

ON THE DESIGN OF A HEALTHCARE INFORMATION SYSTEMS CONCENTRATION

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Abstract: Information Systems as a field of academic study has witnessed tremendous growth both in scope and depth since its beginning in 1960s. With rapid growth of Information Technology in the field of healthcare, there is a need growing worldwide for IT personnel specializing in healthcare area as well. Market surveys involving the stakeholders at the regional level indicate the need for a bachelor's degree in computing and information systems with concentration in healthcare. This paper proposes a curriculum for such a study as an addition to the existing accredited portfolio of BSc. in Computer Information Systems (CIS) program being offered at the university level. Efforts have been made that the proposed HCIS curriculum conforms both to the standards laid out by the accrediting agency and the University mission. The focus of this report is to inform others of local efforts needed on their campuses and to share findings that may be of use to researchers in similar situations.

1 INTRODUCTION

Health information technology has the potential to transform health care delivery, bringing information where it is needed and refocusing health care around the consumer (Tommy and David, 2004). Rapid growth of information technology and its widespread adoption for the healthcare delivery are the indicators of the growing demand for the IT personnel in healthcare organizations. As observed by Richard (2003), healthcare workers with IT knowledge are in great demand. The knowledge and skill shortfalls with healthcare managers in this discipline, however, undermine their strategic and tactical planning responsibilities. Healthcare information management systems practitioners all over the world are keenly aware of this shortage with IT personnel. According to Wilkins, Cheryl and Marilyn (2002), IS jobs are becoming diversified and that generic IS curriculum will not meet all the needs for all IS jobs. According to them, the curricula can be developed for separate and distinctive concentrations targeting the diverse job market requirements. It is the responsibility of educators to offer programs to meet the future healthcare information systems (HCIS) professionals' demand. It thus becomes imperative

to re-evaluate the situation and design the programs as should meet such market demand.

The College of Information Technology (CIT) offers a BSc. in CIS. This program is accredited by Computing Accreditation Committee (CAC) of ABET. Courses in the existing program curriculum meet the ABET standards. CIT has a proposal to offer the same program with six concentrations including the one with concentration in HCIS. The instant paper is the result of efforts at developing a concentration in HCIS.

With a view to assess the feasibility for the proposed HCIS concentration at the undergraduate level, the following questions have been consideration as the touchstone.

- A. Is there is any requirement for this concentration at the regional and the national level?
- B. Is this concentration should serve the purpose of the beneficiary institutions?
- C. Is this course would invite sufficient numbers of prospective students to take up the course?
- D. Is the institution ready with the faculty and other support services needed for implementation of the concentration?

Last two questions are beyond the scope of this research work and hence not dealt with. As for the first two questions, measures were taken to study the market needs and the results are detailed out below.

2 MARKET FEASIBILITY

According to a recent Gulf News (2008) report, UAE’s healthcare sector is showing robust growth and is poised to attract foreign direct investment in sufficient measure in the near future. There are around 36 hospitals in UAE. The Chamber has established Dubai Healthcare City (DHCC), an ongoing project worth \$3 billion, as well as the \$400 million Dubai Biotechnology and Research Park (DuBiotech). DHCC has the distinction to be the world’s first healthcare free zone. It is one of the numerous specialized 'City-within-a-City' in Dubai targeting phenomenal growth in healthcare and pharmaceutical industries. The project comprises of a collection of medical teaching institutions, private hospitals and clinics, pharmaceutical research centers, their offices, spas and rehabilitation centers. Overall, there are 17 hospitals planned for DHCC. These are currently partially functional and expected to be fully operational by 2010. The initiative for establishing DHCC and DuBiotech aligned with global positive healthcare prospects will increase investment in the sector indicating high employment potential for the work force specialized in this sector.

With a view to further substantiate the requirement need; a market feasibility study at the level of all the stakeholders was organized. There were two surveys undertaken inside and outside the University as follows:-

First survey was conducted within CIT to study the need for the six concentrations, including the proposed concentration in HCIS. This survey was done with existing senior and graduating students at the college, university faculty, university alumni, and employers. The survey showed 72.7% demand from the faculty, 24.1% demand from the students currently on roll; 33.3 % from the alumni and 12.5% demand from the employers. Figure 1 here is a graphic presentation of the demand for HCIS concentration.

Second survey was conducted to study the need for the HCIS concentration specifically. Survey data was collected from two premier hospitals located in Dubai.

The survey questionnaire consisted of five parts

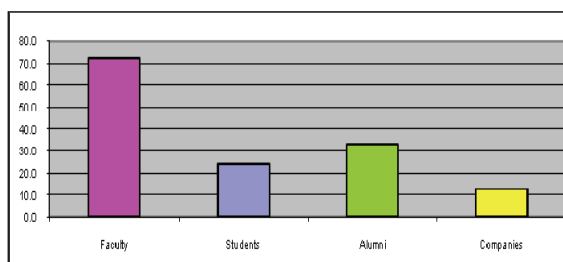


Figure 1: Chart Showing the Demand for New Concentrations in HCIS.

and responses were ranked on 1-5 scale. Response key 1 represented “Strongly disagree” performance, key 2 represented “Disagree”, key 3 denoted “Don’t know” key 4 represented “Agree” and the key 5 stood for “Strongly Agree”.

The survey received feedback from 39 employees from the Rashid Hospital and 60 employees from Al Baraha Hospital. The respondents were the doctors, head of departments, nurses, radiographers, pharmacists, hospital administration staff, executive assistants & etc. There were 66 female and 30 male respondents (three participants did not specify their gender). On the nationality count, 65% respondents were UAE nationals followed by 35% people from other nationalities.

The feedback and summary of the ratings from the employers are shown in Figure 2 hereunder.

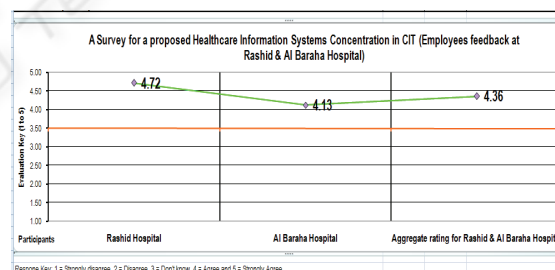


Figure 2: Summary of Employer’s Ratings.

2.1 Analysis

- The overall growth pattern in UAE and initiatives at establishing DHCC and DuBiotech highly indicate the need for services of HCIS professionals here.
- First survey results point to the fact that the
- faculty needs such a concentration most and the least was felt by the organizations, mostly not the healthcare organizations. However, the second survey carried out among the healthcare organizations resulted in an encouraging average of

Table 1: Mapping of HCIS concentration objectives to HCIS outcomes.

HCIS Concentration Outcomes	HCIS Concentration Objectives						
	1	2	3	4	5	6	7
1. Apply knowledge of computing, information systems and mathematics.			X	X			
2. Analyze a healthcare IS- related problem, identify and define the computing and information systems requirements appropriate to its solution	X	X	X	X			
3. Design, implement and evaluate a computer-based system, process, component, or program to meet desired needs.			X	X	X	X	
4. Function effectively in teams to create a project plan to accomplish a common goal.						X	X
5. Understand professional, ethical and social responsibilities.		X			X	X	
6. Communicate effectively with a range of audiences.				X		X	X
7. Analyze the impact of computing on individuals, organizations and society, including ethical, legal, security and global policy issues		X			X	X	
8. Apply current techniques, skills, and tools to enhance the operational and managerial aspects of healthcare organizations			X				
9. Understand the organizational, administrative, managerial, and regulatory processes that support the delivery and management of evolving health systems	X		X				

4.72 on a scale of 1-5 from the Rashid hospital, 4.13 on this scale from the Al-Baraha hospital that gives an aggregate rating of 4.36 from the two hospitals. The results of the surveys strongly recommend the need for graduates with specialization in healthcare information systems.

- The fact that no university in UAE is offering such a specialization reaffirmed the need for offering such a concentration hereafter.
- International recognition of the program, academic and professionally qualified faculty, University association with Dubai Chamber and the University’s focus on learning and applied IT research are the factors that will promote the students to enroll themselves for the HCIS concentration program.

3 CURRICULUM VS STANDARDS

Developing and revitalizing the IS curricula is an evolutionary process because of the exponential development of technology (Hunt, 2004) and (Tracie & Rebecca, 2008). Several available curriculum models provide guidelines for adoption and further shaping the curriculum for undergraduate programs. Recent public draft of IS 2009 and its predecessors IT 2008, OEIS (Organizational End-User Information Systems) and MTC (Managerial, Technical & Communication) models are there to name a few. Accreditor’s guidelines are equally important for developing and analyzing the curricula.

Concentration in HCIS comes under the umbrella of the CIT’s CIS program. Efforts were made to ensure that the HCIS concentration is in agreement with the ABET standards. ABET has five statements about objectives and assessment (Criteria for Accrediting Computing Programs, 2007). First two standards related to the objectives are:

Standard I-1. The program must have documented educational objectives.

Standard I-2. The program’s objectives must include expected outcomes for graduating students.

The objectives and outcomes of the CIS program strongly conform to the University mission. An important design aspect of the HCIS concentration was the need for a HCIS curriculum that would relate to the objectives and outcomes of the CIS program. Objectives and outcomes of the BSc. CIS with concentration in HCIS are defined below.

3.1 Program Objectives (with Concentration in HCIS)

The CIS program with concentration in HCIS is designed to prepare graduates who are able to:

1. Demonstrate knowledge of concepts and practices of healthcare systems and the processes required to support health service delivery.
2. Understand and analyze the important issues with regard to the social impact of advanced and emerging computer information technologies
3. Apply a variety of techniques, software tools and applications to enhance the effectiveness and efficiency of health care organizations.
4. Formulate questions and critically investigate and solve business-related computing &

- information systems problems
5. Be engaged in ethical issues in information systems, particularly questions of social responsibility and professional decision-making
 6. Build and lead team of professionals to tackle challenging Computing & Information Systems Projects
 7. Communicate effectively and professionally with technical and non-technical professionals.

3.2 Program Outcomes (with Concentration in HCIS)

Upon graduation, each CIS graduate with concentration in HCIS will possess the knowledge, skills, and ability to:

1. Apply knowledge of computing, information systems and mathematics.
2. Analyze a healthcare IS-related problem, identify and define the computing and information systems requirements appropriate to its solution.
3. Design, implement and evaluate a computer-based system, process, component, or program to meet desired needs.
4. Function effectively in teams to create a project plan to accomplish a common goal.
5. Understand professional, ethical and social responsibilities.
6. Communicate effectively with a range of audiences.
7. Analyze the impact of computing on individuals, organizations and society, including ethical, legal, security and global policy issues.
8. Apply current techniques, skills, and tools to enhance the operational and managerial aspects of healthcare organizations.
9. Understand the organizational, administrative, managerial, and regulatory processes that support the delivery and management of evolving health systems

The mapping between the HCIS concentration outcomes and the corresponding HCIS concentration objectives is highlighted in Table 1 on next page. These healthcare concentration objectives and outcomes map directly to the CIS program objectives and outcomes and are thus aligned with the University mission to prepare high caliber graduates of lifelong learning and serve the educational and professional needs of all stakeholders.

4 CONCENTRATION COURSE DESIGN PHILOSOPHY

A review of the ABET standards show that students must have at least 30 semester hours of study in information systems topics, at least 15 semester hours of study in an information systems environment, such as business, at least 9 semester hours of study in quantitative analysis, and at least 30 semester hours of study in general education. The information systems area is further broken into core content and advanced content. According to ABET Standard IV-9 (Criteria for Accrediting Computing Programs, 2007) all students must take at least 12 credit hours of advanced course work in information systems that provides breadth and builds on the IS core to provide depth.

BSc. CIS degree consists of 41 courses, an internship and an applied research project. Each course is worth three credits. Students must complete 129 credit hours to be awarded a BSc. degree. CIT requires the same 129 credit hours for the degree of BSc. with concentration in HCIS as shown in Table 2. However, the curriculum for BSC-CIS with concentration in HCIS has been customized to include 15 credit hours for HCIS concentration requirements comprising of five courses.

Table 2: Curriculum for BSc. CIS – Concentration HCIS.

SN o	CATEGORY REQUIREMENTS	General Requirement	I T	Total
1	General Education	27		27
2	Humanities & Social Sciences	6		6
3	Natural & Applied Sciences	6		6
4	Business Requirements for IT professionals	33		33
5	IT Core Requirements		4 2	42
6	HCIS Concentration Requirements		1 5	15
	TOTAL	72	5 7	129

4.1 Design Criteria

According to Srinivasan, Guan and Wright (1999) & Charles and Terri (2002), a strong partnership between IS academics and industry is vital for the curriculum development. There is a growing demand for clearer, higher, and measurable educational outcomes as well as increased industry input into the development of the standards (Grubb and Lazerson, 2004).

Essential characteristic for graduates seeking employment is not the knowledge alone but also their proficiency in technical and non-technical skills (Karoly and Panis, 2004),(Charles and Terri, 2002), (Judy and D'Amico, 1998), (Smith, Hunt, Berry, and Hunt, 2005), (Lee, Trauth, and Farwell, 1995), (Judith, Eric, Gary and Laura,2008), (Karoly and Panis, 2004), (Gandossy, Tucker and Verna,2006), (Karoly and Panis, 2004) & (Judy and D'Amico, 1998).

Addressing the local employment needs is not the only objective for the Bsc. HCIS-Concentration. Students from IS program should be able to accept jobs in widely dispersed geographic areas. Therefore, it is necessary to maintain programs that are consistent both with regional and national level employment job market and with the common body of knowledge of the IS field (IS, 2002).

Relevant and suitable HCIS-Concentration specific courses and their learning outcomes have been designed carefully based on following criteria:-

1. The need to equip the students with the HCIS knowledge and skills.
2. The appropriateness of the support (pre-requisite) courses provided by the existing CIS program.

4.2 List of Newly Introduced Courses

HCIS specialization courses introduced in the curriculum are listed in Table 3 below.

Table 3: HCIS Specialization Requirements.

Specialization Requirements (15 Cr. Hrs)		
Course Code	Course title	Course pre-requisite
ITHS 450	Healthcare Information Systems Management	ITGN 215: Introduction to Information Systems
ITHS 451	Healthcare Computer-based risk	ITGN 315: Object-Oriented Programming
ITHS 453	Healthcare Process Improvements	ITGN 220: Software Project Management BBUS 200: Quantitative Methods for Business
ITHS 464	Electronic /Mobile – Healthcare Systems	ITGN 350: Web Design & Development
ITIS 465	Database Security and Audit	ITGN 250: Database Management Systems ITGN 345: Information Systems Security

Each course in the HCIS curriculum is outcome focused and detailed. All the outcomes are mapped to the assessment tools and HCIS concentration outcome. Finally each syllabus shows (also shown in the Table 4) the course mapping to the program-level outcomes.

Table 4: Mapping CIS-HCIS Curriculum to Program Outcomes.

Specialization Requirements (15 Cr. Hrs.)			Program Outcomes (PO)									
			1	2	3	4	5	6	7	8	9	
1	ITHS 450	Healthcare Information Systems Management								X		X
2	ITHS 451	Healthcare Computer-based Risk		X	X		X			X	X	X
3	ITHS 453	Healthcare Process Improvement	X	X	X						X	
4	ITHS 464	E/M-Healthcare Systems		X						X	X	X
5	ITIS 456	Database Security & Auditing		X		X					X	X

4.3 Course Design Considerations

The following section outlines the design criteria that have been adopted in the selection of the HCIS concentration-specific courses and their learning outcomes.

ITHS 450: Healthcare Information Systems Management

This course will provide students with the ability to define operational and strategic objectives for health services management information systems. Particular emphasis will be placed upon the technical knowledge area and the proper interpretation and utilization of processed information for program management purposes. Students will get hands-on knowledge of software tools and applications. Addressing investment decisions will be a part of this course. By addressing the additional social, legal, and ethical issues related to IS usage and their practical implications from a healthcare perspective (**Criteria 1**). A student with a basic understanding of information systems concepts will be able to take-up this course. Therefore, the course “Introduction to Information Systems” has been chosen as the pre-requisite to this course, in accordance to **criteria 2**.

ITHS 451: Healthcare Computer-based Risk

This course provides an overview of the theory and applications of risk management practices within healthcare organizations and aims to develop students’ ability to manage risk associated with potential system failures. It explains what needs to be done to successfully achieve quality and compliance of computer systems in the pharmaceutical and healthcare industries. This course will address **criteria 1**. In this course, Java will be used as the implementation language to apply

various risk management and validation techniques within healthcare applications. Hence, the course “object-oriented programming” has been selected as the pre-requisite course (**criteria 2**).

ITHS 453: Healthcare Process Improvements

This course exposes students to the programs, techniques, and tools for process improvements in healthcare settings. Students will learn quality and performance improvement tools and techniques and apply them to improve various healthcare processes like patient flow, patient scheduling, inventory tracking etc. Students will use several software tools. This course will address the concepts and applications of IT knowledge area in HCIS (**criteria 1**). With the push towards decentralizing the IT decision-making process, it is imperative that healthcare administrators become adept at managing IT projects. Students will be gaining this knowledge/skill through the pre-requisite courses ITGN 220- Software project management **criteria 2**.

BBUS 200-Quantitative Methods for Business has also been selected as the pre-requisite for this course, as it equips students with the required background in Linear programming and decision analysis.

ITHS 464: Electronic / Mobile Healthcare Systems

The purpose of including this course in the concentration is to make students aware of the recent trends in electronic and mobile healthcare. It will also expose students to the application of these technologies to add value to a health-care organization. Students will learn the best approaches used in developing the internet strategies, in dealing with transition from traditional care to e-healthcare and the legal pitfalls of these applications. In addition, as part of the course work, students will work on a project to develop an on-line health application (**criteria 1**). Hence, ITGN 350 - Web Design & Development has been selected as the pre-requisite to this course (**criteria 2**).

ITIS 465: Database Security and Audit

The ability to structure, access, manage and leverage patient records and associated data is becoming more and more critical to any healthcare organizations, large or small, public or private. Central to supporting this ability, and at the core of every healthcare information system, is the database. Security has always been a problem when implementing medical information systems, where data represent in many cases a valuable and sensitive

asset. The fundamentals of database technology have been adequately addressed in ITGN 250 - Database Management Systems course. Hence, security of the database is the priority and the focus of this course.

5 CONCLUSIONS

Feasibility of adding a concentration in HCIS to the existing CIS program was studied. Curriculum was designed to be in alignment with the University mission and the accrediting agency standards. HCIS-Concentration courses were designed to meet the objectives and the outcomes of the concentration. While conforming to the mentioned design criteria, these courses have been designed to address the market need by preparing IT professionals with the knowledge and skills necessary to fill entry level HCIS management, analytical, technical and administrative roles.

Each specialization course syllabus in the proposed concentration is a descriptive document having specific learning objectives and outcomes. These outcomes become the basis for assessment of students learning. In particular, each course syllabus includes:

1. Course objectives linked to measurable learning outcomes.
2. Course learning outcomes that are measurable and that cover the appropriate spectrum of Bloom's cognitive domains with focus on "higher-order thinking skills" as student's progress in their studies.

Besides following the ABET standards, CIT solicited inputs from the various stakeholders including the faculty, Academic Advisory Council, Business Advisory Council, alumni, and currently enrolled CIT students. Some renowned international schools offering similar concentrations were also studied as input reference for the course designs.

This work can be useful to other institutions offering similar concentrations.

Survey results by Charles and Terri (2002) suggest that the geographic location of the survey sample seems to play a part in the perception of desirable skills. Hence, an important area of improvement is to modify the survey questionnaire to gather information about the knowledge and the skill areas that the prospective employers are looking for. That will help in improving the curriculum based on the market requirements.

The proposed curriculum focuses mainly on the hospital information systems. Current trends focusing on the home care technologies, elderly care

and telemedicine needs to be addressed adequately.

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