Intelligent Agent Based Consultation Scheduling Framework for Institutions of Higher Learning

H. Vasudavan and J. S. Fernandez

Abstract—**This study concerns the utilization of Information System Planning (ISP) in tertiary institutions, and develops a framework that could be used to generate suitable consultation sessions by considering other tasks that lecturers/tutors are involved in. Previous study and data gathering results indicate that most tertiary institutions allocate consultation sessions manually and there are many issues due to this. This paper puts forward a framework made up of two important components to address the issues of manual allocation. The two components are intelligent agent and integrated databases.**

Index Terms—**Consultation allocation, CSF, intelligent agent, tertiary education.**

I. INTRODUCTION

Information System Planning provides guidelines for IS/IT implementation. According to [1], with a strategic IS/IT blueprint, organizations can utilize IT infrastructure more competitively and identify new and higher payback IT applications. The strategic IS/IT plan provides a better forecast of IT resource requirements. Although IS/IT provides great benefits to organizations but it is interesting to note that educational institutions have utilized this resource in a limited manner, this includes tertiary institutions that offer IT programs. The limited use of computer technology by university students and faculties has been emphasized by Selwyn (2007) as cited in [2]. In order to gain competitive advantage, IS/IT infrastructure within the organization has to be aligned to the business process and goals.

One of the core business processes within a tertiary institution is allocation of consultation slots. Most learning institutions encounter difficulty when it comes to scheduling lecturer-student consultation sessions. This is because the student will try to fix consultation times and on the other hand the lecturers have to make sure of their availability. As for the lecturers, they must be fully aware of their existing schedule before they are able to commit to the students. In order to address the issues relating to manual allocation of consultation sessions, this paper provides a framework based on the concepts of integrated databases and intelligent agent.

This research paper is arranged as follows: At first, we assess the problems of allocating consultation slots in higher education institutions. Secondly, we discuss data gathering and the analysis of results. Thirdly, a framework is put forward and lastly we reach the conclusion and future work of this study.

II. LITERATURE REVIEW

Higher education institutions play an important role in cultivating knowledge and skills to prepare students for the competitive job market. As there is higher awareness on the importance of tertiary education these days, this sector is becoming an important part of the service industry in many countries. The author in [3] acknowledges there is stiff competition between institutions due to the increasing number of new colleges and universities. The authors in [4], recognize that this competition has caused institutions to become increasingly aggressive in their service activities to convey a favorable reputation that might influence a student's desire to attend the particular institution. One of the student-driven core services within the education sector is the consultation sessions with educators. These consultation sessions are vital in tertiary institutions to support independent learning for students with different academic abilities, learning approaches, language levels, skills and knowledge levels. In many tertiary education institutions, the manual method of allocating consultation sessions is being practiced. This technique can be quite annoying due to its low success rate. Some issues relating to this method have been highlighted in [5] such as lecturers being unavailable due to class obligations or is sometimes unknowingly booked for that time, some lecturers not having read the email or sometimes students make an appointment over the phone and its written down somewhere and misplaced. In addition, cases of double booking or over booking can lead to confusion especially when lecturers work in multiple capacities at higher learning institution and if bookings are not coordinated carefully. According to [5] it gets even more complicated when students make appointments with lecturers but also the head of school organizes meeting with other lecturers. Strategic information system planning (SISP) is the process of identifying a portfolio of computer based applications that assist an organization in executing its business plans and realizing its business goals. In this technology driven era, strategic information system planning (SISP) plays a crucial role in achieving opportunities and competitive advantages for an organization by incorporating the use of IT/IS to support their daily operations. The successful utilization of IS is built upon SISP [6]. However, IS in the education sector have not been thoroughly explored and this is proved by two researches conducted by [1]. The first study carried out in Thailand concludes that many institutions of higher education have limited understanding and experience of strategic IT planning, which restricts IT

H. Vasudavan and J. A. S. Fernandez are with the Information Communication and Technology Department, University College of Technology and Innovation (UCTI), Bukit Jalil,57000 Kuala Lumpur, Malaysia (e-mail: hemalata@ucti.edu.my; jsharmini@hotmail.com).

development in learning institutions. In the second investigation which was carried out in 2005, the Malaysian Administrative Modernization and Management Planning Unit (MAMPU) found that only 7 out of 48 private universities and colleges in Malaysia that participated in the study had implemented SISP. The limited use of SISP has caused poor planning and this has led to solutions being introduced in phases to meet the evolving needs and strategies of an organization. As a result, a lot of different information systems have been developed independently over the years for the same or specific purposes. Suggestions and recommendations of IS/IT solutions and then the implementations of these solutions are done as the need arises. Examples of common service-oriented sub-systems that exists in education institutions are timetabling, project presentation scheduling system and leave application systems and all these systems are not linked to each other. Due to this, there is lack of compatibility and capable interfaces between such systems which prevent reliable decision-making. IS/IT solutions that do not assist the decision making process are not effective in providing an edge to the organization. Competition in the higher education industry has been increasing for both the public and private sectors, thus reliable decision-making tools are essential to improve the reputation of tertiary institutions in order for them to attract students and absorb the impact of globalization [7].

It is clear that organizations which adopt technological aspects grow at a rapid pace compared to their competitors and it is essential for educational institutions to adopt SISP in order for them to remain relevant. SISP can be used to identify the direction on how to plan for the future that guides current day decision making. Education institutions need to develop a strategic plan in order to provide a context for decision making. When sudden opportunities embark, education institutions need to respond instantly to take advantage.

Critical success factor (CSF) has been selected as the SISP technique to provide guidelines in order to produce the proposed framework. The objective of CSF is to define key areas of activity in which favorable results are absolutely necessary to reach goals [8]. These goals are areas that an organization has to pay close attention to in order for them to succeed. The critical success factors are very crucial factors affecting the success of the outcomes. Besides that, critical success factors are collection of circumstances, facts or influences which contribute to the process of scheduling student-lecturer consultation slots [9]. The process of scheduling student-lecturer consultations require much analysis of time slot factors, lecturer availability, level of appointments, etc. With all of this in mind we need something that can schedule and notify both parties involved if there is a time available to meet and if not to advise them accordingly.

III. RESEARCH MODEL

The research activities conducted for this study is based on Figure 1. The authors did preliminary reading on different areas of IS to identify common problem areas. The problem

statement was then formulated and literature review was conducted to identify issues with the implementation of IS in the education sector as well as challenges faced in higher education institutions.

Primary data gathering was conducted twice with two different sample sizes, the first one with sample size of 20 and the second one involving 100 participants. The purpose of conducting the first survey was to identify factors which are crucial to ensure the success of education institutions. This was followed by a second survey which was aimed at gathering accurate results of user feedback relating to consultation services. Results that were collected in the second survey and findings of literature review were evaluated by the authors. This led to the generation of a theory based framework which was proposed to solve the problems that were identified through primary and secondary research which was carried out earlier.
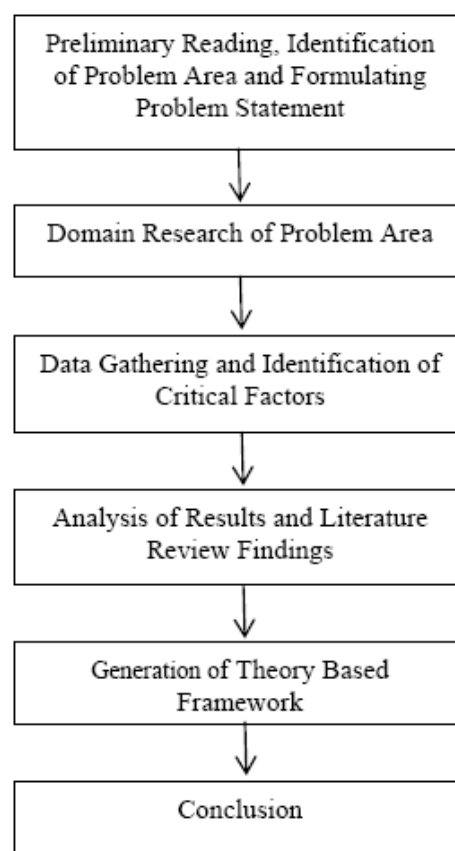

Fig. 1. Research model.

IV. RESEARCH METHOD AND ANALYSIS

This research study is based upon data which was collected in 2012. A survey was conducted involving 100 tertiary students and lecturers in a private education institution. A quantitative survey was carried out to gather information about methods that were being utilized to arrange student lecturer consultation. The respondents were selected randomly for sampling purpose from different countries.

The survey contained questions to gather information, opinions and familiarity of the respondents on utilizing consultation methods adopted by their education institutions. Data gathered was tabulated and then analyzed using tools available in Microsoft Excel 2010. The summary of the results have been documented in Figure 2.
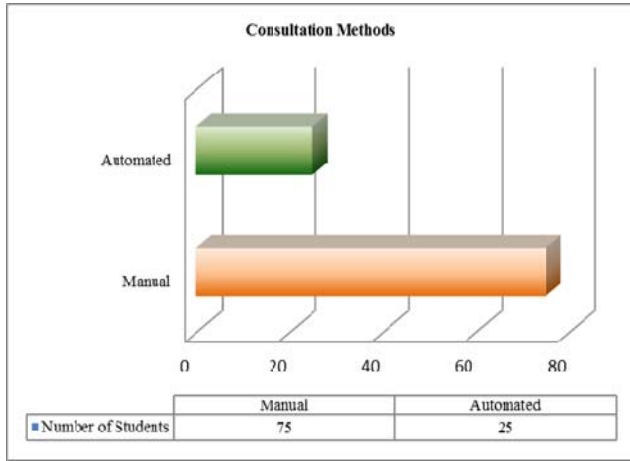
Fig. 2. Consultation methods.

Figure 2 show that most institutions utilize the manual method of arranging consultation between students and lecturers. Although most businesses today are automating more and more of their processes, a large number of tertiary institutions are still dependent on the manual method of arranging consultations between lecturers and students.

For the manual method, students would meet their lecturers in the staffroom, after and/or before class. This could also refer to students who send an e-mail to arrange for a meeting. In the automated system, students and lecturers utilize a system to allocate and/or book consultation slots.

Tables 1 and 2 summarize students' and lecturers' perception of manual and automated consultation methods. For both methods, respondents were first asked to assess the level of flexibility provided by the selected method in arranging consultations between lecturers and students. This is to assess the extent to which the method is able to adapt to the changing needs of the users.

Next, the respondents were asked to evaluate the level of usability and to assess the reliability of the method adopted in effectively allocating suitable meeting slots. Finally, respondents evaluated the method in terms of cost effectiveness. The criteria used to assess the satisfaction level of the respondents were measured in a Likert scale of 1 out of 5 whereby the lower end indicates support. The Likert scale denotes 1 (Strongly Agree), 2 (Agree), 3 (Neutral), 4 (Disagree) and 5 (Strongly Disagree).

The results are shown in terms of mean values, mode values and standard deviations. The mean, mode and standard deviations that are closer to the value 1 indicate a positive response from the respondents of the criteria that is being assessed.

Overall, the results in Table 1 show that the respondents have provided negative feedback towards the manual approach of arranging consultations. This is clearly indicated in the mean values that are all above Neutral which is equivalent to a score of 3 and above. There is little discrepancy in the data collected from the respondents and this is shown by the mode values and standard deviations that were calculated.

In comparison to the scores collected for the manual approach, the results in table 2 display a more positive response for the automated method of allocating student lecturer meetings. There is a lower mean value for all the criteria that has been evaluated.

TABLE I: Manual Consultation Method

Evaluation Criteria	Mean Value	Mode	Standard Deviation
Flexibility of the method	3.73	4.00	0.64
Ease of use	3.61	4.00	1.00
Reliability of the method	3.48	4.00	0.91
Cost effectiveness of the method	3.45	3.00	0.93

TABLE II: Automated

Evaluation Criteria	Mean Value	Mode	Standard Deviation
Flexibility of the method	1.44	1.00	0.65
Ease of use	1.88	2.00	1.05
Reliability of the method	2.72	3.00	1.10
Cost effectiveness of the method	1.44	1.00	0.82

The values are all less than 2.00 except for the reliability criteria which has a score of 3.00 for mode and a standard deviation of 1.10. The most common value that was provided by the respondents is Neutral and there is possibility for this score to reach a maximum of 1. There were several suggestions from the respondents that highlight lack of integration between different sources of information systems such as timetables, academic meetings, events, examination scheduling.
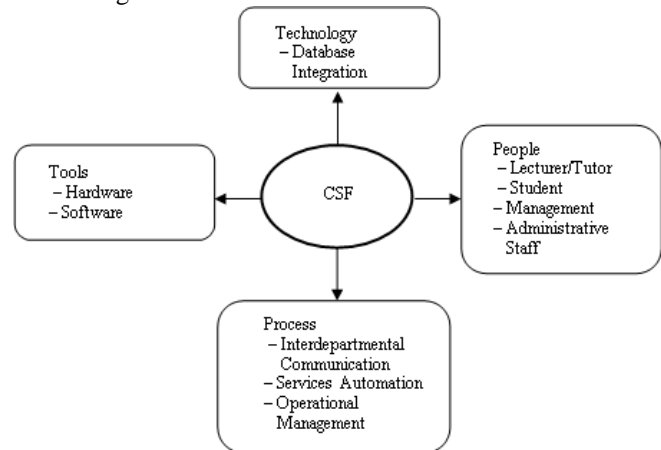

Fig. 3. CSF

Figure 3 reflects the key areas of CSF which are categorized into 4 groups and they are tools, technology, people and processes. The elements for each CSF were identified through the analysis of literature review findings and primary data gathering results.

V. An Intelligent Consultation Allocation Framework (I-CAF)

i-CAF is a theory based framework designed to generate lecturer-student consultation sessions. Users who will be

interacting directly with the framework would be lecturers/tutors, students and staff in the Human Resource department. i-CAF consist of the following components:

1) Presentation layer – The presentation layer is made up of the user interface where lecturers and/or tutors would be able to select a suitable category for the task that is being recorded in the system and then select time slots that would be reserved for these tasks. Only tasks relating to assessment preparation and marking, self-development and leave days will be keyed in by the lecturers and/or tutors.

2) Processing layer – Decision analysis is done by the intelligent agent at this layer. The intelligent agent would check all entries in the different databases to ensure that there are no clashes. When lecturers/tutors key in their login identity, the intelligent agent compiles all the related tasks for that member of staff and recommends consultation slots by providing a gap of 10-15 minutes from the previous and following engagement.

3) Data layer – Data layer consists of a set of databases that would be used by the intelligent agent. Time slots that have been reserved for assessment preparation and marking will be stored in the Assessment Preparation and Marking database. This would allow lecturers to focus on assessment preparation and marking without being interrupted. In addition, lecturers would also be able to dedicate some time for self-development activities relating to education, certifications, seminars, trainings and research. These entries will be captured and saved in the Self-development database. The Leave database will hold the dates that the lecturer/tutor will be away on leave. This is only applicable if the leave has been planned for in advance. Unpredicted leave due to medical reasons, deaths, emergencies, etc. would be recorded by the Human Resource department staff. The data in all the other databases will be captured from existing databases such as sign in/out times will be recorded when employees swipe their cards to enter the institution premise, timetable for each lecturer/tutor will be prepared by the scheduling team and stored in the Timetable database while the administrators arrange final year presentations and store them in the Presentation Schedule database.

The objective of this framework is to assist interdepartmental communication, enable services automation and improve operational management. The architectural design of i-CAF is indicated in Figure 4.

In [10], it is stated that the success or failure of a project depends on the important criteria determined by the stakeholders. Considering the exploratory nature of the data gathering method that was adopted, four criteria has been established and the extent to which the proposed framework meets these criteria is discussed in the following page.

1) Flexibility – the framework provides flexibility by allowing lecturers/tutors to reschedule and make changes to existing consultation slots as new tasks are identified.

2) Ease of Use – the allocation of slots will be done by the intelligent agent within the framework which provides convenience to lecturers/tutors.

3) Reliability – recommendation of available slots which are provided based on the collection of information in existing databases generate accurate results.

4) Cost Effectiveness – by accurately identifying available consultation slots, less cost would have to be spent in rescheduling meetings.
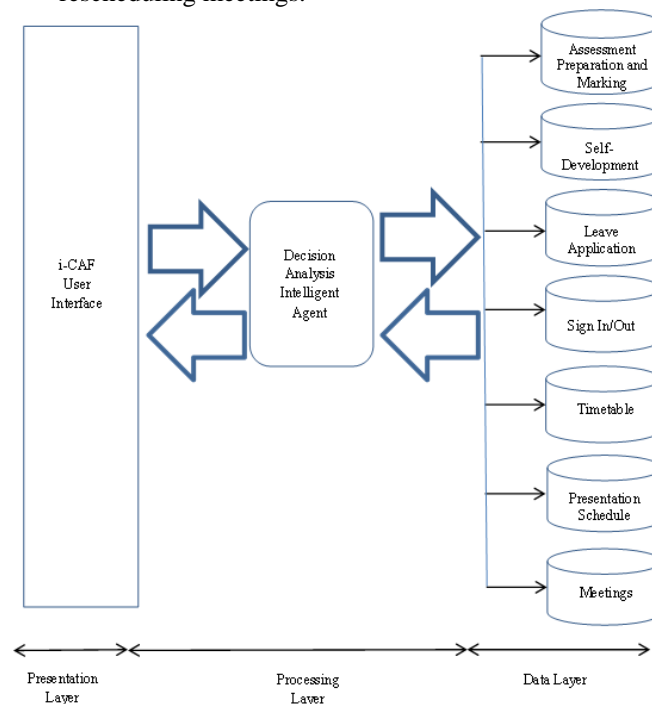

Fig. 4. i-CAF.

VI. CONCLUSION AND FUTURE WORK

The Information System Planning implementation method is multipart, normally incorporating many factors such as technical and non-technical. This study shows that, the proposed framework is able to improve business processes of higher learning institutions. This research is notable as there are not many significant studies on the application of information system planning in higher learning institutions. The theoretical feasibility of the framework has been evaluated against the critical success factors that were generated through data gathering while the technical feasibility will be determined after the implementation of the framework within an education institution. The framework for allocating consultation sessions consists of two main components which are intelligent agent and integrated databases. The intelligent agent acts as the decision maker based on the information derived from the integrated databases. The integrated databases comprise of lecturer/tutor activity information. The decision making method for lecturer/student consultation session is a critical process and the use of the intelligent agent increases the reliability of the proposed framework.

As this is a theoretical framework, some limitations of this proposed architecture may have been overlooked. Therefore, future research includes developing a system based on the proposed framework and determining its usability and efficiency through various testing methods. The framework can be further refined by considering the feedback received

from system users.

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