D are jointly forming the coalition based on increasing individual utility values, then, each peer would be expecting a share from the Jobs processed by the Coalition. Moreover, if the Job is a parallel job and all the nodes are put to use as they represent the Coalition with a parallel service, then, there is no problem with respect to pay-off.

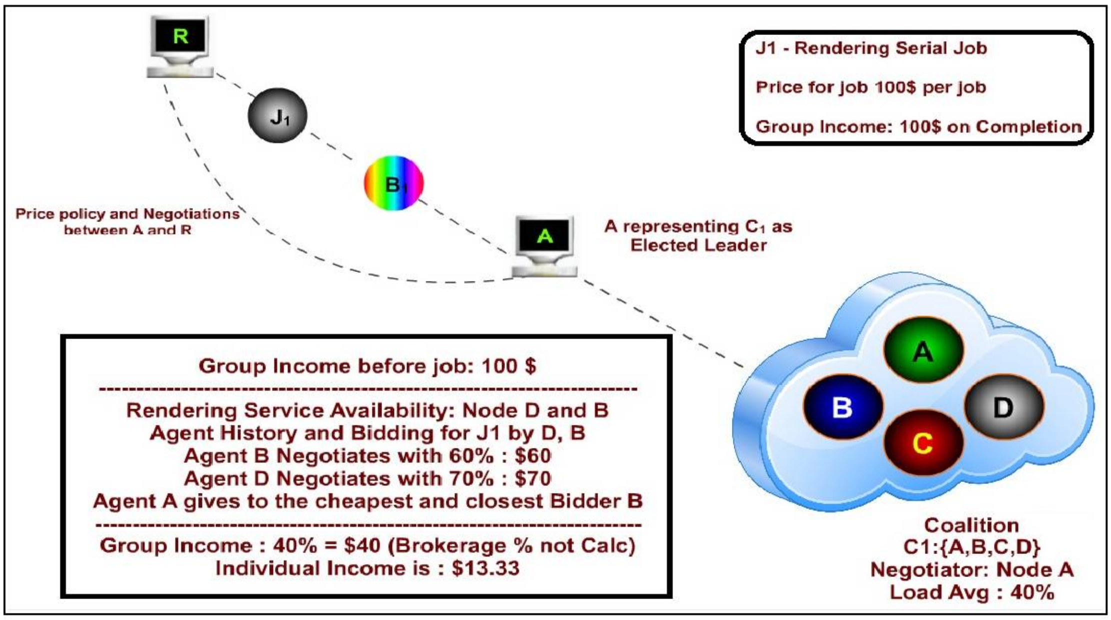
Figure 4.10: CA-Brokering Service



Source: Amaldas et al., 2013a

So, for example, if the Job J_1 as shown in the Figure 4.10 on page 221, is a parallel job and the load of the job is shared among the four nodes A, B, C and D, then, with regards to pay-off, the value obtained is 100 divided by the 4 nodes which leaves 25 dollars per node for the job being processed.

Figure 4.11: Agents QoS: Gains, Losses and Other Characteristics



Source: Amaldas et al., 2013a

Here with respect to serial job processing, if J_1 is a singular job that cannot be parallelized for job processing among the four nodes, then, based on the load balancing schemes the better node, say D, is given the job J_1 for job processing. At this point, if the pay-off value remains the same, then, it will be equally divided among the nodes; thus, fairness in the pay-off value is lost, i.e., D would be underpaid for the work it is doing which indicates depreciation in individual utility value. Both serial as well as parallel jobs were discussed in the previous section and both the schemes pose two common problems.

4.1.10 Limitations Imposed on CA-Brokering

Problem 1: It becomes virtually impossible to monitor the resources utilized by a process and to calculate a pay-off value for the job or part of the job processed by a node.

Problem 2: Fairness of pay-off is depreciated if a particular node or set of nodes are capable of doing a job but the pay-off is shared equally even though the job was processed by a singular or set number of peers.

4.1.10.1 Profits and Losses

In this section, we will discuss how coalition affects individual gains and loss of the various agents that have formed or are forming coalition among their neighbouring peers and their respective agents.

Calculating Profits

First, we will look at how a coalition become an advantage with respect to autonomous agents joining the coalition. Some of the gains obtained by agents joining or leaving are discuss below:

Coalition Gains

Usually two or more agents tend to form a coalition based on the commonality of resources or services offered. When a coalition is formed, different types of services and resources are gained mutually by the various agents coming together to form the coalition. This is termed as Group gains or Coalition gains.

Services Gained

We know that a remote node or peer can have a number of agents running in its environment forming a sort of multi-agent schematic in the local domain. Furthermore, each agent has different goals to play with respect to its environment; therefore, a system is said to have multiple agents representing it with a variety of resources and services available. When Agents form a coalition, usually it is based on a commonality of services with respect to the CA-Cloud system. Since a peer can have many types of services and resources available, every agent tends to communicate to obtain the possibility of utilizing these services and resources effectively under the coalition formed. Next, the new coalition tends to offer more than just an individual service which proves to be, services gained by the Coalition which in turn increases the individual node's utility value.

Initial Costs with Predictable Gains

Initially when an agent or peer joins an existing coalition, the elected leader of the coalition and its associated agents will have to mutually agree upon allowing a remote agent to join based on the gains and also on the foundations of trust. But a cost is involved with respect to either an agent joining or leaving the coalition. A good example would be the fairness in the pay-off gained by individual agents. When an agent joins the coalition, it means that an extra peer has to be paid, with relation to job processing. Therefore, the Coalition leader and its agents have to predict and analyse the necessity of allowing a remote agent to join with regards to the gains or losses in entering or leaving the group.

Individual Gains

This is called the Utility value of every autonomous agent. An agent works alone and only forms or joins a Coalition to increase its Utility value. Hence, individual gains are to be considered when an agent tries to join or leave a Coalition.

Mutual Interest Changes

Generally, a set number of goals and commonality of services brings together a host of agents to form a coalition. But sometimes an individual or autonomous agent's objectives overlap to bring a change of mutual interests. A good example would be an overloaded system that could trigger an agent to stop new jobs from being processed. As per the rules set, an agent could change its targets based on its environmental experiences.

Profit by Coalition with other Sub Groups

Two or more Coalitions having a commonality of services, resources or goals can become as one electing a singular leader. When two coalitions become one, there is a mutual increase in the throughput of parallel jobs processed. Also, there is an increase in the overall services and resources offered for remote job processing.

4.1.10.2 Calculating Losses

In this section, we will be discussing the losses incurred in agents joining or leaving a coalition formation.

Agent Joining Costs

Whenever an agent joins a coalition, costs is involved with respect to decrease in pay-off of individual nodes due to the joining of a new node. Although in the long run, it can be noticed whether an agent or its respective peer is capable of providing an increase in the utility value of the coalition formed. Normally, the initial cost is high with reference to the number of agents joining the coalition.

Agent Leaving Costs

Similar to Costs of an agent joining a coalition, there is costs involved when an agent leaves a coalition; e.g., services and resources lost due to which individual pay-off might get affected either for good or bad. Services lost means that existing negotiations and trust issues might come into play. Thus, as denoted earlier, a set of rules are formulated prior to entering or exiting a coalition.

More Value for Stay

Sometime if an agent is leaving, a better pay-off scheme or value could be offered to ensure the continuous stay of the agent.

Replacement Loss

When an agent leaves a coalition if a promised set of services are already negotiated and the services offered are pertaining to that agent leaving the coalition, then, a replacement agent is searched for processing. If it is successful, then, a negotiated value for replacement is placed; and the cost of replacing is termed as "replacement pay-offs" incurred by the coalition.

Individual Losses

Individual losses incurred by independent agents or peers where there is a decrease in the utility value of the coalition. These are losses incurred when an Agent(s) leaves the Coalition which is termed as "individual or independent" losses with respect to utility value creation.

State Updating in APM Losses

Each time an agent(s) leaves or joins a coalition, the services gained or lost have to be updated with respect to the APM directory services model. Thereafter, each update or state information maintained requires connectivity to the APM which includes incurring of communication costs.

The CA-Brokering mechanism with respect to the CA-Cloud architecture is a work in progress research and needs more implementation and testing. The researcher has attempted to incorporate the brokering scheme in an actual working architecture. In the near future, the researcher will look forward to reporting the progress of the CA-Brokering mechanisms with real time data and statistics with respect to consumption of Cloud services in an educational context.

4.2 System Implementation and Learning Outcomes

The previous sections described the theoretical realms of the CA-Cloud framework comparing and contrasting current algorithms. This section and the final Chapter answers the following research questions as implied in Chapter 1:

> *"Technology integrated learning has its effects on learning...Is there any improvements in learning when utilizing technologies such as Technology Mediated Learning (TML), Classroom based learning (CBL),*

Learning Management Systems (LMS), WebCT (online or e-learning) and other related technologies?"

"To what extent does current systems satisfy the needs of the end user (in our case the students)?"

The purpose of the study is to examine which Internet Rich Applications (IRAs) are expected to be available for use by students. A CA-Cloud computing system was developed by the researcher during interactions in a Classroom Based Virtual Learning Environment (CVLE). The research focuses on various factors influencing students' needs inside and outside the classroom environment[1]

An empirical evaluation was undertaken to validate the research questions formulated in the research. The study was carried out at an Institution in Japan and two International Satellite Campuses in Vietnam, during the MOT based training given in three phases (Semester 1, 2 and 3) towards improving the teaching and learning outcomes of the faculties and students. As an employee of the institution, it was instrumental in gaining entry towards conducting the research on the students in Vietnam and Japan in a global context. Respondents in the research consisted of 91 students (trained by the researcher on each site) using the interaction survey method by building a

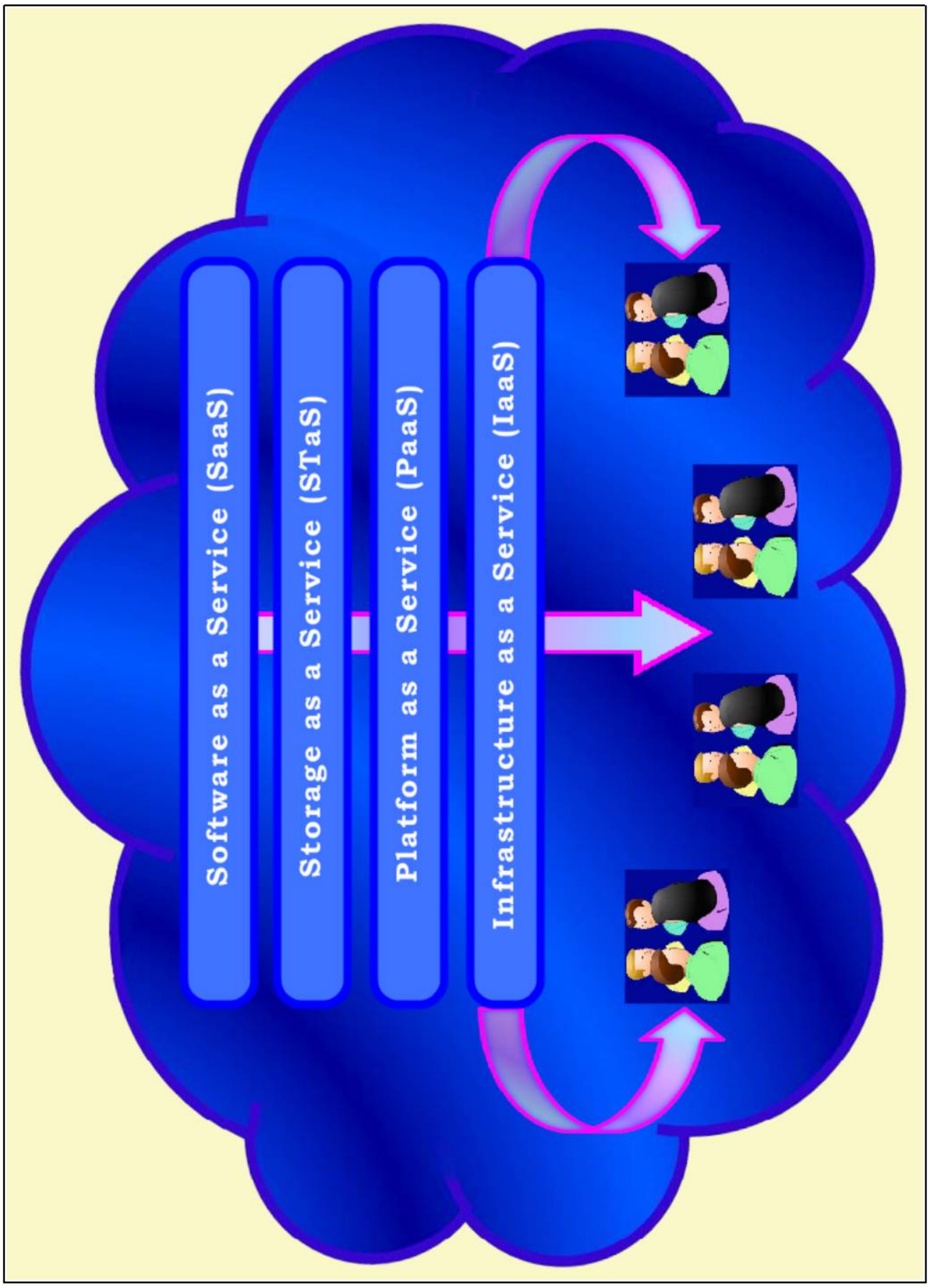
[1]Some parts of this section has been adapted from Amaldas *et al.* (2012a). Technology Instigated Learning Outcomes (TILO) : A Management of Technology (MOT) based framework for enabling student needs inside and outside the classroom environment. *Proceedings of E-Learning, E-Business, Enterprise Information Systems, & E-Government (EEE)'12, 1*, 502-508, Las Vegas, Nevada, U.S.A., CSREA Press.

customized minimalist questionnaire consisting of 12 questions. The demographic backgrounds of these students were taken from the aforementioned institutions; and thus, policy recommendations and decision making with respect to Cloud based LMS deployment and usage should be dealt with prudence and pragmatism. SPSS, version 21.0, 64-bit software (IBM, 2013) was employed to analyze and interpret the collected data. Chi-square, Frequency, independent samples T-Test and percentage methodologies were utilized during the analysis phase of the study. The results of the study indicate that the students' perception of technology instigated learning outcomes (CA-Cloud) seems to be positively motivated towards adopting CA-Cloud as the default choice for deployment as a cloud based learning management system in future. Each Department gets access to the CA-Cloud utilizing a de-centralized Cloud Farm having its choice of Operating Systems, Web Server (Power server) Peer, Virtual Machine controlled by a user Agent, databases and so on. The CA-cloud can be technically made scalable on demand with individual security measures in place.

4.2.1 Emphasis on the CA-Cloud Framework

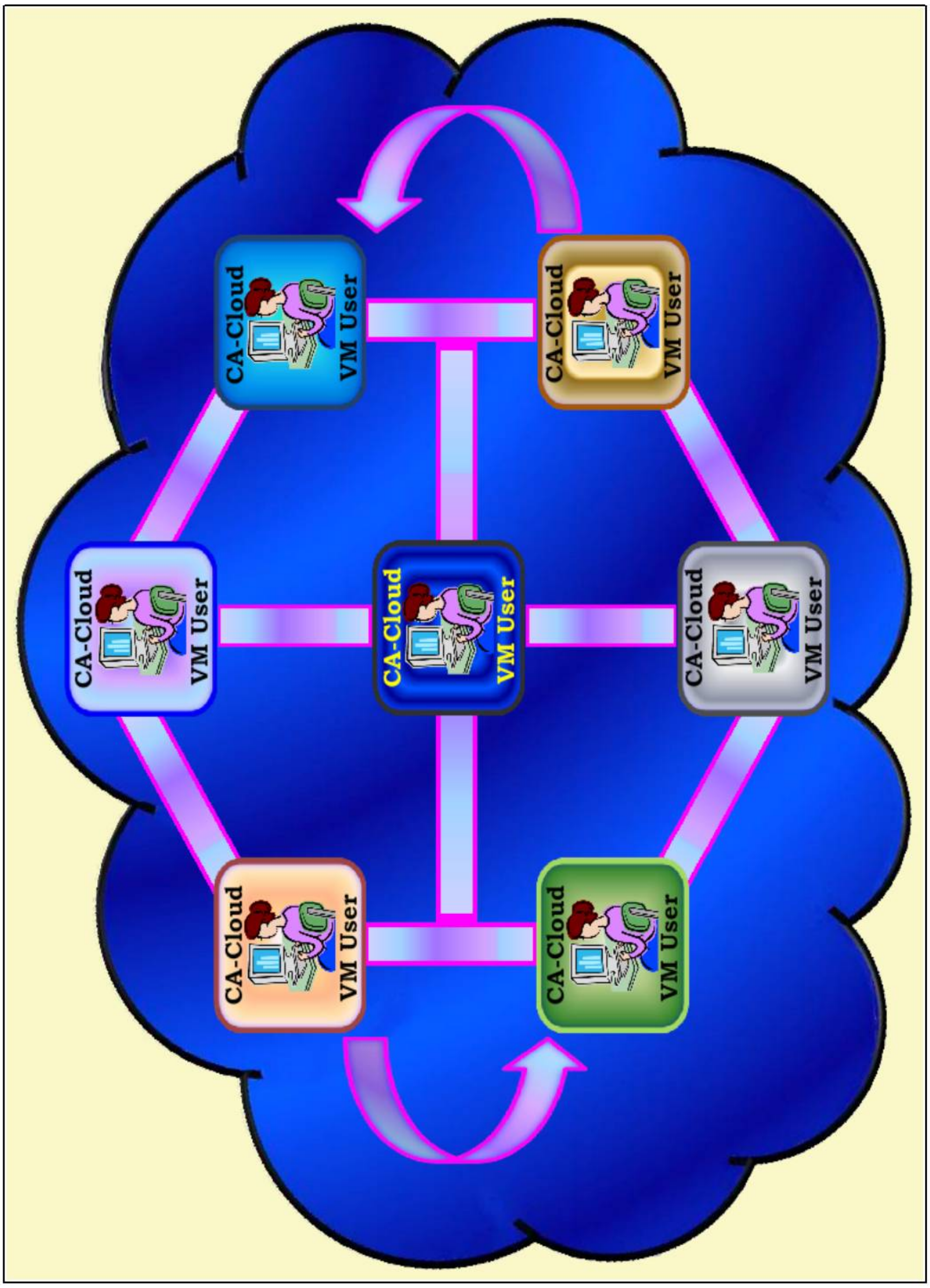
As shown in Figure 4.15 on page 235, we present the design of an instructional model using the aforementioned framework, CA-Cloud, by exploring the available physical and learning technology infrastructures; and the pedagogical setup resulting from it.

Figure 4.12: CA-Cloud Public Usage Scenario



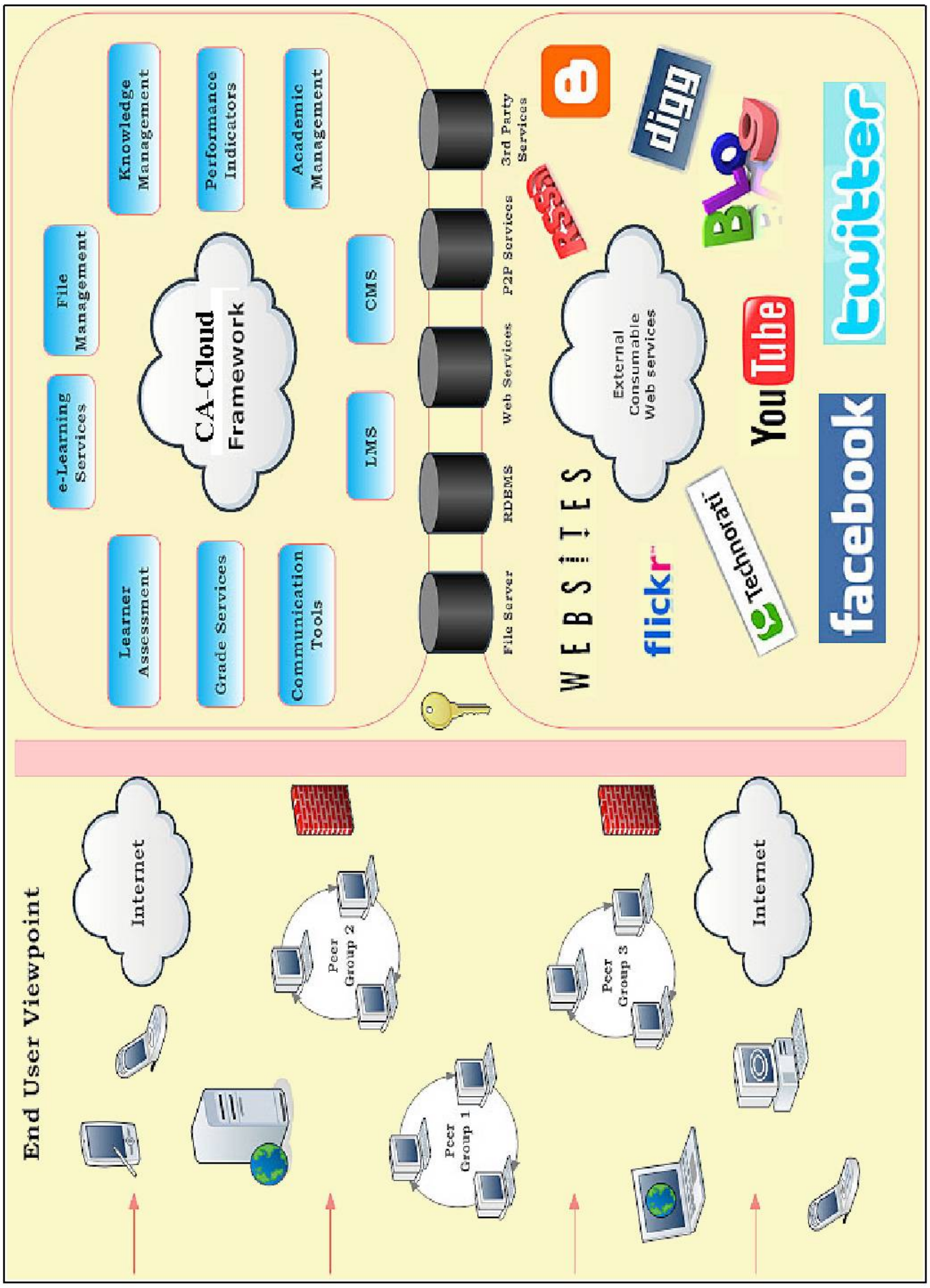
Source: Amaddas et al., 2013a

Figure 4.13: CA-Cloud Private Usage Scenario



Source: Amaldas et al., 2013a

Figure 4.14: Blueprint of the CA-Cloud Framework



Source: Amaldas et al., 2013b

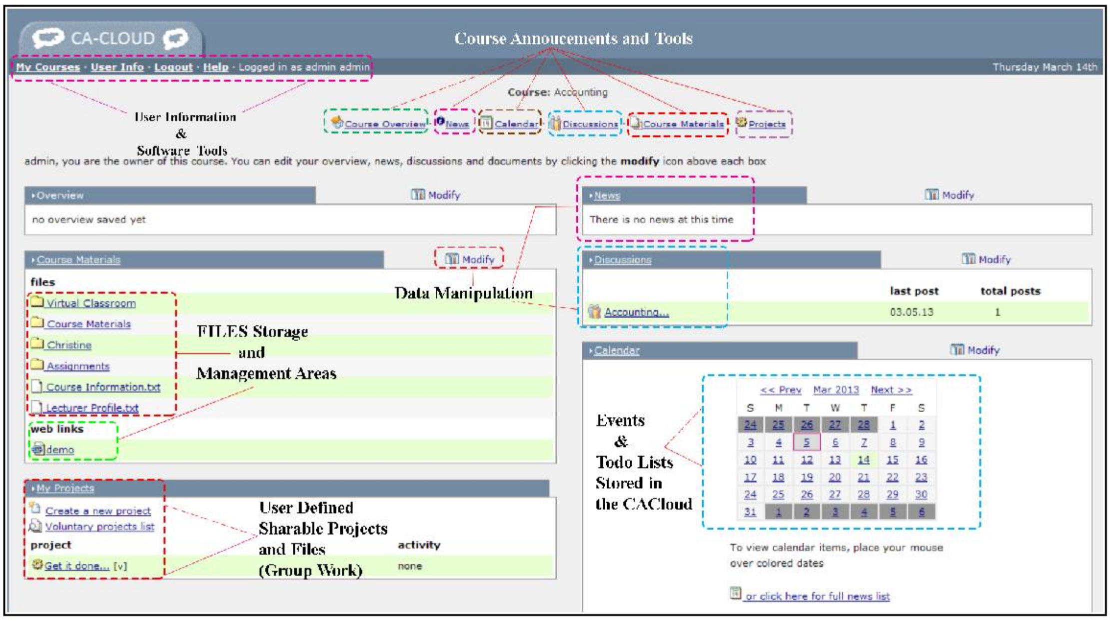
4. CA-CLOUD ARCHITECTURE

The main purpose of the current design effort is to determine those e-course modules that would reflect our instructional approach for enhancing the classroom environment by adopting a blended learning instructional methodology involving the following:

- Rich pictures;
- Guest Lectures;
- Classroom based interactions;
- Interactive White Board; and
- Virtual Classroom Based Interactions (VCI), LMS based.

Our pedagogical setup federates a "student-teacher-centered" learning mechanism derived from the American Psychology Association (APA, 1997). Design factors also involve the use of Merrill's first five principles of instructions: Learning is promoted when learners observe a demonstration, the demonstration principle; Learning is promoted when learners apply the new knowledge, the application principle; Learning is promoted when learners engage in a task-centered instructional strategy, the task-centered principle; Learning is promoted when learners activate prior knowledge or experience, the activation principle; Learning is promoted when learners integrate their new knowledge into their everyday world, the integration principle (Merrill, 2002). Motivational factors involving Viau's theory as follows: Understanding the future competences to be acquired; Appreciating the interest and value of the task at hand; and feeling in control of the activities that are being carried out (Viau, 1994).

Figure 4.15: CA-Cloud User Interface



Source: Formulated by the Researcher, 2013

An LMS is a system that plans, communicates and manages educational materials in both on-line and virtual classrooms. LCMS, however, is a multi-user system that can produce, store, recycle, and manage digital learning materials, and transfer them to users (Han, 2010). In defining an LMS framework, users learn educational materials provided by the LMS in their preferred devices, such as a computer, PDA, laptops, smart phones and other devices that can access the internet using an IRA or website. In this case,

Figure 4.16: User Login Screen and Security

Source: Formulated by the Researcher, 2013

learners only initiate the interactions which are recorded by appropriate services initialized and consumed for exchange of information. The figure 4.15 on page 235 suggests a framework for utilizing a learning management cloud service involving the consumption of e-Learning services and communication tools.

Consumable services (Web or Grid services) using intercommunication mechanisms enable true IRA experiences when it comes to utilizing a high performance LMS platform. The proposed framework tries to provide for a variety of consumable services and tools such as Sharable Content Object Reference Model (SCORM) standards which are a collection of standards and specifications for web-based e-Learning by the end users (students) using inter-connecting devices and applications through a variety of networks (P2P, LAN, WAN, etc). The framework defines all the respective communication links between the client side and the host system usually referred to as a run-time environment. The figure 4.17 on page 238 illustrates the current gaps in existing LMS systems indicating that the CA-Cloud is capable of service consumption and resource management (with respect to managing DI and DT based on MOT) making it a viable solution in an academic contexts.

4.2.2 Research Instruments Used for Data Collection

A questionnaire was developed based on the research questions formulated as "Students' prospects on (CA-Cloud)" which was prepared by the researcher in relation to IRA tools aimed at finding out students' prospects on Technology Instigated Learning Outcomes (TILO), (Amaldas *et al.*, 2012d). The internal consistency of the questionnaire was observed to be 96.5% using the Cronbach Alpha Method (CAM) wherein the content verification and validation of the questionnaire were validated by the respective heads of the department (experts of Management and Information Technology) in the area which were found to be satisfactory. The questionnaire consisted of two sections: First section consisted of 5 items which were developed as a specific section towards observing the demographic backgrounds of the respondents; and second, the questionnaire consisted of 12 questions, prepared to understand the

Figure 4.17: Feature Set Comparison of CA-Cloud and Other Systems

LMS/CMS and other Systems	File Management	Digital Library	Results	Cloud based File Sharing	Load Balancing	Brokering	Resource Management	Chat	Forum	Wiki	LMS
Open Source											
CA Cloud	✓	✓	✗	✓	✓	✓	✓	✗	✗	✗	✓
Moodle	✓	✗	✓	✗	✗	✗	✗	✓	✓	✓	✓
OLAT	✓	✗	✗	✗	✗	✗	✗	✓	✓	✓	✓
Claroline	✓	✗	✗	✗	✗	✗	✗	✓	✓	✓	✓
Docebo	✓	✗	✗	✗	✗	✗	✗	✓	✓	✓	✓
Dokeos	✓	✗	✓	✗	✗	✗	✗	✓	✓	✓	✓
ILIAS	✓	✗	✓	✗	✗	✗	✗	✓	✓	✓	✓
eFront	✓	✓	✗	✗	✗	✗	✗	✓	✓	✓	✓
sakai	✓	✗	✗	✗	✗	✗	✗	✓	✓	✓	✓
Ganesha	✓	✗	✗	✗	✗	✗	✗	✓	✓	✗	✓
.LRN	✓	✗	✗	✗	✗	✗	✗	✓	✓	✓	✓
Proprietary											
JoomlaLMS	✓	✓	✗	✗	✗	✗	✗	✓	✓	✓	✓
Blackboard	✓	✓	✓	✗	✗	✗	✗	✓	✓	✓	✓
Share Point LMS	✓	✓	✓	✗	✗	✗	✗	✓	✓	✓	✓
Meridian	✓	✓	✓	✗	✗	✗	✗	✓	✓	✓	✓
Hotchalk	✓	✓	✗	✗	✗	✗	✗	✗	✓	✗	✓
eCollege	✓	✓	✗	✗	✗	✗	✗	✓	✓	✗	✓
CCNet	✓	✗	✗	✗	✗	✗	✗	✗	✓	✗	✓
its Learning	✓	✓	✗	✗	✗	✗	✗	✗	✓	✗	✓
Owncloud	✓	✓	✗	✓	✗	✗	✓	✓	✓	✓	✗
Desire2L	✓	✓	✓	✗	✗	✗	✗	✓	✓	✓	✓

Source: Formulated by the Researcher, 2013

learning traits and requirements of the students' which represented a positive reaction to the introduction of a holistic CA-Cloud software based on the respondents rating of each question utilizing a Likert scale (LikertScale, 2013), ranging from: "(1) Strongly disagree"; "(2) Disagree"; "(3) Neutral"; "(4) Agree"; and "(5) Strongly agree".

4.2.3 Respondents

This study has been carried out at two institutions namely: Institution A in Japan and Institution B in Vietnam during 2012 - 2013. Participants in the study consisted of 91 students in both institutions spanning two classes in Japan and three classes in Vietnam (trained by the researcher). The Japanese institution consisted of 78% (n = 71) male participants and 22% (n = 20) female participants across three classes while the Vietnamese institution across two satellite campuses had female participants comprised of 58.4% (n = 54), while the male participants were 41.6% (n = 37).

4.2.4 Data Analysis and Results

An online questionnaire was used to collect the data wherein 100% of the respondents (all 91 students) enabled the data acquisition process by making the questionnaire a part of the students' assessment criteria. All the data collected was made possible using an online web based questionnaire designed and developed in-house by the researcher. The data collection principles were based on the theoretical foundations involved in the collection of data in the form of individual interviews (faculty and students) and questionnaires collected at both sites which were coded in SPSS, version 21.0, 64-bit software (IBM, 2013) as shown in the Descriptive and Frequency tables earlier in this research. The collected data was coded using the Likert scale and the total counts of the individual scores were tabulated individually using SPSS (*ibid*). The obtained dataset was independently prepared using a spreadsheet and exported as a text "Comma-Separated Value" (CSV) file named data.csv. This is a typical spreadsheet product with several inadequacies for processing in SPSS (*ibid*) which was fixed during data processing. Data processing using spreadsheet applications' such as, Microsoft Excel or Open Office Calc is a tedious but necessary first step for almost every data set being processed. After importing the data, the SPSS (*ibid*) was utilized to analyze and interpret the collected data. Chi-square test, Frequency distribution, independent samples T-Test, and percentage methods were adopted during the analysis phase of the data processing stage.

The interesting aspect of the questionnaire design was to have a minimalist set of questions in order to reduce user fatigue during the data collection process. Most of the time questionnaires are quite elaborate in the sense of collecting large series of datasets of questions being answered by most users (students) which includes repeated evaluations of assessment types. Table 4.4 on page 242 presents the mean and standard deviation for individual questions coded from the respondents pertaining to the given questionnaire. The results indicated that students have great expectations from the CA-Cloud computing system wherein, the inevitable truth is that "educational technologies are very important to educational institutions" (Amaldas *et al.*, 2013a).

Table 4.4: Questionnaire used for Assessment in Japan.

Number	Question	Mean	SD.
8	CA-Cloud should provide options for group or peer study.	4.96	0.419
2	CA-Cloud should provide opportunity to send our homework to our Lecturers via the Internet.	4.74	0.929
1	Lessons contents should include appropriate multimedia-enabled contents (animation / audio-visual) with print support.	4.64	1.028
3	CA-Cloud must provide lessons for self assessment (tests) of the user with instant support for appropriate content.	4.49	1.109
5	CA-Cloud users need access to communication tools (email, instant Messaging, blogs, etc) to communicate with lecturer and peers.	4.40	1.246
6	CA-Cloud should provide a to-do list of learning activities automatically (announcements, homework, exam, mails, etc).	4.30	1.329
4	CA-Cloud must provide each lesson with context sensitive self help system.	4.22	1.332
10	CA-Cloud should provide self-test evaluation for final examinations preparation and provide a way to exchange user files with peers.	4.03	1.538
12	CA-Cloud should be interactive with prompt feedback of user's online assessments.	3.89	1.501
7	CA-Cloud should provide options for displaying my performance.	3.79	1.595
11	CA-Cloud must provide secure access to personal information and content using a collaborative learning environment.	3.71	1.551
9	CA-Cloud should provide profile information of the Lecturers.	3.00	1.732

Source: As designed by the Researcher

Table 4.5: Questionnaire used for Assessment in Vietnam.

Number	Question	Mean	SD.
6	CA-Cloud should provide a to-do list of learning activities automatically (announcements, homework, exam, mails, etc).	4.97	0.233
10	CA-Cloud should provide self-test evaluation for final examinations preparation and provide a way to exchange user files with peers.	4.56	1.176
8	CA-Cloud should provide options for group or peer study.	4.45	1.148
1	Lessons contents should include appropriate multimedia-enabled contents (animation / audio-visual) with print support.	4.41	1.211
2	CA-Cloud should provide opportunity to send our homework to our Lecturers via the Internet.	4.36	1.269
5	CA-Cloud users need access to communication tools (email, instant Messaging, blogs, etc) to communicate with lecturer and peers.	4.30	1.329
4	CA-Cloud must provide each lesson with context sensitive self help system.	4.26	1.200
3	CA-Cloud must provide lessons for self assessment (tests) of the user with instant support for appropriate content.	4.24	1.361
11	CA-Cloud must provide secure access to personal information and content using a collaborative learning environment.	4.15	1.282
12	CA-Cloud should be interactive with prompt feedback of user's online assessments.	4.05	1.440
9	CA-Cloud should provide profile information of the Lecturers.	3.99	1.479
7	CA-Cloud should provide options for displaying my performance.	3.60	1.490

Source: As designed by the Researcher

As shown in Table 4.4 on page 242 and Table 4.5 on page 243, the highest mean recorded from the respondents (students from Japan) prospects was from Question number 8 "CA-Cloud should provide options for group or peer study (M = 4.96)". Similarly, students from Vietnam indicated that Question 6: "CA-Cloud should provide a to-do list of learning activities automatically (announcements, homework, exam, mails, etc)" had the highest mean recorded (m=4.97) across the two satellite campuses. Question 8 and 6 highlights the importance of information exchange which is increasing day by day at an exponential rate especially when the rate of users are quite high like in that of a classroom environment. Hence, applying and managing continuously updated information using and between peer groups with networking technologies (ICT resources) and infrastructures (MOT enablers) in the management based educational sector is quite vital as rightly identified by the group in Vietnam. Zhang, Perris and Young (2005) found that flexibility of time and place is a major advantage in the delivery of online courses.

As shown in Table 4.4 on page 242 and Table 4.5 on page 243, the second highest mean of the students' perception was found to be Question 2 "CA-Cloud should provide opportunity to send our homework to our Lecturers via the Internet (M = 4.74 in Japan)" and Question 10: "CA-Cloud should provide self-test evaluation for final examinations preparation and provide a way to exchange user files with peers" (m = 4.56 in Vietnam). Students require an optimal mechanism for downloading and uploading information especially their homework. There are a host of technological solutions such as, AJAX or JQuery based homework drop boxes which could be custom built for uploading homework or assignments to the respective lecturers. Technology and infrastructure (access and connectivity) play a crucial role in the delivery of information at the right time. An example of this would be, a student sending an assignment file for evaluation. The system should be able to record the date and time at which this information was uploaded to enable assessment as soon as possible. Infrastructure plays an important role in connecting the staff with the respective students both within and outside of the classroom environment using proper technologies and infrastructure made available to the end users. Consequently, it is observed that technology usage and its associated infrastructure could be put to good use; showing in our case, a positive outcome among the students indicating that these students give extra importance to technologies' usage during assessments inside and outside the classroom environment physically and virtually (online).

Another observation (as observed in Table 4.4 on page 242 and Table 4.5 on page 243) that is closely useful for the discussions here is that "Question 1: Lessons contents should include appropriate multimedia-enabled contents (animation / audio-visual) with print support", (M = 4.64 in Japan) and Question 8: "CA-Cloud should provide options for group or peer study.", (M = 4.45 in Vietnam) wherein students have given importance to appropriate multimedia content having a creative angle. Including print support to lecture materials is crucial for students to save not only on paper but also print only those slides or information that is important to them. Multimedia enabled content helps students to interact with the virtual environment which should also include assessments (quizzes) at every level being taught virtually. The element of self paced learning is always misjudged where lecturers regularly feel lazy (sometimes fatigued due to commitments) to update the contents online or they tend to overdo it and not teach well inside the class room environment. This scenario is closely perceived in the two institutions where lecturers are expected to develop both the online content (multimedia included) and the contents of the course which is generally time consuming.

This leads to improper design and constraints both the energy and creativity of the staff in charge leading to failures in the learning outcomes of the students. In case of Question 3, students indicate that they strongly agree with "Question 3: CA-Cloud must provide lessons for self assessment (tests) of the user with instant support for appropriate content (M = 4.49 in Japan)" and Question 1: "Lessons contents should include appropriate multimedia-enabled contents (animation / audio-visual) with print support.", (M = 4.41 in Vietnam) indicating the need for visual aids during learning.

As a result, assessments and assessment tools are important to provide self assessment mechanisms for students to significantly improve themselves during their virtual classroom experience. This is most useful especially when looking at "Question 5: CA-Cloud users need access to communication tools (email, instant Messaging, blogs, etc.,) to communicate with lecturer and peers (M = 4.40 in Japan)" and Question 2: "CA-Cloud should provide opportunity to send our homework to our Lecturers via the Internet.", (M = 4.36 in Vietnam) wherein communication tools, specifically, online chat tools and personal blogs etc., enable to improve the interactions between student group and their moderator (usually the lecturer or a tutor). These tools need to be available all the time using appropriate menus to enable the users to constantly stay in touch making the online experience a unique one for each of the users. When students attend classes and do their work / assignment submissions online, the faculty can better monitor the students online than using a face to face system (with the current results indicating this factor) as the attention span of the lecturers starts to decrease due to increase in student teacher ratios. The rest of the questions are related to students agreeing with having a collaborative environment which includes profile information of the Lecturers, interactive learning activities, automatic announcements, homework, examination, mails that include context sensitive self help system. The students also perceive the need for having administered a self-test evaluation before final examinations preparations and mechanisms to provide for a way to exchange user files with their respective peers groups. Prompt feedback of user's online assessments (displaying faculty performance) needs to be securely displayed based on the user's point of access using a user name and password within the collaborative learning environment.

4.2.5 Gender Analysis (Japan and Vietnam)

For a given class (two in this case) of Management students in an International University, we were interested in observing whether there was indeed a statistically significant difference between the gender and the results obtained for CA-Cloud. The acquired results are based on gender opinions gathered from the questionnaire shown in Table 4.4 on page 242 wherein independent samples of T-Test were carried out and the results are shown in Table 4.6 on page 248 and Table 4.7 on page 248.

Table 4.6: Gender T-Test (Japan)

Gender	N	Mean	F	P
Male	71	1.21	0.495	0.048
Female	20	1.25		

Source: As Calculated by the Authors

Table 4.7: Gender T-Test (Vietnam)

Gender	N	Mean	F	P
Male	37	1.05	9.027	0.003
Female	54	1.15		

Source: As Calculated by the Authors

The mean of male students' opinions on technology-based learning environment was 1.21 when compared to 1.25 for female, a statistically significant difference was found to be significant at p = 0.048 for Japanese students. Likewise, based on the results as disclosed in Table 4.7 for Vietnam, a statistically significant difference between gender opinions were observed on the CA-Cloud framework introduced to the students. The mean of female students' opinions on technology-based learning environment was 1.15 when compared to 1.05 for male, a statistically significant difference was found to be significant at $p = 0.003$. Most authors refer to statistically significant as $P < 0.05$ and statistically highly significant as $P < 0.001$ (less than one in a thousand chance of being wrong) as in our case. Many studies include that the women are as successful as the men in most cases, which is clearly not the case in our study as the results indicates that women are more technology oriented than men in the case of Vietnam.

4.2.6 Evaluating Classes Independently (Japan and Vietnam)

Based on the results obtained in Table 4.9 for Vietnam and Table 4.8 on page 250, there is no statistically significant differences between the two classes assessed for either sites in Vietnam and Japan on CA-Cloud which indicates $p > 0.05$. The results obtained indicates that Business IT (IM & MS) students have more prospects (satisfaction) from CA-Cloud in terms of IRA usage than Business Management (AF & SM) students. Similarly, from Table 4.8 on page 250, Information Management have more prospects (satisfaction) from CA-Cloud in terms of IRA usage than Management Studies students as shown in Tables 4.9 and 4.8.

The results indicate a mix of technology savvy students who are inclined towards technology-enabled as opposed to entrepreneurial outlooks. But the findings should not be judged simply as statistically significant as sources in

Table 4.8: Independent Classes T-Test (Japan)

Independent Classes	N	Mean	F	P
Information Management	71	1.29	1.228	0.27
Management Studies	20	1.21		

Source: As Calculated by the Authors

Table 4.9: Independent Classes T-Test (Vietnam)

Independent Classes	N	Mean	F	P
Business IT	52	1.12	0.147	0.702
Business Management	39	1.10		

Source: As Calculated by the Authors

Vietnam indicate that one in ten people are interested in having their own business as opposed to working for corporates after education. The situation is vice-versa in Japan where students are more inclined to get trained in the industry than to gain any exposure from being educated. This is a major indicator of the differences in developed versus developing countries work culture and education as observed here. Nonetheless, it cannot be really concluded that Information Management students are really more technology savvy than the Management Studies students as per the results obtained. Therefore, we cannot draw the conclusion that Business IT students are definitely more technology savvy than the Business Management students as per our results obtained.

The correlation between ICT as a resource in the contexts of MOT and management in business schools and high economic growth has not been well researched in most Asian countries. ICTs impact all the current MOT best practices particularly in eradicating resource constraints and access to information especially by faculty and students. LMSs are simply a collection of tools, even if they embody some kind of a pedagogical "vision" (Georgouli *et. al.*, 2008). LMSs are likely to become a common place technology that would be adopted as fluidly as that of the Internet or E-mail. Majority of the institutions of higher education will need to adopt one form of LMS or the other being either an open source or a commercial version of the software platform. LMS will occupy an ever increasing and prominent role in the teaching and learning processes, paving new pathways towards changing the existing techniques of teaching and learning, from a traditional methodology to totally synchronous or asynchronous distant mechanisms. In the case of business and management courses, the transition from the traditional instructional methods to one being enhanced by CA-Cloud has proven to be a useful model towards supporting collaborative learning which has been proposed here as a framework. The framework of the model could be easily extended as a LMS instructional system: geared towards delivering educational materials; activate current knowledge bases; produce and apply new knowledge; support the teaching community; and motivate the students in Vietnam. It is believed that this framework could be easily extensible to other management based educational courses in the field of management and technology domains. In general, the survey results showed that students are in need of a very techno savvy platform similar to a LMS in future towards utilizing IRAs. The analysis suggests that students have limited access to such resources in the current institution and if the CA-Cloud framework and its methods are incorporated and adopted into the current LMSs or existing platforms such as the Blackboard or WebEMS, it could enhance the adoption of IRAs in the near future. Further studies should enable the correlation of the results with additional demographic data of the students, their grade levels and the number of times they took the prospective courses.

4.3 Chapter Summary

This chapter has brought together data which was calculated based on a series of assumptions deduced by proposing a new architecture based on available primary and secondary sources of data collected on the field. The next Chapter will focus on revisiting the research questions, followed by policy evaluations and recommendations towards implementing and duplicating the proposed High performance CA-Cloud computing system for managing MOT based infrastructure, resources and technologies as a viable solution in the two selected study sites (Japan and Vietnam) respectively.

Chapter 5

Conclusion

The final chapter will focus on revisiting the research questions, implications, limitations and de-limitations of the study followed by policy evaluations and recommendations towards implementing and duplicating the proposed projects.

5.1 Introduction

MOT based technology adoption and hybrid learning in the selected study sites were evaluated through field studies and continuous assessments utilizing empirical evaluations and survey methodologies. The primary aims of this research were to map MOT adoption and its related potentials in the selected sites towards creating awareness of the potential benefits of utilizing MOT related technologies towards hybrid learning. [1] [2]

The research was undertaken to indicate viability and duplication of MOT related mechanisms at the selected Institutions in the Asia Pacific region. The formulated research question is restated here for the sake of readability. The research question was formulated based on the data obtained from primary and secondary data sources as follows:

> *"To what extent does MOT adoption impact the learning and teaching methodologies with respect to classroom and online learning respectively?"*

Our focus is on two specific epistemological issues pertaining to international institutions in the Asia Pacific. Globalization has accelerated the movement of universities and their faculty to the market in which assessment of students could be a harbinger of success for an entrepreneurial university intent on attracting international students. We explore the relationship between international students and assessments made on their education at universities.

Four aspects are proposed as the core components that formulates the research questions. The first section, defines the assessment mechanisms and

[1] Some parts of this chapter has been adapted from Amaldas *et al.* (2010). Impacts of Western Education in Asia: A Case Study on International Student Assessment Mechanisms. *The Asian Conference on Education Official Conference Proceedings 2010*, 1150-1162, Osaka, Japan. ISSN: 2185-6133.

[2] Amaldas *et al.* (2012c). Japanese Sojourners in Higher Education Reform for Internationalization in Contemporary Japan. *Proceedings of The Frontiers in Education: Computer Science & Computer Engineering (FECS) 2012, 2*, 632-637, Las Vegas, Nevada, U.S.A., CSREA Press.

the ways in which it affects the learning experiences of students. The second section, describes the cultural mores that come into play when international students are assessed by faculty. The third section, relates to the question of the assessments being ameliorated by including the cultural diversity of students. The penultimate section, examines the assumptions that are held by academics when international students are assessed. The concluding section briefly summarizes the major points raised in the research and comments on the effects of what will occur if contingency theory (Morgan, 1998) is applied to tertiary teaching in comprehending the possible scenarios for established off-shore universities as well as those launched specifically for International students in the Asia Pacific region.

International students are the consequence of the whirlwind of changes that characterizes contemporary universities. The trend of globalization and digital revolution is increasingly forcing students and universities to become internationally competitive in an 'increasingly globalised higher education marketplace' (West, 1998:63). In a constructivist environment, ICTs are currently used in a web centric instructional delivery mechanism (McManus, 1996). In relation, higher education can be investigated as a mixed mode method of instruction that could involve web based and face to face teaching mechanisms which emulates constructivist models by learning the effects of student epistemological believes. (Tang & Austin, 2009) advocates that students' ability to apply, analyze, create, evaluate, understand and remember information may lead to the highest amount of learning and understanding. Students' top "preference" (Video for Enjoyment) serves a prioritized necessity and purpose in classes; it does not project the highest level of "learning". Teaching technology and course requirements may reflect contrasting levels of Perceived Demand Characteristics (PDC). In order to achieve the highest possible learning outcomes, faculties must maneuver the optimum technologies, assignments, and teaching materials which leads to students' learning, satisfaction, and good teaching evaluation which derives from a balance between materials and technology.

Deep learning approaches are characterized by an intention to seek meaning and to establish relationships between areas of knowledge. Surface learning approaches, aim solely to memorize and reproduce knowledge for examination or other assessment (Marton and Saljo: 1984; Prosser and Trigwell: 1999; Biggs:1999). Schommer (1990) and Schommer *et al.*, (1992), have developed five epistemological models of persuasion which includes four factors: (1) Simple Knowledge (knowledge characterized as independent pieces of information contributing to inter-related concepts); (2) Certain Knowledge (tentative and evolving knowledge); (3) Fixed Ability (innate abilities improve learning); and (4) Quick Learning (micro-learning perspectives). The researcher manipulated and interchangeably focused on all the four factors especially paying close attention to Quick Learning. This was used to achieve two goals: (1) To instigate and motivate the faculty; and (2) To kindle the thirst for knowledge and enforce students to have 'deep learning' (life long learning) instead of 'surface learning' (for the sake of getting a certification). On one hand, deep learning successfully attributed to the transition of an individual's mindset; and on the other hand, it contributed to the high quality learning outcomes as empirically analyzed by the author (Amaldas *et al.*, 2010).

In this milieu, more and more students are interested only in knowing what is being tested (surface learning) wherein assessment of international students is a double-edged sword by which educational institutions (including professors) may be avoided if they are found to be failing them or condemned by university rankings and job markets as being non-educative and easy. Globalization has accelerated the movement of universities and their faculty to the market Slaughter & Leslie (1997:5) states that assessment of students could be a harbinger of success for an entrepreneurial university intent on attracting international students. This research explores the relationship between international students and assessments made with reference to their education at both the universities in Japan and Vietnam.

5.1.1 Student Learning Experiences and Assessments

Assessment of international students plays a vital role in communicating with students of their learning patterns. Student assessments provide an important basis of self esteem and the key measure of their success in a place far from their regional norms and cultural values. International universities in the Asia Pacific have become a place for gathering valued cultural capital for students from various cultural and demographic backgrounds. The assessment stakes can be very high as most international students and their families have made significant financial and emotional commitments for overseas study. Brown *et al.*. (1997), cited by Brown & Joghhin (2007), have argued that assessment preempts all other pedagogic experiences and may have the greatest impact on student learning experiences:

> *'Assessment defines what students regard as important, how they spend their time and how they come to see themselves as students and then as graduates. Students take their cues from what is assessed rather than from what lecturers assert is important', Brown* et al., *(1997:7), cited by Brown and Joghhin, (2007).*

Besides the importance of assessment from the psychological angle of international students, assessment itself differs in different educational systems. While Asian students (especially from the Japanese and Vietnamese cultural norms) are oriented to respect the teacher and what is taught as sacred; western orientations to teaching (with references to British and Western-American norms) and assessments very often takes the extreme position of being profane.

A pass grade in the United Kingdom (U.K.) can be as low as 45 marks, causing bewilderment among international students whose background would urge them to aim for the highest grade. The differing marking conventions may cause disrespect for knowledge itself among international students. In the Japanese tradition of university grading, for instance, class attendance alone is seen by students as entitling them to 'a pass' in any course. Many students have experienced shock when called upon to make presentations as part of the grade assessment. International students also find that their written presentations often do not receive favor among academics in the British influenced educational institutions of Australia and New Zealand. Most international students have to expend enormous energy in learning the assessment culture of the host university which has then lead the students to obtain degrees that are often recognized only in the region where their study were undertaken. As power is asymmetric in most universities with the international students being at the lower stratum, they realize that assessment is highly culture-specific and in order to attain better grades they need to learn the educational culture of the host society. Bearing in mind the asymmetric nature of power in any university, a good starting point would be the mental reform among assessors. It is important for them to recognize that international students are bearers of culture, not bearers of problems, Carroll and Ryan (2005), cited in Brown & Joghhin, (2007).

Ryan (2000:11), cited in Brown and Joghhin, (2007), has proposed the use of variations of approaches that take into account cultural factors of international students.

- The extent to which historical texts and previously accumulated knowledge are respected;
- How far authority figures, including teachers, are respected (or not);
- How far it is acceptable to be overly critical of authoritative texts or figures;
- Whether a 'correct' answer is sought and the extent to which alternative responses are acceptable;
- Issues about avoidance of making mistakes or losing 'face';
- How far students are expected to speak up or listen quietly;
- How far personal opinions are valued (or whether this implies arrogance);
- The importance of harmony and cooperation within the group over the interests of the individual within it Brown and Joughin (2007:59-60), cited in Ryan (2000:11).

Each of the factors has application for how students approach assessment and can help explain the actions of students. Western universities expect students to be demonstrative, challenging and questioning the pedagogical process, whereas in Asian societies, respect for the teacher and the knowledge imparted are unquestionable. Asian students are brought up to view the class as an epitome of harmonious relationships. The class then becomes an arena of compromising with the teacher for survival and social well-being. Thus, international students, even in their written presentations may avoid radical and unfamiliar ideas of lesser known researchers and prefer acceptable publications that advance harmony.

5.1.2 Effects of Cultural mores and Assessment Pitfalls

Cultural mores affect both international students and the faculty that assess them. Even though most western institutions and many Asian academics now express commitment to the values of cultural diversity, problems arise when faculty and administrators interact with international students. Knight and de Witt (1995), in an overview of the field, argue that internationalization is a meaningless term without a conscious effort to integrate an intercultural dimension into the teaching, research and service of the institution. According to Kalantzis and Cope (1997), a key to internationalization is the recognition and valuing of global diversity and the capacity to understand and respond to cultural differences, with a combination of local and global values, such as openness, tolerance and cosmopolitanism (Rizvi & Walsh 1998:9).

Difference is in the resources that students bring to university. It is something that is constitutive of social relations within the university. It is constructed and enacted through the practices of curriculum. Viewing difference as an external factor in the construction of curriculum is to treat it in an instrumental manner. Assumptions would posit the practice that student diversity is mainly 'related to interpersonal relations and not to the issues of academic content and pedagogies'. As a consequence, those institutions within which the curriculum is being constructed may themselves be culturally biased and exclusionary. What this argument implies is that the relationship between curriculum and cultural difference needs to be reconsidered in a more dynamic, relational way, rather than in purely instrumental terms. The problem is not that, in a global university, students are different but that we find it difficult to 'read' the difference (*ibid*).

Assessment of international students is closely associated with the issue of impacts on quality when universities have international students. By 1995, it was argued by Marginson that the aggressive expansion in overseas markets has occurred with little attention being paid to quality or educational objectives. There are several problems which potentially affect academic work. First, there is the problem of coping with students who are clearly not equipped to undertake university studies. Monash academic Dr. Andy Buffory (1998) has written about his astonishment at being asked to employ lower marking standards leading him to lament the lowering of standards occurring as a result of the quest of universities to make 'a killing in the Asian market'. Similar situations has been dealt with on a regular basis by the researcher at various institutions in the name of cooperate governance and emotional harassment of being publicly termed 'academically challenging to the policies of the institution'. Similarly, there have been public lamentations of accepting students with significant language difficulties into courses which is often the case when the student's 'mother tongue' is not English and the students are branded as non-native speaker of English. Students are often allowed to continue for several years before they are being told that their proficiency in English is inadequate (Coorey 1996:43; Maslen 1998:5).

Problems associated with assessment of international students are not uncommon. Export programs supervised by local institutions generally tend to assess students as having attained a distinction or high-distinction average leading up to final examinations. This has been particularly observed in the Australian styles of teaching where these students face substantial failure rates when the final examinations are Australian-marked, they seek redress. Some 'whistle-blowers' at Australian universities have raised ethical concerns of assessment of these students. The following are some examples of the ethical issues related to international students and their assessments.

- Curtin University academic, Dr. John Kelmar, was suspended by the university after appearing on television explaining how he experienced problems after failing nine students, including five international full fee payers, for plagiarism (Johnston 1995:27).

- Former University of Wollongong ethics lecturer, Dr. Gall Graham, who claims she was 'forced' to lower standards in her subject. Dr. Graham claims that problems began after she failed several full fee paying international students, and resulted in her contract not being renewed (*ibid*).

- University of Sydney academic, Dr. Paul Hopwood, expressed concern that a full fee paying student was admitted to veterinary science in August (the course began in March) with no previous training or background in the field. He was placed on disciplinary charges by the university after expressing this concern. However these were later dropped (Reily, 1998:42).

- A tutor at Metropolitan College in Malaysia, a 'twinning' institution offering the first year of Curtin University degrees, inter alia, alleges that he was sacked after claiming that students were given full marks provided assignments were submitted on time, despite wholesale copying and that students who could hardly speak English were given examination passes and permitted to enroll in degrees (Maslen 1998:3). Some institutions may accept more students than they can comfortably support, while others might make an assumption about the ability of a student to satisfactorily complete a course that goes a little bit too far (Reily, 1998:42). In a similar vein, additional training has been called for in cross-cultural awareness training, cultural sensitivity training, and even 'simple education methods' (Coorey 1998:43). The question of whether opportunities are provided for the inclusion of cultural diversity through assessment programs was examined.

- Research undertaken in the graduate engineering and management faculties of a major United States University consistently revealed high support among faculty for international activities. It is also noted that only two-thirds of faculty disagreed with the statement that foreign students are a nuisance because they are always haggling for higher grades Lulat (1993:337-339), cited in Pratt and Poole (2000:20).

5.1.3 Assessment of Best Practices

Biggs (1997), explores teacher's orientations when encountering culturally diverse groups by proposing a model of three levels. At the first level, teachers are unaware of different learning behaviors among different cultural groups. When difficulties arise in learning activities, however, the teacher attributes the problem to student deficit, possibly culturally determined. He refers this phenomenon as 'conceptual colonialism' whereby the concepts of one's own culture are imposed on another, as if they were universal (Biggs, 1997). At the second level of abstraction, the teacher respects and values cultural differences, accepts learning behaviors and tries to encourage expression of beliefs, values and world views to design appropriate learning activities. The teacher attempts to use a teaching style while corresponding to the observed learning style. In order to respond to the different learning styles, it is quite time-consuming where the teaching techniques result in too little attention being made to the learning outcomes involved in inculcating intellectual and social development. At the third level of orientation, the focus is on cognitive outcomes and cultural similarities. The teacher assumes that universal principles apply across cultures. Thus, the teacher seeks to engage cognitive processes that are common to all students, thereby transcending cultural differences.

Edwards *et al.*, (2003), have suggested a number of solutions to developing international awareness and international competency in assessment:

- Focus of cognitive processes would suggest an approach that differentiates between different levels of development of international and inter-cultural literacy and the teaching methods and learning activities that support them.

- International awareness may be achieved through teaching strategies that foster an understanding that knowledge and curriculum do not emerge from a single cultural base. Nonetheless, the silencing of diverse cultural literacies in tutorial and written work may still result in students not given clearly articulated 'space' for the inclusion of their cultural diversity. It is equally important than that in the discussion students are encouraged to critically reflect on their assumptions and beliefs.

Appropriate teaching and learning strategies embedded with a cross-cultural perspective may therefore lead to rethinking about assessment criteria. However, MacKinnon and Manathunga (2003), argued that assessment is the nexus where intercultural communication skills are developed within the curricula and for students, the crucial communication rests on assessment.

5.2 Findings and Discussions

Traditionally, most assessments center on an end product. The process by which that product is researched, constructed and presented is often taken for granted. Socially and culturally responsive assessment recognizes that the student requires not only an understanding of the process of constructing an assignment, but also how different cultural knowledge can be relevant and valued. MacKinnon and Manathunga (2003), suggests a number of practices:

- Linked assessment tasks that provides a series of connecting steps that assist students in identifying the elements necessary in constructing large-scale assessment pieces like essays.
- Peer assessment in class where students mark examples is an appropriate strategy for uncovering and understanding the elements of successful assessment pieces.
- Flexible assessments like written assignments, class presentations, designing websites, writing and performing drama, etc., extends inclusivity through greater choice.
- Negotiation of alternative topics that have a cultural value and relevance

for the student.

Visualization is a gateway into the minds of both students and adults as the saying goes, "A Picture Speaks A 1000 Words". According to Paivio *et. al.*, (1968), it is a known fact that pictures are instantaneously retained than text. Students also mentioned that RP help them with their recollection during their examination preparation. The role of visual components of the learning environment in deep learning will be the subject of future study, especially with respect to RP (Horan, 2000). It attracts any age group or gender. It is simple graphical versatile technique in tertiary education and increasing students learning outcomes. Infinitesimal language barrier as minimal text is utilized which makes everyone comfortable. RP can uniquely symbolize any type of system from Biological to Machinery with ease and easy modification and additions or amendments to any area. Individuals or groups can employ RP to interpret any scenario. It reflects one's conflict, emotions, politics or sequence of events, etc. It also portrays valuable synopsis of a topic without any dependence on text. RP demonstrates hierarchical relationships and importance of interdependence by revealing misconceptions. It gives a formal perception of understanding. It enables students to quickly view and laugh at their mistakes especially increasing their artistic view of the situation. Snowballing one's ideas and interacting capabilities which lays a platform for innovating combined and new developed RP for any given environment.

Table 5.1 on page 269 provides a summary of assessment practices used in two institutions where students from diverse societies and educational systems study. The studies were conducted in institutions where the researcher had previously worked, catering for both international students and domestic students alike who were external to the prescribed curriculum as some assessment practices used in these institutions were clearly not suited for their cultural background of the students.

Table 5.1: Assessment Practices at Institutions A and B

Assessment	**Institution A (Japan)**	**Institution B (Vietnam)**
Attendance	NIL	20
Individual Assignment	25	30
Group Assignment	25	30
Final Examination	50	20
Total	100	200

Source: Formulated by the Researcher, 2013

Table 5.2: Grade Distribution - Institution A (Japan)

Grade Distribution	**Marks Range**
A+	90 - 100
A	80 - 89
B	70 - 79
C	60 - 69
D	50 - 59
F	0 - 49

Source: Japanese Grading Scale, 2013

As shown in Table 5.1 on page 269, the assessments at both the institutions were taught by the researcher who was trained by British and Western educational institutions. Instead of following and inculcating the practices

Table 5.3: Grade Distribution - Institution B (Vietnam)

Grade Distribution	Marks Range
HD (Higher Distinction)	80 - 100
DI (Distinction)	70 - 79
CR (Credit)	60 - 69
PA (Pass)	50 - 59
PX (Pass with no GPA)	50 - 100
SP(Supplementary Pass)	Pass through Supplementary Exams
NN (Fail)	0 - 49
WDR	Withdrawn from Course

Source: Vietnamese Grading Scale, 2013

observed in the British and Western educational systems, the researcher had to negotiate the type of students and faculty to whom the training was being offered based on regional and cultural norms. The final examination ceased to be a criterion of success in the course. Instead, continuous class work became the benchmark at these institutions. Students, even if they were alien to the final examination, could pass the course as long as they answered logically the questions. In comparison, Japanese cultural practices censure any teacher for failing a student who has attended all classes. Thus, attendance alone could guarantee 50 per cent of the marks in some classes. The researcher, however, ensured that there was a balance of assessments during the delivery of courses.

5.2.1 Critical Reflections, Results and Analysis

Assumptions & Beliefs of Academics

Good practice for international or domestic students is good practice for all. International students may be useful indicators to the health of the learning organization:

> *"Harkening back to the time when coal-miners took canaries into mines to monitor air quality, if the canaries died, they knew that the atmosphere threatened the miners' well-being, too. We are also at a 'coalface'. The international student 'canaries' thankfully show us their difficulties in less dramatic ways but nevertheless point out aspects of our teaching that all students will probably experience as challenges. By paying attention, we can change conditions to make sure that everyone can thrive in the higher education environment. If we improve conditions for international students, we improve them for all learners" Carroll and Ryan (2005:9-10), cited in Brown and Joughin (2007:69-70).*

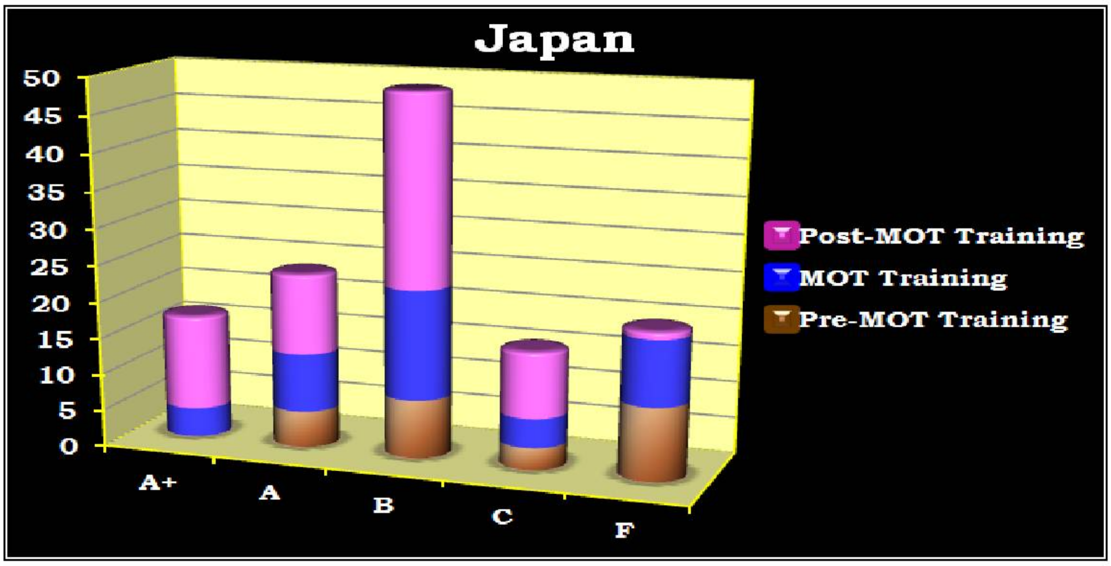
If assessment approaches can be made to fit international students in mind, then, domestic students will also benefit, since they often have trouble coming to grips with assessment requirements. Students need to learn about assessments just as they need to learn about subject content. A number of assumptions and beliefs do affect the way assessments are perceived and practiced. Most university settings do not give adequate attention to curriculum and administrative mechanisms through which differences are identified and integrated into teaching and learning mechanisms. Assessment practices as well as other administrative practices may privilege some values and marginalize others. Differences are politicized in antagonistic ways by defining and locating different kinds of people as exotic or even inimical in various realms of everyday life. It needs to be recognized that the discourse structures and ideologies of Australian, British and other Western universities are constructed to normalize and legitimate certain existing patterns of power relations. Favored ways of representing, speaking and acting, as well as favored conceptions of knowledge are the cultural capital of such educational discourse structures which govern and control student engagements with the curriculum. The success of international students depends on the extent to which they can orient themselves to the dominant groups of educational discourse. Those who either do not understand or resist the dominant discourse become the failures of a system unsympathetic to difference. Some become excluded entirely.

The cornerstone of all changes in assessments of international students is the academics (grassroots of the institutions) at universities. It may be argued that teaching, learning and assessment strategies will not be relevant to internationalization if they do not reflect the generic principles of good practice in higher education. This implies the development of inclusive learning, teaching and assessment strategies among teaching staff. They need to develop new skills, knowledge, attitudes and values. In any academic environment, academics may have legitimate concern that there is no space in their subject for a holistic approach to internationalization. Institutions like University of South Australia have responded to such concerns with what is known as the infusion approach. Using its graduate qualities as a framework for curriculum development, a team-based approach to international teaching has been adopted. It provides clarification of what internationalization means in different subjects within a discipline.

Findings emanating from the study indicated that both the hybrid learning and traditional course methodologies effectively presented materials and enhanced knowledge levels of the students enrolled during the 2012 - 2013 Semesters (data was collected over three semesters and evaluated as indicated in Figures 5.1 on page 274; 5.2 on page 275; and Table 5.4 on page 276). Although significant differences were found in pre/post-MOT test scores, students enrolled in the blended sections achieved higher in final course grades as observed in Table 5.4 on page 276 in semester three of both sites indicating Post-MOT training performance of students.

Thus, it can be suggested that both the Hybrid and traditional teaching and learning mechanisms provided a similar degree of knowledge acquisition to a certain extent. This findings provides a persuasive argument to the traditionalists that effective learning can take place in nontraditional or hybrid learning environments. Currently, there are limited studies on MOT based Hybrid learning that compares outcomes to traditional course formats. A previous study on this, did find students in a traditional, blended and on-line course in Information Systems had no significant differences between learning achievements (Rivera & Rice, 2002). There are, however, more studies that look at on-line learning compared to traditional course formats, for which researchers have found similar results of no differences between the groups (Block *et al.*, 2008 & Allen *et al.*, 2004). Additionally, this study found significant differences in class satisfaction (using surveys as shown in Appendix 1) between the hybrid learning and the traditional learning mechanisms.

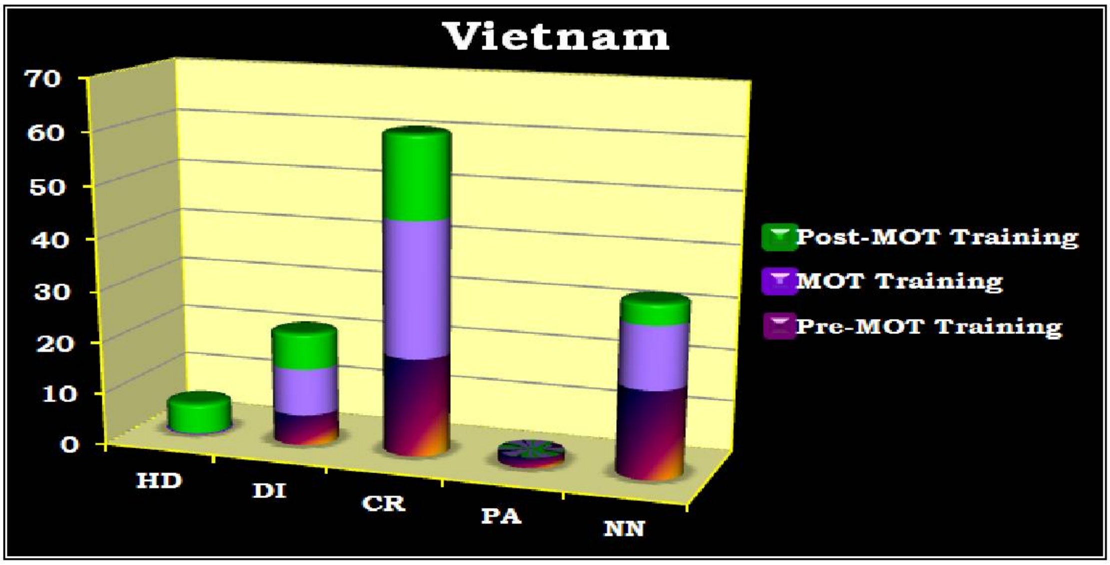
Figure 5.1: Student Performance: Pre-MOT, MOT & Post-MOT Training (Japan)



Source: Formulated by the Researcher, 2013

So, it can be safely concluded that hybrid learners reported a higher level of class satisfaction with respect to MOT based motivation and training utiliz-

Figure 5.2: Student Performance: Pre-MOT, MOT & Post-MOT Training (Vietnam)



Source: Formulated by the Researcher, 2013

ing the CA-Cloud as a LMS through the CES results being positive to hybrid learners. The blended learning design focused on active learning in the classroom portion of the course; the students might have rated higher satisfaction due to the enjoyment of the in-class portion, and not necessarily the blended design. A consideration when providing educational alternatives is whether students enjoy the alternative forms.

The current study found that the mean satisfaction scores were significantly different between the hybrid and traditional business courses. The analysis also revealed a significant difference in females, who reported to be more satisfied than males in their traditional classroom environments. Again, there is very limited research on satisfaction in the blended course

Table 5.4: Student Performance - MOT Training (Japan and Vietnam)

Grades			**Results Across 3 Semesters**			
			Pre-MOT S 1	**MOT S 2**	**Post-MOT S 3**	**Total**
A+ or HD (Higher Distinction)	Gender	Male		1	2	3
		Female		3	15	18
		Total		**4**	**17**	**21**
A/B or DI (Distinction)	Gender	Male	6	8	7	21
		Female	5	9	9	23
		Total	**11**	**17**	**16**	**44**
C or CR (Credit)	Gender	Male	14	16	19	49
		Female	13	25	19	57
		Total	**27**	**41**	**38**	**106**
D or PA (Pass)	Gender	Male	2	1	1	4
		Female	3	3	7	13
		Total	**5**	**4**	**8**	**17**
F or NN (Fail)	Gender	Male	9	5	7	21
		Female	18	16	7	41
		Total	**27**	**21**	**14**	**62**
Total	Gender	Male	31	31	36	98
		Female	39	56	57	152
		Total	**70**	**87**	**93**	**250**

Source: Calculated by the Researcher, 2013

methodology. Rovai & Jordan (2004) looked at the course satisfaction as it relates to the classroom community using connectedness and its learning community. They found a higher rating of satisfaction in the blended learning courses compared to traditional and online formats. Furthermore, Rivera and Rice (2002) also found only a lower satisfaction level in on-line courses compared to traditional and blended learning courses, and no difference between traditional and blended courses. Several studies have looked at class satisfaction of exclusively on-line course compared to traditional with mixed findings. Allen *et al.*, (2002) found that students in distance learning appear to be as satisfied as those in traditional formats. However, other studies have reported higher satisfaction with the on-line courses (Newlin & Wang, 2002, Althaus, 1997, and Huang, 1996). Furthermore, Pereira *et al.*, 2007, found no significant difference in satisfaction of blended learning compared to traditional formats; yet, they found a significant difference in achievements scores, with higher achievement scores found in the blended learners. With this mixed support in the literature, the researcher believes that achievement and satisfaction is dependent on the quality of the online and classroom design which is reflected in the results obtained during the evaluation period of three Semesters in three phases as denoted in Table 5.4 on page 276.

Previous studies have looked at age as it relates to on-line and traditional participation. Cooper (2001) noted the average age of on-line students to be 27, and traditional students to be 23: other studies support an increase in age with respect to on-line courses (Karber, 2002; Eastman & Owen-Swift, 2001). In the current study, the researcher found younger students (under the age group of 17 - 23) had reported a higher rating of course satisfaction which in future will need to be further investigated.

5.2.2 Recommendations

The current study on student achievement and satisfaction scores presents interesting findings, and challenges the educator to question teaching strategies, methodologies and content delivery. The blended model seems to create a win win situation for the both instructor and student. The blended model offers to the more traditional educator a merger between classroom contact and cutting-edge technology. The millennial student, with their proficiency and use of technology, is comfortable with this pedagogical structure as well.

This research represents an initial attempt to measure student achievement and satisfaction between blended and traditional course formats. Results purporting higher learning achievement and satisfaction by the students most likely were impacted by the more active classroom teaching approach utilized in the blended format. This phenomena needs to be investigated more fully. A blended course format may actually lend itself to more active teaching due to students becoming more responsible for learning content on their own time, while classroom time is spent with application of newly acquired knowledge. Active learning may also account for the higher grades in the blended group.

Recommendations emanating from the study include repeated research on achievement and satisfaction among different course formats in general business courses, accompanied by longitudinal studies to determine any long-term effectiveness. An important consideration will be whether students can continue to have acceptable achievement and satisfaction scores when blended formats are applied to upper level courses of various degree programs with more specialized content material. One may find that initial documented success of the blended format may be limited to lower level undergraduate courses. As future research studies continue to document effectiveness of the blended articles, educators will be challenged to embrace new teaching protocols and methodologies.

5.2.3 Major Contributions of this Research

The contributions of this study are mainly as follows:

- First, this study analyzed the status of the current MOT based infrastructure and its related digital technologies in tertiary institutions. Industry links indicate some of the key problems related from small to medium-sized enterprises with respect to training which were identified as gaps faced by the immediate faculty and students on site (adapted from Amaldas *et al.*, 2007a; 2007b).
- Second, on that basis, the study summed up the characteristics of the

MOT related technologies and digital infrastructure requirements and problems encountered during training of business students for the industries in business related departments. Hence, gaps in the TCO of MOT resources and related training constraints were observed.

- Third, based on the observations above, a general application of a CA-Cloud based computing system was prototype to satisfy the management related resource constraints faced by end-users in the selected two Institutions (A and B).

- Finally, this study manages key information (user oriented state information updates) of end-users, compute resources and delves into making institution utilize a SaaS based CA-Cloud computing system solution to all departments utilizing Cloud based services and resource management.

Other Contributions from this Research

The few other contributions of this study are as follows:

- A hypothetical brokering mechanism was proposed based on the CA-Cloud Architecture which was previously researched by the researcher.

- Utility value needs to be computed dynamically based on the current resource status which needs to be polled by every agent.

- Some concerns related to the Agent language used in building trust mechanisms amongst agents like KQML might lead to mis-communication and protocol problems. This is solely based on the system designer.
- For our model, we consider jobs (or processes) as applications that need to be run on a node. These jobs may consists of parallel computationally-intensive tasks. In this case, these processes are the ones that are mapped onto a node (machine) which again should be assessed by the agents for utility value.
- Once a task or a job is commenced on a machine, it runs till completion, i.e., there is no pre-emptive migration of tasks. This means that when a job fails an agent needs to either try to restart the job or forfeit the contract for that particular task leading to losses in utility or individual trust values. Compensation for faults and tolerance level is not discussed here as it is beyond the scope of implementation at the moment.

5.3 Limitations and De-limitations of Study

Limitations identify potential weaknesses of the study. The following are some of the limitations faced by the study:

- This study was undertaken at only the specific study sites namely Institutions in Japan and Vietnam spanning various Management courses and departments.

- The respondents of this study are focused on two specific groups namely: International academics (Tenured) and Contractual teaching staff. Thus, the generalization of study is limited to all the international academics in the selected institution where the researcher had worked previously.

- Studies show that the extrinsic or outer factors do not show any relevance to extrinsic motivation.

- Other institutions could have been compared but resource limitations, financing, familiarity and time constraints of academics played a bigger role in limiting the scope of the research.

- The proposed Architecture is currently in the stages of development and needs to be tested with educational services and loaded conditions to observe a real time statistics and performance of the processes in virtual classroom environments simultaneously geographically in the two study sites.

- The current research does not state the advantages of the CA-Cloud computing system in another educational setting as further testing and feedback is required to announce more information pertaining to this.

- Trust based mechanisms are only discussed here as theoretical constructs and actual implementation and results will vary based on the usage of the agents in a real world Cloud context.

- Cloud related architectures do suffer from lags and failure of computational resources (need for fault tolerance) which has to be tested in an information aggregation environment with actual loaded conditions which is beyond the scope of this study. To get permission to access actual compute resources to use our load balancing scheme, policy implementation and adoption of such disruptive technologies need to be made available by institutions.

- The Cloud architecture services were deployed to test the process requirements of faulty and students at the two selected sites towards acceptance of a MOT based Service Oriented Architecture called the CA-Cloud computing system which could contribute to the management of ICT resources, infrastructure and other educational services.

De-limitations address how a study will be narrowed in scope and how it is bounded. The discussions here will be about the areas NOT focused upon and the reasons for not doing so:

- The study does not focus on the local teaching assistants employed as most were not inclined in being involved with the study (more than 95%). This was due to the policy obligations of the institutions where they were instructed not to engage in any research other than the given workload. Therefore, the researcher did not take this part of the sample data for use in the research.

- Being international institutions, funds were allocated only to full time staff and so policy prejudice can be observed where no funds were allocated for part time and contractual staff towards doing research.

- The study did not focus on administrative staff and their involvement with the academic staff members as it was not relevant to the objectives of the research.

5.4 Conclusion and Future Directions

Asiatic regions such as Japan and Vietnam with respect to international education still have scope for improving their adoption and utilization of technologies and content delivery in terms of technological development. The outcomes of MOT promotion at the selected sites (Institution A and B) were observed in the field research as follows:

- MOT promotion at Institution A and B was largely led by policy makers and key administrative officials.

- The faculty plays a subdued role with no responsibility for promotion of MOT as one of the key stakeholders of the University.

- MOT promotion does not reach all the students as surveyed separately by our previous research.

- MOT promotion policies are incoherent at Institution A; and therefore, are inadequately implemented to achieve the expected outcomes.

Evidently, much of the current MOT promotion policies were formulated during the planning years for the establishment of Institution A and B. As such, all the Management courses that were made part of the curriculum were done with the purpose of complementing the overall learning at the University. They were never meant to turn out MOT experts for the industry. Once the policy makers had decided on the curriculum it is mainly implemented by the Academic Office, where the administrators were in a race against time to appoint enough lecturers (mainly contracted and part-time staff) to teach the overflowing classes of students. The curriculum of the Management courses was largely determined by policy-makers in the early years, with the faculty trying to fulfill the broad descriptions given to each course in the course handbook. Thus, there has been very little coordination between what policy-makers had in mind to what was loosely implemented at the curriculum level.

Rivera (2013) claims optimistically that to teach via online, hybrid learning must be integrated to attain optimum results. Online courses are not a good fit for remedial students who lack the self-discipline, motivation and even technical inclination to pass the classes. These students tend to benefit better when attention is given on a face-to-face basis from instructors (Los Angeles Times, 2013). This argument is applicable to the viability of our research which can be observed here. It was also found that faculty passivity in the promotion of MOT is directly related to the staff recruitment policies of Institution A and B. As the University's policy makers had never intended to promote MOT as a specialist area in the curriculum, faculty recruitment was not fine-tuned to recruit industry and academic experts. Two tenured faculty and two contracted staff were seen as adequate in the initial years for simply teaching MOT as complementary subjects to content based courses. Eventually only one tenured faculty and two contracted staff with two additional part-time staff were used to manage the teaching of MOT subjects. Most language teaching faculty used only one program, the Web-CT for teaching. Despite the exclusion of faculty from policy making regarding MOT education, some of the faculty were concerned about the content of instruction and tried to write teaching aid materials for students. However, as they did not play an active role in the planning, they only thought about courses in the context of the classes they taught rather than curriculum reform for effective promotion of MOT education. The lack of leadership and initiatives did not allow the faculty to seriously question the content and complementary nature of MOT education at Institution A. The non-existence of coherent policies for the promotion of MOT is rather a worrying trend. In the two administrations that Institution A had undergone, none have attempted, so far, to bring together policy makers, administrators, faculty and students. Policy decisions on MOT promotion are transformed into curriculum based subjects by administrators, who themselves are not faculty members.

MOT is a process requiring a change in mindset and outlook shifting towards a more strategic mindset starting with the admissions process where there is need to improve and effectively manage technology at the policy level. Unfortunately, not all sectors of the economy would appreciate this reality with the same level of enthusiasm. High-performing enterprises and institutions would most likely rise up to the challenge and move along in accordance with the MOT framework with ease. Sadly, majority of our enterprises and institutions are still rigidly closed to the idea of changing and adapting to new paradigms which impair adoption of such frameworks at the policy level. On one hand, much work needs to be done and the pressure remains with the government to create the right environment for effective MOT adoption amongst all organizations. On the other hand, the challenge to academe is to initiate curricular reforms that would address the MOT needs of Japan in this case. Meanwhile, businesses should be more open to collaboration where immediate monetary benefits may not be apparent and training along with international exposure from a university environment will be a sort of luxury for its future employees. Individual learning in organizations is very much a social, not a solitary, phenomenon (Simon, 1991:125 as cited in Mehta 2012).

Perhaps issues related to assessment of international students arise because it is a new industry. This industry may indeed be a 'global market in the early stages of development' (Pratt & Poole 2000:20). This does not give an excuse for inadequate responses to problems in the assessments of international students. An alternate explanation can be presented by a two-dimensional explanation. First, Western public policy and institutional approaches to entrepreneurialism encourages the view that students are consumers in a traditional marketing sense. The natural consequence of this view is that customers (students and their parents) demand not just high-quality products and services but also expect a tangible product (degrees) in return for the significant price paid for this service experience. Direct or indirect pressure is then applied to academics to provide this 'product'. If academics feel that such pressure is unwarranted, then, they have only one alternative, i.e., to quit their jobs. 'Most academics do not have many employment options' as it has become a de-facto model of the education industry as opposed to being a qualitative temple of knowledge. Second, the ongoing expansion in international education market has enabled institutions to sometimes neglect issues of quality assurance and the maintenance of standards.

From an institutional perspective, it has historically been possible to take the view that having some dissatisfied students was not a major cause for concern as there would always be more markets and students to pursue. However, the international market is evolving towards maturity with competition from places such as Singapore and Hong Kong. Even non-native English speaking countries such as Japan and Vietnam have joined the race for international student customers. In this millennium, issues such as quality, standards, and brand image begin to assume new roles having high importance in Internationalization of these institutions.

LMSs are likely to become as commonplace as the Internet or email. No institution of higher education will be able to do without either an open source or a commercial version of the software component. LMS will occupy an ever increasing and prominent role in the teaching and learning process, paving a new road changing the existing ways of teaching and learning, from a traditional in class way to totally synchronous or asynchronous distant one. LMSs are just collections of tools, even if they embody some kind of a pedagogical "vision" (Georgouli *et al.*, 2008). In the case of business courses, the transition from the traditional instructional methods to one enhanced by TILO of the CA-Cloud model has proven to be a useful model to support collaborative learning which is proposed here as a theoretical framework. The framework of the model could be easily extended as an LMS instructional system geared towards delivering educational materials; activate current knowledge bases; to produce and apply new knowledge, to support the teaching community and to motivate the students of Vietnam. It is believed that this framework could be easily extensible to other management based educational courses in the field of management and technology domains. The survey results showed that students are in general in need of a very techno savvy platform of an LMS in future towards utilizing IRAs in general. The analysis suggests that students have limited access to such resources in the current institution and if the CA-Cloud computing system and its methods are incorporated or adopted into the current LMS systems or existing platforms such as blackboard or WebEMS, it could improve the adopting of IRAs in future. Further studies should enable the correlation of the results with further demographic data of the students, their grade levels and the number of times they undertake such courses in future. In summary, one can postulate whether the contingency theory may be applied to the problem of international students and assessment in the first place. The contingency theory concerned with the 'fit' of an organization to an environment may raise the issue of whether international institutions can achieve a balance between its academic goals of excellence and assessment practices in a foreign environment. While students in the Asia Pacific may value the cultural capital that is gained by studying at international and foreign institutions, the educational environment is highly volatile. Western influences in Asia is picking by the adoption of foreign capital based educational enterprises that may open shop in Asia, by offering better incentives like migration to countries of host universities and planned career choices. In the current scenario, instead of the individual fitting into the organization, the organization would have to compete with other institutions for the same students. Another potential competitor would be the government itself setting up elite universities that may confer the same prestige that is given by international universities. As market driven universities, these institutions would have to adapt and convince its potential customers (students) that its products are the best that money can buy.

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Appendix A

Relevant Publications

1. Amaldas *et al.* (2013a, January 1). CA-Broker âĂŞ A Cloud based Brokering Mechanism for Multi-Agent Intelligent Computing. *The International Journal of The GRID, 4*, 09-33. ISSN 2301-329X.

2. Amaldas *et al.* (2013b, January 5). Understanding Academic Assessment Practices: A Case Study on the Impact of Western Educational Influences on Faculty & Students in Asia. *The International Journal of Creative Thinking & Educational Research, 10*, 40-51. ISSN 2301-3087.

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Appendix B

Student Surveys

Figure 5.3: Student Survey (Japan and Vietnam)

What is your current Age? ……………… Date: ……………… / ……………… / ………………

Male or Female? ………………

In which program are you currently enrolled? ……………………………………………………………………………

No	Questions	1 Highest - 5 Lowest				
		1	2	3	4	5
1	The learning goals/objectives in this course are clear to me.					
2	The teacher is extremely good at explaining my questions.					
3	The teacher normally gives me useful feedback on my progress throughout the course. (Feedback such as: personal communication with teaching staff; written notes on assignments submitted; comments in general on the standard of performance of the whole group studying this course; and the performance in examinations, or activities assessed in classes.)					
4	Tasks given in assessments require me to demonstrate the skills learnt for this course.					
5	The teaching staff motivates me to do my best work in this course.					
6	The learning resources (e.g., Readings, AV material, Notes, Handouts, etc.,) for this course are very useful to me for Career development and course completion.					
7	The web-based (online) materials are effective in assisting me for using online learning materials and learning aids like text, rich pictures, diagrams, animations and quiz/feedback documents, etc, adequately for this course.					
8	There is an effective use of other computer-based teaching materials including learning aids such as specialized software, computer simulations and other software programs used at home or in a computer laboratory.					
9	The facilities including Technology/Classroom Based Learning (TBL/CBL) such as classroom facilities, lecture theaters, studios, labs, online learning, PowerPoint, research, videos, etc., are adequate for this course.					
10	In this course, there a good balance between theory and practice.					
11	I can see how I will be able to use what I am learning in this course in my future career.					
12	The teacher make a positive effort to understand the difficulties I might be having with my work load.					
13	The teacher put in a lot of time into giving comments on my assessments continuously.					
14	I am overall satisfied with the quality of this course.					
15	I would like to use Technology initiated tools like Face book during the course.					
16	During the course, I would like to use Technology initiated tools like Twitter.					
17	Throughout the course, I would like to use Technology initiated tools like Online Chat to do group study.					
18	I would like to use Learning Management Systems like WebCT, Blackboard, etc. to do group study and Review of the course notes.					

Your Comments:

Source: Amaldas et al., *2013c*

Table 5.5: Pre-MOT & Post-MOT Satisfaction Survey

Satisfaction Survey
The learning objectives in this course are clear to me.
Assessment tasks in this course require me to demonstrate what I am learning from inside and outside the class.
I am learning what I expected to in this course.
The amount of work required in this course is about right.
This course is well organized.
The teaching staff in this course motivate me and are extremely good at explaining things.
I enjoy doing the work for this course.
I find the learning resources for this course useful.
The teaching staff normally give me helpful feedback.
The web-based (LMS) materials in this course are very useful.
This course contributes to my confidence in tackling with the effective use of computer-based training.
Overall, I am satisfied with the quality of this course.
There is a good balance between theory and practice.
I feel I can actively participate in my classes and through the web.

Source: Calculated by the Researcher, 2013

Appendix C

Student Questionnaires

Table 5.6: Questionnaire used for Assessment in Japan and Vietnam.

Number	Question
1	Lessons contents should include appropriate multimedia-enabled contents (animation / audio-visual) with print support.
2	CA-Cloud should provide opportunity to send our homework to our Lecturers via the Internet.
3	CA-Cloud must provide lessons for self assessment (tests) of the user with instant support for appropriate content.
4	CA-Cloud must provide each lesson with context sensitive self help system.
5	CA-Cloud users need access to communication tools (email, instant Messaging, blogs, etc) to communicate with lecturer and peers.
6	CA-Cloud should provide a to-do list of learning activities automatically (announcements, home-work, exam, mails, etc).
7	CA-Cloud should provide options for displaying my performance.
8	CA-Cloud should provide options for group or peer study.
9	CA-Cloud should provide profile information of the Lecturers.
10	CA-Cloud should provide self-test evaluation for final examinations preparation & provide a way to exchange user files with peers.
11	CA-Cloud must provide secure access to personal information and content using a collaborative learning environment.
12	CA-Cloud should be interactive with prompt feedback of user's online assessments.

Source: As designed by the Researcher

Appendix D

Faculty Surveys

Table 5.7: Survey of Faculties in Institution A and B (Japan and Vietnam)

Number	Survey Questions
1	Usage of ICT/MOT tools such as Computer, PowerPoint, Interactive Software or e-Learning tools.
2	Encouraging students to use these tools.
3	Course Notes and Online Information Content.
4	Student's interaction in class and in Virtual Classroom sessions.
5	Others A. Never heard of MOT Technologies/have no idea on how to define it. B. All of the above. C. All of the above plus an understanding of how it is promoted with the student and faculties. D. Did not Answer.

Source: Formulated by the Researcher, 2012

Appendix E

Consent Form - Students

Introduction to the Study

We are inviting you to be a part of an interesting research study on the Management of Technology (MOT) and its effects on education. The Questionnaires and Surveys are divided as: Pre-MOT / Post-MOT Questionnaire and/or Coalition Agent based Cloud (CA-Cloud) Survey. I am studying about the effects of MOT usage of Institution A in Japan and Institution B in Vietnam comprising of the students' usage of MOT mechanisms and related technologies.

Purpose

The purpose of this study is to learn about the impacts of MOT in two tertiary Institutions consisting of Japanese, Vietnamese and International students. I am trying to learn about all the things Japanese, Vietnamese and International students learn both within the class and outside the class. The introduction of a new software service called CA-Cloud web service will allow me to understand the social impact of MOT on the performance and motivations of students in using these software services. We hope to utilize what we learn from this study to help other researchers even more than the program does currently in these two tertiary Institutions (A and B).

What happens during the study?

1. We will ask you to take part in the (Pre and Post-MOT) Surveys by answering 18 Questions using a point scale.

2. Sometimes the researcher will observe you while you take part in the activities at the Institution.

3. We may ask you to take part again towards the end of the semester and after several months from the time you finish the course.

4. If you agree, we will tell you exactly what you would have to do to be in that study, and you would have the chance to decide on your own if you want to be in the new study. Your efforts will be commended to your future lecturers.

5. If you have any questions or concerns about being in this study, please send to Christine Amaldas an email: dollgirl08@yahoo.com.

Your Privacy is Important

We will make every effort to protect your privacy. Your name will not be reflected in any of the research reports or information we collected from this study. Any information we received will be recorded with a code that will only be known to Ms Christine. After completion of the study, the key that links the code number to your name will be destroyed to protect your privacy.

I understand that:

- I can decide on my own free will as to whether I want to be included in this study.
- I will not be punished or treated any differently if I decide to be excluded from this study.
- I will have the right to withdraw at any point of time.
- This is a research to see how well the MOT techniques and methodology is utilized at the Institution to help students.
- I have had the chance to ask any question(s) I have about this study; and all the questions have been answered by the researcher.
- I have read the information in this consent form; and I agree to be in this study.
- I will get a copy of this consent form after I signed it.

This study is done as part of my Doctoral degree research at the Ritsumeikan University, Japan. When you answer the questions, please remember that there is no right or wrong answers. I will be only using the combined information from all the Japanese, Vietnamese and International students I am planning to interview in Japan and Vietnam. Your kind help and cooperation will be useful to complete the study. The study will help to understand the benefits of Japanese, Vietnamese and International students gained after the training and the usage of MOT enabled methodologies and the CA-Cloud in all subjects relevant to the study at the Institutions to enhance the learning and performance of students.

Yours sincerely

Ms Christine Amaldas

Doctoral Student

Graduate School of Technology Management

Ritsumeikan University, Japan

E-mail: gr0141vr@ed.ritsumei.ac.jp

An Empirical Analysis on the Promotion of MOT based Training

Comparing Japanese and International Institutions

CONSENT FORM

Dear Christine

I agree to participate in the interview for the above study.

Name: ______________________________

University: ______________________________

______________________________ ______________________________

(Please Sign) Date

Appendix F

Consent Form - Faculty

Consent of Faculty to Participate in the Interviews and Surveys

Investigator

This study will be conducted by Christine Amaldas, a Doctoral Student at the Graduate School of Technology Management at Ritsumeikan University.

Purpose and Invitation to Participate

You are invited to kindly participate in the discussion and contribute your views. Thank you for taking time out of your busy schedule to consider in participating in the interview and survey.

Voluntary Participation

Your participation in this discussion is completely on voluntary basis. You may withdraw at any time during the interview or survey process. If you choose to do so, any information from your participation thereafter will not be used in the study.

Methods/Procedures

The methods of data collection used in this study will be both Qualitative and Quantitative. The sessions will be audio-taped and transcribed to ensure accurate reporting. The transcription will be done by the researcher without any third party support which safeguard your privacy in the process. No one's name will be asked or revealed during the individual interviews or surveys. However, should another participant call you by name during the interview process, the researcher will remove all names from the transcription. The audio-tapes will be stored in locked files before and after being transcribed and will not be revealed to anyone. Tapes will be destroyed within 2 weeks of completing the transcriptions and the transcriptions will be destroyed 3 years after the completion of this evaluation. Nothing you do or say will in any way influence your present or future employment. Also, this information will not affect your use of your present employer as a reference or any job references that you may list. I hope you will take a few minutes to complete this survey and to return it to me in this envelope. Without the help of people like you, research on employees would not be conducted. Your participation is voluntary and there is no penalty if you do not participate. Regardless of whether you choose to participate or not, you can have a summary of our findings. To receive a summary, use the enclosed letter sized self-addressed envelope and the address form. To preserve your anonymity, you can send this request by separate mail. In this way, I have no way of knowing who sent back a questionnaire and who requested a summary of the results. Understanding why people leave their jobs in very important in this research and through your participation, I eventually hope to understand how best to satisfy the needs of organizations and the needs of employees.

Confidentiality

If you choose to participate, you will not be required to write your name at the individual interview or survey. You will not need to use your name in the former and the latter. If by chance, you or someone you know addresses you by name in the sessions, the transcriber will be instructed to delete all names from the transcription. You will be asked at the end of the interview or survey if there is anything you said which you do not want to include as a quote and we will ensure that they are not used.

Risks and Inconveniences

There are no anticipated physical risks to participants. Staff members will be asked to keep the information provided in the interviews as private and confidential as possible.

Benefits

A potential benefit of participating in this research for you could be having an opportunity to describe your experience with this project with others who have shared their experiences. The study will be useful to future researchers for their study as well as for the universities involved.

Questions

If you have any questions about this study at any time, you may contact Christine Amaldas, a Doctoral Student in the Graduate School of Technology Management at Ritsumeikan University or you may contact her through e-mail address: gr0141vr@ed.ritsumei.ac.jp. The researcher will be happy to answer your questions about your rights as a participant of the research.

Authorization

You will be given a copy of this consent form to keep for your records. Once again, we thank you for taking time out of your busy schedule to participate in this research.

Printed Name of the Participant: ______________________________

Signature of the Participant: ______________________________

Date: ______________________________

Printed Name of the Investigator: ______________________________

Signature of the Investigator: ______________________________