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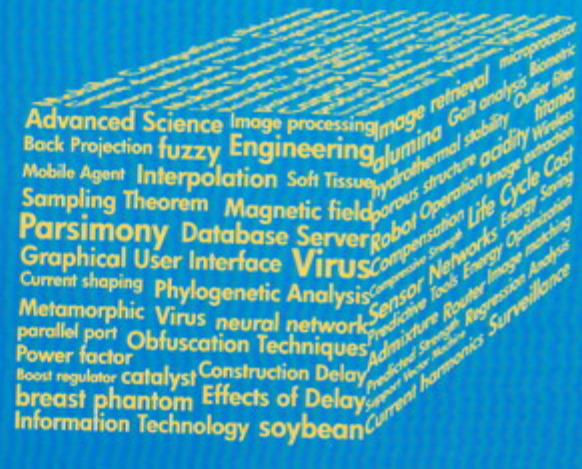

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Foreword

It is our great pleasure to present the Vol. 2 of the International Journal on Advanced Science, Engineering and Information Technology (IJASEIT). Continuing our collaboration in publishing the Proceeding of the International Conference on Advanced Science, Engineering and Information Technology (ICASEIT) in the Vol. 1, this volume comprises articles which are presented in the 2nd ICASEIT held in Kuala Lumpur 12-13 December 2011. Article submissions came from different countries that cover varies topics in engineering and science.

This volume consists of 105 articles classified into six issues based on their field of study. The first issue, No. 1, has 23 papers in the major of electrical engineering whereas the issue No. 2 and 3 contain 19 papers in civil engineering and 16 papers in mechanical engineering respectively. For natural science field, 16 articles in biology and chemistry are published in the issue No. 4. In the issue No. 5, we combine 16 articles in mathematics and computer science since both topics are closely related while the last issue, No. 6, presents 15 papers in computer science major.

We would like to take this opportunity to thank all colleagues who had submitted their articles to the IJASEIT through the committee of the 2nd ICASEIT. A lot of number of submissions indicates their high trustworthy to us to publish their current findings and spread to wide academic communities. We also send our appreciation to all reviewers who had dedicated their valuable time and comments to ensure articles significantly contribute to science and technology. In addition, we would like to acknowledge the organizing committee of the 2nd ICASEIT for this great collaboration and the Editorial Board who had worked hard to prepare this volume.

We are pleased to inform you that the editorial boards of the journal have been trying to widen the journal indexing to main databases and to receive regular submissions for publication for the forthcoming issues. We are committed to serve a fast publication and provide quick access to the recent articles for academic communities globally.

Finally, we do hope that articles published in this volume might inspire a state of the art research and new findings for the advancement of science, engineering and information technology.

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ICT Based Information Flows and Supply Chain in Integrating Academic Business Process

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Abstract— **Organizations' viability is a complex issue, owing to the high number of factors that affect it. In recent years, they have made increasing use of systems thinking, which has proved useful by helping them to a better understanding of problems arising in complex situations, and by providing them with a set of tools suitable for dealing with such problems. The implication is the higher education institutions has been facing the more complex situation that should be considered on giving better education service: including Ahmad Dahlan University (ADU). This paper attempts to show how the new communication and information technologies and the internet in particular can help in the design of viable organizations especially at ADU. The paper presents and describes the management information system named SIA (*Sistem Informasi Akademik*/ Academic Information System) based on internet technology, created for the purpose as mentioned above. This system covers almost the value chain of academic business process from student enrollment to student graduation. This information system can be accessed by all relevant internal stakeholders with some level of authority. Communication and information technologies enable the university to help in the design of viable organizations by means of internet-based information system. The satisfaction of student service has increased as an implication of customer oriented framework because of less bureaucracy, reducing time response of some services, and increasing accurate decision.**

Keywords— **higher education, business process integration, ICT, supply chain, customer oriented**

I. Introduction

The intensification of global competition and the demand for better customer service as well in the higher education institution have considerably increased the need for integration all unit to be solid organization. The value chain, quite correctly, identifies a complex series of activities that coordinate supply and demand. In contrast to economic theory the value chain is concerned with the diverse activities that manage the demand and supply curves (Glaser, 2006). Consequently, supply chain integration, aimed at coordinating processes along the supply chain seamlessly, nowadays is considered an important determinant to maintain a competitive advantage over competitors.

In the era of information system, Ahmad Dahlan University (ADU) does not want to be left behind by its rapid change. The use of IT has been made impossible to decline. IT has made efficiency in service possible. In the beginning of 2009, ADU has proclaimed that it will gradually develop a paperless academic service to its students. This policy is assumed to be much influenced by the increasing of global warming. By using less paper, we will help the mother earth to save its energy. In doing so, the use of IT becomes the priority.

Facing the dynamic change of environment, ADU develops all activities and services to support the best educational service quality achievement based on student satisfaction oriented. There are three pillars which are important to build in the university; they are (1) Quality Assurance System, (2) Internal Performance Control System, and (3) Information Technology and Knowledge Management System. Those three pillars are stated as strategic goals in managing quality including:

1. Developing quality management by combining ISO 9001:2007 and IWA2: 2008
2. Developing mechanism of organization performance measurement covering all the staff by using competence-based human resource management framework
3. Developing information technology and knowledge management by using smart campus framework

Then, integrating all information islands is very important to be more efficient and effective organization. We reveal that using the technology especially information and

communication technology will improve our service. In the other hand, the supply chain management gave many opportunities to view the organization as a modular activity that should be integrated and measured its performance comprehensively. Now, the higher education institutions have been challenged by the information technology (IT) advancement that dramatically change with new features and capabilities, moving away from the data processing era to a strategic information systems era.

In the effort to strengthen the service to its students and to make some process convenient, ADU develops several integrated information systems to arrange the business process. For its budgeting system, ADU builds SIAGA (Integrated information system on finance and budgeting). Through this particular system, every person in charge will be able to check the transparency of financial and budgeting in the university. ADU also develops a system which can manage the optimal usage of classrooms and laboratories. The person involved will be able to see the available or unavailable rooms in certain session. So, there will be fairness for everybody. ADU also creates an integrated academic information system which optimizes the service to its students in their academic business process. The system is called SIA, an abbreviation of *Sistem Informasi Akademik* (Academic Information System).

II. Conceptual Background

A. Process Approach and Supply Chain on Academic Service

Since 2005, UAD had started to implement quality assurance especially using ISO 9000:2007 perspective. Customer (i.e. student) oriented is a very important factor to be considered. As an impact of this orientation, the adoption of a process approach when developing, implementing and improving the effectiveness of a quality management system, to enhance customer satisfaction by meeting final customer requirements exist. Based on this approach, the value chain of the academic service functions effectively, it has to identify and manage numerous linked activities to ensure student success. An activity that uses resources and is managed in order to enable the transformation of inputs into outputs can be considered as a process, so is academic service. Often the output from one process directly forms the input to the next. The application of a system of processes, together with the identification and interactions of these processes, and their management, can be referred to as the "process approach". When used within a quality management system, such an approach emphasizes the importance of: understanding and fulfilling requirements, the need to consider processes in terms of added value, obtaining results of process performance and activeness; and continual improvement of processes based on objective measurement (Cagnazzo et al., 2010; Carmignani, 2009). Using the process approach, the academic process is shown by figure 1.

Fig 1 Academic value chain as a common

Each process figured above is managed by different unit. The supply chain approach can be assumed for this situation. The supply chain approach is derived from the fact that there are dependencies between levels in channels from the point-of-origin to the point-of consumption (Bigliardi and Bottani, 2010; Lambert et al., 1998; Håkansson and Snehota, 1995). Usually in supply chain, the point-of-origin refers to suppliers or manufacturers (Kim, 2006; Zailani and Rajagopal, 2005; New, 1996; Carter et al., 1995; Ellram and Cooper, 1993; Novack and Simco, 1991), while the point-of-consumption refers to consumers, customers or end-users in a supply chain (Cagnazzo, et al., 2010; Min and Mentzer, 2000; Lambert et al., 1998). But, in this case point-of-origin refers to admission unit which responsible to student recruitment. We have to be careful to this assumption, because we can fall to assume student as a product like at the manufacture business. Malhotra and Robinson (2005) suggest that traditional quality programs focusing on approaches such as TQM, the Malcolm Baldrige National Quality Award and ISO 9001 (2000), must now transform to a supply chain perspective in order to simultaneously make use of supply chain partner relationships and quality improvement gains, essential to marketplace satisfaction. In the current intense global competition, supply chain principles and technologies are taking centre stage as a mean to achieve business excellence (Carmignani, 2009). Higher education should consider this competition shifting. The use of technology is a must to compete and to deliver the better education service. The integration of supply chains will improve the organization performance significantly. Clancy describe the integration of supply chains as:

> . . . attempting to elevate the linkages within each component of the chain, (to facilitate) better decision making [and] to get all the pieces of the chain to interact in a more efficient way [and thus] . . . create supply chain visibility [and] identify bottlenecks (Clancy, cited in Power, 2005)

Effective application of information technology to the integration of supply chain activities has the effect of reducing levels of complexity. Senge (1990) defines two types of complexity, detail and dynamic. Detail complexity exists when there are many variables needing to be managed. The three principal elements of an integrated supply chain model as being information systems (management of information and financial flows), inventory management (management of teaching and learning), and supply chain relationships (management of relationships between supporting units and faculties). The basis of integration can

therefore be characterized by cooperation, collaboration, information sharing, trust, partnerships, shared technology, and a fundamental shift away from managing individual functional processes, to managing integrated chains of processes (Akkermans et al., 1999; Lehtinen and Ahola, 2010; Halldorsson, et al., 2007; Wouters, 2006). Advances in internet technologies and software are also affecting the application of longer established technologies on higher education management.

The conceptualization of supply chain integration will be similar in meaning to business process integration among units in this case. It can be as one in which the effort associated with information flows between activities is minimized, and business process integration describes the practices associated with the minimization of this effort, or the tighter coupling of organizational activities in a business process. Activities in the higher education institutions become more tightly coupled with each other by minimizing the human effort associated with communication and coordination of their inputs and outputs. As an impact, the higher education institution should improve the human resources skill to adapt at the new role. Business processes deal primarily with information-based inputs and outputs, improving the timeliness, accessibility, granularity, and transparency of information flows between activities in a process are keys to business process integration. The ideal concept of this integration is described in the IT Roadmap as guidance to develop such information system. Academic information system is one of many information systems that need to be integrated with other system. But, in some degree, this information system has integrated many activities as mention in the figure 1. The academic information system includes the list of menu as expressed by table I.

B. *Performance Measurement of Supply Chain/ Business Process Integration*

Modern performance measurement (PM) systems are multi-disciplinary and they incorporate general systems theory, organization theory, behavioural science, operational research, economics/ accounting and information technology.

TABLE I
ACTIVITIES AND AVAILABLE MENU ON SIA

Activities	Menu	Remark/ Menu Function
Enrolment	-	Available in the other IS named SIPENMARU (*Sistem Penerimaan Mahasiswa Baru*/ Student Enrolment Information System)
Registration	Semester	To define the semester period
	Syarat Batas SKS (Maximum Credit)	To define the rules of prerequisite and maximum credit that can be taken
	Kemahasiswaan (Student Affairs)	To manage the master data of students
	Registrasi Mahasiswa (Registration)	The activity to handle registration process
	Rencana Studi (Semester Study Plan)	To manage study plan, key-in by students
Teaching and learning	*Kurikulum* (Curriculum)	To manage the curriculum
	Jenis Nilai (Scoring system)	To manage the scoring system
	Manajemen Ruang (Room management)	To optimize room usage
	Jadwal (Course Schedule)	To manage the schedule of each course
	Dosen (Lecturers)	To manage the schedule of each lecturer
Research and thesis	*Tugas Akhir* (Final Project/ Undergraduate thesis)	To identify who takes the final project for how long
Final examination	*Syarat Predikat Kelulusan* (Minimum score requirement)	To define the minimum requirement to pass each course
	Input Nilai (Score input)	To manage lecturer in score inputting
	Hasil Studi (Semester Grade Point)	To define students' semester achievement
Graduation	*Transkrip Nilai* (Academic Transcript)	To manage the issue of academic transcript
	Kelulusan (Graduation)	To manage the graduation
Others	*Evaluasi* (Monitoring and evaluation)	To manage internal and external money
	Laporan (Report)	To provide some academic report
	Laporan DIKTI (DGHE Report)	To provide some academic report for DGHE

Since 1990s, much research has focused on the development of individual performance measures, evaluation criteria/principles, frameworks, models and PM systems (Folan and Browne, 2005; Neely, 1995) for example Kaplan and Norton's (1992) Balanced Scorecard, Keegan et al.'s (1989) Performance Measurement Matrix, and Cross and Lynch's (1989) Performance Pyramid.

Further, the supply chain or business process integration can cover two things; the organizational integration and information integration. Organizational integration looks organization as a collection of differentiated, interdependent functional units. The level of integration between units was measured by the quality of the collaborative relationship linking them. Information systems literature shows how information technology can support integration across functional groups, business units, or entire organizations through data integration, application integration, and systems integration (Davenport et al., 2004; Gattiker and Goodhue, 2005). Information integration is the foundation for integrated processes (Davenport et al., 2004; Browning, 2002).

However, information integration is not a sufficient precondition for a fully integrated business processes because different individuals and groups responsible for process activities have different information needs, interpretations, and practices. Business process integration involves the minimization of communication and coordination effort between activities of a process. The time associated with the flow of information between distributed

activities is a key indicator of the level of integration of a process (Berente and Vandenbosch, 2009)

III. Methodology

Higher education institutions competitiveness has been very tight. Each institution seeks many possibilities to serve better education process and support. This research based on practical experience of ADU to maintain its information system as an effective tool to improve teaching and learning satisfaction of students. In the beginning, some literature studies are conducted to build the theoretical background on how important the ICT for increasing higher education performance. A brief preview of academic information system at UAD is explained to give an understanding of the nature of the system. At the discussion section, we will elaborate the experience of the user on benefits and pitfalls.

The information systems are integrated by web services technology through SOAP as the integration protocol. This protocol provides simple and easy mechanism for information exchange among computers in the distributed system. SOAP protocol is applied for several reasons. First, SOAP is platform and programming language independent. It means that SOAP supports the interoperability between some programming languages and platforms. Second, SOAP is simple. It contains one-way messaging, yet, it can be used to have request-response by using RPC (remote procedure call) mode. Third, SOAP can manage complex data type (UDT: User Define Type), both as input parameter and return value. And fourth, by using SOAP there is no need to manage different platform and different programming for serving different clients (Box, 2000).

IV. Result and Discussion

Process integration is often not explicitly defined or related to other forms of integration, such as data integration, application integration, systems integration, and organizational integration. Also, what is known as process integration to some often goes by another name, such as electronic integration, business integration, and integration of information flows (Berente and Vandenbosch, 2009). Four principles of process integration from the literature on organizational integration and information integration are accessibility, timeliness, transparency, and granularity. Each of these principles in detail is shown by table II.

TABLE III
Principles of Process Integration

Principle	Definition
Accessibility	Information is readily available to activities
Timeliness	Information is available when needed
Transparency	Information is understandable
Granularity	Information is at the right level of detail

(Source: Berente and Vandenbosch, 2009)

Using this view, we can make an analysis of the implementation of business process integration at UAD. SIA enables both students and lecturers have convenient access to the academic business process. This system covers the whole academic business process from the enrolment process to the graduation of the students. Starting from the enrolment, the future students will be asked to put some data entry in the system. They must fill the forms provided in the system. The forms will cover some basic information, i.e. name, date and place of birth, address, their origin, their high school score, etc. The data of those who are accepted as ADU students will be transferred automatically into the database of ADU students. Each student will be given a private account in which they will manage their academic business process personally. Once they have registered, they have every right as ADU students. In registration phase, students will have to execute some data entry in accordance with the subjects they will take in the on going semester. A few weeks before the semester starts, the head of Department had uploaded the schedule and subjects offered. He or she also decided the quota of each class. Based on this, students can decide what subjects they will take. The system is also equipped to detect the GPA of each student. The maximum credits that students can take are based on the GPA that they get in the previous semester. Once they make the data entry, it will come to the database. From the data put by the students, the academic staff in the faculty will print the attendance lists. Only those who have registered and put their data on the system will be on the attendance list.

The SIA also provides each lecturer with their own account. Each lecturer can go into their account to do some academic business process. Their account will cover the subjects they teach completed with the assessment forms, the students of whom they become the academic advisor, and the progress of each student under their advisory. In the end of semester, each lecturer has to input the score of their students for each subject. And on the appointed day, students can print their transcripts just as needed. The faculty does not have to issue the transcript unless it is needed for some specific purposes. Students can ask the Head of the department to verify their personally printed transcript.

SIA system also enables to identify students who are taking their final project. It records the data input and will remain so until the students graduate. From the system, the length of study and the length of the final project writing process will be recorded. Once the students have graduated, their data will be classified in the graduates' data. By using the system, one entry done by the students in the beginning of the semester will provide many things. The validity of the data must not be in question. There will be no much paper involved. Everything will go by the system.

V. Conclusions

In the rapid change of information system era, it is impossible not to be involved in the changing. We must be able to follow and make use of IT in every aspects of life. In managing a higher education institution, IT will be very helpful when it is used accordingly. In recent and current years, ADU has developed several integrated system as its commitment to increase costumers' satisfaction. One of the systems developed is ICT based information flows and supply chain in integrating academic business process. By developing this system, it is expected that the students' satisfaction will increase, and in the time it will also increase the number of prospective students to enrol in ADU. That will be a snowball effect to regenerate the development of the university.

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