Information Systems Analysis: What should we teach our students?

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ABSTRACT

After teaching a graduate diploma course entitled "Information Systems Analysis" for few semesters the author found that there is a mismatch between students' perception of the contents of such a course and that of the provider. This paper describes the current contents of the course and students achievements for the two semesters of 2009. To understand why students did well in some parts of the course and not in others an investigation was made to gauge students' expectations and those of industry experts who guide how the course contents are determined.

Keywords: Information, Systems, Information Systems Analysis, Business Events, Systems Response.

1. INTRODUCTION

Callaos and Callaos [15] claim that the term information is one of the often-used but very abused word in the information age. After doing an epistemological investigation into the meaning of the terms information and information systems the authors conclude that information has two polar but complementary connotations – a subjective and an objective perspectives.

This paper uses the objective notion of the term information as describe by Callaos and Callaos in delivering a graduate diploma course in information systems analysis. Senn [8] defines system analysis as the process of gathering and interpreting facts, diagnosing problems, and using the facts to develop a new system or improve an existing one. Similarly, Whitten and Bentley [9] refer to systems analysis as "a problem-solving technique that decomposes a system into its component pieces for the purpose of studying how well those component parts work and interact to accomplish their purpose".

The aim of this paper is to synchronize what students learn in academia with the expectation of the information systems sector of the information and communication industry. This is done through an informal evaluation of the contents of the course by the students. Furthermore, industry experts were asked to comment on students' feedback. The author presents the results of the investigation in this paper and invites comments and constructive feedback from readers and conference participants in order that students' perception of the course contents is aligned to what the industry expects. The author wishes that international experts and readers of this paper will provide insight into the meaning, and purpose of information systems analysis as a basis for redesigning the contents of the course in his institution.

2. INFORMATION SYSTEMS EPISTEMOLOGY

Greek philosophers have classified knowledge into *doxa* and *episteme,* where doxa refers to that which is intuitively believed to be true, and episteme is that which has been scientifically tested, proved and known to be true. Science and research are the mechanisms in which what is believed to be true (doxa) may be tested and transformed into what is proved and known to be true (episteme). Klein et al. [7] postulate that the Greek philosophers' felt that the primary role of science was to turn doxa into episteme. The word *epistemology,* from the Greek episteme or knowledge, is the study of what we know or how can we know what we know [12]. It refers to the part of philosophy that deals with the nature and limits of human knowledge where knowledge is a matter of community acceptance. Klein et al. (op. cit.) further claim that conventional philosophical wisdom now holds that knowledge is not infallible but conditional which is a societal convention and is relative to both time and place. The author, in this paper, argues that we know what we know and we know how much we know about a particular subject depend to a large extent, on the type and quality of facts that are made available to us and our ability to discern, analyse, evaluate and interpret the facts. Those facts are provided by an informer to inform us or to give us the knowledge that is needed in order that we make informed decision.

3. THE INFORMATION CONCEPT

Information is a crucial resource for the functioning of an organisation. It is so essential that it is often referred to as the *"life blood of the organisation"* and the *"fabric of an organisation"* or the *"agent for sustaining organisational viability"* [3], [10]. Information has been classified by [4] into descriptive information, probabilistic information and qualitative information.

- Descriptive information may be further subdivided into information that describes *the rules that govern or constrain the affairs of the real world*; information that describes *the state of the real world;* and information that describes the *changes in the state of the real world*.
- Probabilistic information is further classified into *predictive information* which provides a model of some aspects of the real world in the future; information which describes the real world by means of inferences from a finite set of observations of the real world phenomena; and *information derived from a model of the real world.*

- Qualitative information may be categorised into *explanatory information* explaining why a real world situation arose; *judgemental information* which tend to be based on subjective or intuitive appreciation of a situation; and *information about values, attitudes and power* which are the mainsprings of action in an organisation and some of the most powerful motivating forces which are the result of people's values and their attitudes towards particular issues. There are also *qualifying and qualitative information* which are used to moderate descriptive information; *patterns and norms* which form part of the memory of how things should be done; and *theories, hypothesis and conjectures.*

Since information is treated in this paper as one of the fundamental resources of an organisation, its production must be managed and controlled systematically to avoid costly mistakes. Ray [14] maintains that, while managing information as a resource is a concept that has considerable appeal, implementing that concept has proven to be problematic and utilises diverse resources. The type, quality and the amount of information that is required for the efficient functioning of an organisation has to be determined before committing the expensive resources that are required for its production.

The Webster's dictionary refers to information as the *"act or process of informing"* and *"that which is received or obtained through the information process"*. As such, information may be regarded as both a process of reasoning and transforming discrete but inter-related data items, and the product or the output of that process. In a digital environment, information is referred to as the coherence of interrelated data items where data are signals in a database which stores occurrences.

Davis and Olson [6] present a general definition of information as data that has been processed into a form that is meaningful and is of real value in the current or prospective actions or decisions. A real world phenomena (eg: a person) is referred to as a *feature* by the database community and a feature is called an *entity* in the data base models. Characteristics of the feature in the real world are called attributes of the entity in the database. Therefore, a person's name, nationality, sex and age are treated as attributes or data without meaning when we look at them individually.

If we look at the age alone, we do not know whether the entity is a house, an animal or a human being. If we attach sex and nationality to the age the data started to make sense to us because we know that the entity can be an animal or a human being. It is only when we add the name and check what data file we are interrogating (personnel file) that we are clearly and succinctly informed (information) by the database about what we need. Information, therefore, is made up of parts or components which are put together in a particular structure. For example, a person's name is made up of individual characters which are put together in a particular sequence.

Ims [11] argues that information is not a thing. He has suggested that information presupposes an act of *inner formation* or *formation from within*. In his line of thinking, Ims contends that information is not the signs or signals in the data base. Rather, information is the interpretation of the signs. However, since interpretation is regarded as the act or the process of reasoning and trying to understand something, the product of interpretation therefore, is understanding or knowledge.

The World Book dictionary defines information as the "*knowledge given or received of some fact or circumstance"*. As such, Ims [11] as well as Callaos and Callaos [15] arguments are considered valid and have the same meaning as that presented in the dictionaries. Signals in a database are raw and discrete data items and the act or the process of interpreting the raw data (*formation from within*) and the product of that process constitute what the Webster's dictionary has proposed.

In the context of this discussion the author, of this paper, considers information, an output of a process and an input to another, as the means to an end but not the end in itself. Information provides its users with the knowledge that they do not prepossess or cannot predict. It reduces uncertainty and increases the probability of making proper decisions. However, claiming that information should support managerial activities does not imply that information is a sufficient condition for good management because information is only one of the factors that enable good management strategies. De Man [16] maintains that, most probably, the true basis for sound management is wisdom and the capacity to use the information.

4. THE SYSTEM CONCEPT

The word *systems* has been defined as a group of elements, either physical or non-physical in nature, that exhibit a set of interrelations among themselves and interact together toward one or more goals, objectives, or ends ([13]. Others define it as a set of objects with a given set of relationships between the objects and their attributes [17], [1], [12]. A system therefore, is considered in this paper to have several components or properties and the properties can only make sense in terms of the whole but not in terms of the individual parts. Holism, which is the idea that the whole is more than the sum of its parts, should be employed as the foundation of systems theory.

The fundamental property of a system is that it is a complex ordering of people, tools and techniques. In addition, a system may be broken down into dedicated and manageable subsystems. The holistic character of a system can only be realised when the individual subsystems that make up the whole interact with each other toward a common goal. The Apostle Paul has commended: *"If the ears were to say, 'Because I am not an eye, I don't belong to the body', that would not keep it from being a part of the body. If the whole body were just an eye, how could it hear? and if it were only an ear, how could it smell? ... As it is, there are many parts but one body."*

(I Corinthians, ch. 12, v.16)

The apostle has demonstrated that a single whole is made up of different dedicated parts and each individual part has a very important role to play in order for the whole to function properly. In other words, each subsystem is an integral part of a whole system and is held responsible for the well being of the other subsystems.

4.1. The Information Systems Concept

Technological innovations have caused revolutionary development in the field of information and communication technology. Consequently, people tend or are forced to change

the ways in which they generate, manipulate and disseminate information. The rapid increase in the number of possible applications of hardware, software and communication facilities has had a great and unavoidable impact on the functions of many organisations. Moreover, the opportunities offered by information technology can only be realised and appreciated when the expert opinions of information systems developers, computer scientists and the end users are integrated and focused on providing better services. Frenzell and Frenzell [2] refer to information technology as a term used to describe an organisation's computing and communications infrastructure including computer systems, telecommunication networks, multimedia, hardware and software. Similarly, Whitten and Bentley [9] define information technology as "a contemporary term that describes the combination of computer technology (hardware and software) with telecommunications technology (data, image, and voice network)". Whitten and Bentley [9] further refer to information system as "an arrangement of people, data, processes, and information technology that interact to collect, process, store, and provide as output the information needed to support an organisation". As such we can now safely say that information technology is the technological subset of an information system.

In the early days of information systems development, practitioners had a reputation for developing systems which were implemented late, were over-budget, tended to fail, were difficult to maintain, and fell short of expectations [4]. This had happened because the people who were responsible for systems development collected and analyse information about what the system was to provide and used that as the basis for system development. Unfortunately, the systems analyst was an expert in structuring the information and he/she had no knowledge of the users' jobs and the business of the hosting organisation. In addition, the analysts appeared to dictate how the users and owners of the information systems performed their tasks. This paper proposes that our knowledge of information systems, their structure, development, use and benefits that they offer must be improved. Furthermore, our knowledge of the concept of information systems has to be revisited to see whether we, as analysts or developers, know exactly what is our role and what are the users/owners' roles and requirements. Bloomfield and Danieli [18] assert that the technical and socio-political skills that are required for information systems development cannot be separated out because they are inextricably intertwined.

5. THE INFORMATION SYSTEMS ANALYSIS COURSE

After teaching a graduate diploma course entitled "Information Systems Analysis (ISA)" for few semesters the author, in this paper, argues that tertiary education providers need to scrutinize the contents of their courses to make sure that students are equipped with the necessary tools and techniques that are needed when asked to analyse an information system for an organisation. More importantly, how information systems strategies can be aligned to the business goals and objectives of the hosting organisation. The author believes that the state of knowledge of information systems in many companies, small to medium enterprises in particular, has not reached the level of understanding of what an information system is supposed to be. Our knowledge of the structure and the functionalities of information systems determine what we know about information and information systems. Moreover, it is only when we are convinced and understand that we really know what we think we know, and we know what we do not know that we are able to design and implement an effective information system.

The goal of the ISA course is to familiarise students with the characteristics of information system together with the processes and tools used in developing computer application systems. In order to reach that goal participants are expected to achieve the following Learning Outcomes (LOs):

- LO 1.: identify the purpose, type and evolution of information systems,
- LO 2.: prepare a feasibility report for a business solution, and
- LO 3.: analyse a current information system and prepare design specifications for databases using modelling tools.

In order that the preceding prescribed learning outcomes are achieved lecturers are asked to cover the following topics:

1. purpose and types of information systems,
2. feasibility assessment and preparing a feasibility report,
3. systems development including systems analysis and design, and databases and data modelling.

5.1. Learning Outcome 1 (LO 1)

Looking at the first LO, the types of information systems have been covered in many textbooks. However, the purpose for organisations to have new or upgrade existing information systems needs to be scrutinised. Harry [12] claims that "an information system can be seen as a subsystem of a control system, and a control system as a subsystem of a management system." Accordingly, an information system cannot exist in isolation and there must be a need for it and it should serve a purpose and that is to act as the informer, providing information, to the control system of an organisation's management system. Therefore, in order for the information system to serve its intended purpose its place in the organisation should be understood thoroughly before committing the resources that are needed for its development and maintenance. Frenzell and Frenzell [2] claim that information systems comprise a large and growing percentage of an organisation's revenue earning.

To identify the purpose of information systems within an organisation as part of the ISA course the students are advised that the first step is to carry out a macro environmental scanning or market analysis using tools and techniques such as PEST (Political, Economic, Social and Technical) and P5Fs or Porter's Five Forces. This is done in order that potential and viable sectors of the market or a particular industry may be identified for matching with the company's potential.

The second step that is needed to accomplish LO 1, is to look at hosting organisation itself to check whether it is capable of participating in any of the sectors identified in the first step. Students are encouraged to use the SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis tool to identify what the hosting organisation has and what they are good at (their strengths). Furthermore, students are advised to look at

things in which the organisation is not good at (their weaknesses) and see whether information systems can be used to strengthened their weaknesses or see if others can do those things better and in a cost effective way that the hosting organisation. After doing an internal analysis of the hosting organisation an attempt should be made to check what opportunities out there in the market that are attractive and how can the organisation uses information systems to leverage and minimise if not totally remove the potential threats. Corporate structure, culture and skill levels of employees are parts and parcel of this internal analysis. At the conclusion of the second step the students should have a superlative idea of WHAT business the organisation is capable of doing.

5.2. Learning Outcome 2 (LO 2)

Having identified the business that an organisation can do in a particular industry, the students are required to develop a set of criteria with which to assess the feasibility of a new or upgrading an existing information system for the hosting organisation. A case study, about a company that has some business problems and one of the solutions to those problems is to upgrade their existing information system is handed out to the students. The students are asked to identify at least three alternative IS/IT solutions and use the set of criteria that they have developed earlier to carry out a thorough feasibility assessment and produce a report recommending to the hosting organisation the most feasible IS/IT solution to their problems. In their report students are encouraged to address and try to provide answers, but not limited to the following questions:

- How well their recommended and most favourable solution will work in the organisation?
- Is appropriate technology available – if yes then is that technology mature enough?
- If the technology is not available: can it be acquired?
- Do the problems or opportunities warrant the costs of developing a new or upgrading the existing IS?

The feasibility assessment activity also involves look around the Information and Communication Technology (ICT) industry and find out HOW the WHAT of the organisation may be implemented. Many systems analysis and design textbooks rightly pointed out that there are many solutions to a given problem or proposal. The task of an analyst at this stage of feasibility assessment is to find out the most favourable technical solution that can solve or handle the organisation's business problems/requirements. Students are asked to consider important characteristics of an information system such as applicability, affordability, usability, maintainability and scalability to name but only a few. At this stage students are taught and assessed on how to carry out a detail feasibility analysis, including developing criteria with which to assess whether the development of an information system is feasible to an organisation. Tools such as candidate systems matrix and feasibility analysis matrix as shown in [9] are used for this purpose.

When preparing and developing the candidate systems matrix the characteristics of each potential information system are evaluated on the basis of their capability to serve the information requirements of organisations thereby facilitate the achievement of organisational goals. The emphasis at this stage is more on systems requirements rather than information. This is done in order that an appropriate (aligning information systems strategies to business goals) information systems architecture for the hosting organisation can be chosen from among the proposed alternatives.

5.3. Learning Outcome 3 (LO 3)

To achieve LO 3 the students are required to do a detailed analysis of the problems encountered by the hosting organisation. This problems analysis activity involves helping and encouraging students to try to develop problem solving skills such as identifying and analysing problems whether they are real or not. If the problems are real then are they solvable and if they are solvable then can the hosting organisation afford to pay for the development and maintenance of the solution to their problem. After identifying and analysing the problems the next step is to analyse WHAT the proposed system needs to do in order to minimise, if not totally remove, the problems. This activity involves finding out what business events the information system must respond to and what information that is needed to successfully address the business events. The responses are system processes that must occur in response to the business events and the inputs to and outputs from these processes are the data that are needed to generate the required information. In the past data were modelled separately from system processes using entity relationship diagramming technique and nowadays data are modelled together with processes using object oriented analysis technique, to determine the inter-relationship between relevant data items. The focus of this step is on WHAT (business events and systems responds) needs to happen and not HOW things should happen.

Students are required to prepare a requirements statement or requirement specification identifying the inputs, processes and outputs of the system. The hard part of this activity for the students is learning how to use a CASE tool to model requirements. Students are encouraged to use Rational Rose or Systems Architects to logically model system requirements and at this stage many students find using a CASE tool very difficult and complain about the nature and structure of the course.

A clear distinction needs to be made between systems analysis and information systems analysis. Systems analysis refers to the different components of the system that capture and analyse data in order to generate, disseminate and store information that is needed by an organisation to perform its business functions.

5.1. The Assessment

In 2009, students' achievement of the learning outcomes was assessed by giving them a case study of a company that has some business problems caused, to a large extent, by the failure of their existing information systems to provide the much needed information in a timely fashion. For each semester of 2009 a different case study was used. Seventeen students enrolled in semester one and eighteen in semester two. The result shows that students did well in achieving the first two learning outcomes namely, identify the purpose, type and evolution of information systems; and prepare a feasibility report for a business solution as shown in Tables 1 and 2. All participants achieved the assessment of LO 1 for both semesters. Only 11% percent failed to achieve the assessment of LO 2. Alarmingly, Tables 1 and 2 below show that 33.3% percent and 41.2% failed to achieve the assessment of LO 3 (analyse a current information system and prepare design specifications for databases using modelling tools) in semesters one and two of 2009 respectively. Fortunately the overall pass

rates for the course were 79% and 78% for semester one and semester two respectively. This was due to the fact that students did well in the assessment of LO 1 and LO 2 which helped to compensate for the low pass rate in the assessment of learning outcome three.

Table 1: Semester 1, 2009 results

Results for Semester 1, 2009			
Grade	% Achieve LO 1	% Achieve LO 2	% Achieve LO 3
A	22.2	22.2	16.7
B	33.3	38.9	16.7
C	44.5	27.8	23.3
D	-	11.1	33.3

Table 2: Semester 2, 2009 results

Results for Semester 2, 2009			
Grade	% Achieve LO 1	% Achieve LO 2	% Achieve LO 3
A	23.5	17.6	11.8
B	41.2	29.4	-
C	35.8	41.2	47.0
D	-	11.8	41.2

5.2. Course Evaluation

An informal evaluation of the course was conducted at the end of each semester to gauge how the students feel about the course, whether they get what they expected from the course and anything that is needed to improve the course to meet their expectation. Responses from the students reveal that a mismatch occurred between their expectation and that of the course. A large number, 68%, of the respondents believed that the course needs to focus on finding a technical (information systems) solution to business problems but not on analysing the technical (information systems) itself. The participants claimed that a clear distinction should be made to distinguish information systems analysis from systems analysis. In their response students argued that modelling information systems requirements (developing logical models and the subsequent physical models) is a major task of a systems analysis course and students need to focus and devote most of their time and efforts exploring the business needs for an information system or modernising an existing information system to give the hosting organisation an edge over their competitors. Students further argued that failure to consider business goals and strategies thoroughly and satisfactorily, any IS development initiative will be suspected as a waste of valuable resources. Furthermore, failure to establish a strong link between IS/IT strategies and business goals and objectives will cause the executive suite of the hosting organisation to doubt that proposed IS solution would supports and contributes to the achievement of the goals and this may lead to the "lack of executive support" phenomena that top the ten main reasons found by the Standish Group in their 2004 version of their Chaos Report series that causes information systems development failure.

In their response, students claimed that they spent a large amount of time learning only one of the CASE tools recommended and available in the computer labs for them to use to complete only less than 30% of the contents of the course (logical modelling and design specifications). They stated that they prefer to learn more about analysing how the business of an organisation may be functionally decomposed or separated into manageable units in order that they may be able to determine the informational requirements for each functional arm and the most suitable application portfolio to support the operation and activities of each department of the organisation.

In contrast, few industry experts when asked to comment on students feedback have stated that students should be informed, when they enrol, that if they prefer to focus and concentrate their efforts on studying and analysing the most optimal way in which an organisation may be divided into in order to better serve the reason for existence of the organisation then a business systems analysis course can be a better option. Furthermore, these industry experts say that the information systems analysis course needs to concentrate more on modelling information systems solutions to business requirements rather than vice versa although the two complement each other. The students should be able to model systems processes in response to business events instead of spending time trying to find out who is responsible for performing what business events and with what resources.

CONCLUSION

The author uses, in this paper, the objective notion of the word information and tries to find a common thread to align what students of information systems analysis courses needs to learn in response to industry requirements. Assessments of students' achievements of the prescribed three learning outcomes of the course were analysed in order to find out why participants did well in the analysis of business requirements for an integrated information system and not on analysing systems requirements.

The investigation reveals that a clear distinction needs to be made between information systems analysis and the analysis of information systems needs of an organisation. The former needs to focus on gathering, analysing and modelling of informational requirements and the subsequent systems architecture and infrastructure and the latter needs to focus on analysing the business in relation to the industry in which it participates, the competitors and how information systems may be used as leverage and give the hosting organisation an edge over its competitors. The author argues that emerging technologies should be seriously considered in developing information systems for business to make sure that companies invested their money in something that will ease off the pressures on core business activities. Accordingly, students' needs to be generalists when looking for solutions but they also must be specialists when analysing the most favourable solution to business problems.

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