Development of IS Teaching in North-America

Schauer, Carola; Schmeing, Tobias

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Carola Schauer
Tobias Schmeing

Development of IS Teaching in North-America

17

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An Analysis of Model Curricula

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Authors' Address:

Carola Schauer
Tobias Schmeing

Institut für Informatik und
Wirtschaftsinformatik (ICB)
Universität Duisburg-Essen
Universitätsstr. 9
D-45117 Essen
Germany

carola.schauer@uni-due.de
tobias.schmeing@stud.uni-due.de

Managing Assistant and Contact:

Jürgen Jung

Institut für Informatik und
Wirtschaftsinformatik (ICB)
Universität Duisburg-Essen
Universitätsstr. 9
45141 Essen
Germany

Email: icb@uni-duisburg-essen.de

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Abstract

This research report is part of a series of papers on the development and status of the Information Systems (IS) discipline in North-America and Wirtschaftsinformatik (WI) its counterpart in the German speaking countries (Germany, Austria, Switzerland). The corresponding research project (IF-WIS) aims at comparing both disciplines. It is funded by the German Research Foundation (DFG).

In this report we aim at reconstructing the development of teaching programs in IS at North-American universities. To this end official model curricula for undergraduate and graduate IS programs since the 1970s until today serve as primary source for relevant prescriptive as well as descriptive information. Our analysis results indicate that the IS discipline has undergone considerable changes in terms of (recommended) teaching contents and structures, the role of practice experience in teaching, and the variety of recommended future job positions. An additional literature analysis focuses on the actual adoption of model curricula at US universities. Analysis results indicate that IS programs are rather diverse and have very few courses in common – even when focusing on "IS core" courses.

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1 Introduction

This research report is part of a series of papers on the development and status of the Information Systems (IS) discipline in North-America and of Wirtschaftsinformatik (WI) its counterpart in the German speaking countries (Germany, Austria, Switzerland). The corresponding research project (IFWIS) aims at comparing both disciplines. It is funded by the German Research Foundation (DFG). Prior results of the IFWIS project show remarkable differences between both disciplines in terms of typically targeted research objectives and research methods applied, despite information systems in organizational or business contexts as common subject of research (see [Lang03], [Fran06]).

The profile and status of an academic discipline is characterized not only by its research programs and results but also by its teaching programs. Thus, in this report we focus on degree programs in IS: We aim at reconstructing the development of IS teaching programs since the 1970s until today. To this end, we analyze official model curricula, which represent one perspective on the development of teaching contents and course structures in an academic field over time. While model curricula in general and in IS in particular may not provide an exact picture of actual IS teaching programs, we assume that they, nevertheless, do provide valuable insights on IS teaching as viewed and recommended by the respective associations and researchers involved. Other studies of the IFWIS project address further aspects of IS/WI teaching: An analysis of introductory textbooks for IS and WI investigates terminology, topics, and didactic frameworks (see [FrLa04] and [ScSt07], respectively). The development of teaching (as well as research) in WI as documented in publications and curricula recommendations is subject of focus of a separate research report [Scha07a].

Since the early 1970s a number of model curricula have been published providing various recommendations on IS teaching, including entry level requirements, course contents and relationships, job descriptions, and – in some cases – teaching methods. We do not intend to reproduce the vast amount of information provided in the model curricula in every detail, but we focus on selected aspects of interest, which are derived from the general subject of research and public debates in the IS discipline. Note, that the selected curricula cover a period of 35 years. Hence, the terminology used and recommendations specified must be interpreted in the respective historical context. For example, it is rather likely that the terms used to denote future job positions of IS graduates in the 1970s differ from the terminology used in the most recent model curricula.

Our analysis is intended to focus on university study programs in North-America; against this background seven relevant model curricula are selected for further analysis (section 2). In order to underline the importance of model curricula as normative views on IS teaching, section 2 also includes an overview of organizational participants in the various model curricula development processes and describes typical publication outlets where IS teaching issues are addressed. Section 3 provides a concise summary of the various types of contents included in the selected model curricula. The detailed analysis of the model curricula is presented in section 4; the discussion covers selected descriptive curricula contents (statements related to the job market for IS graduates) and prescriptive contents (recommendations). In order to complement the reconstructions IS teaching the analysis presented in section 5 focuses on the actual adoption of IS model curricula and, thus, provides a descriptive perspective on IS teaching. A discussion presenting conclusions and issues for future work finalizes this research report (section 0).

Note, with this report the authors, who belong to the German Wirtschaftsinformatik community, take on an outsider's perspective. Hence, the analysis can – necessarily – only take into account the aspects and "facts" concerning IS teaching as documented in the selected model curricula and other referenced publications. We welcome any suggestions to correct or complement the reconstruction of IS teaching in North-America as developed in this research report.

2 Model Curricula Development Process

Before we select relevant model curricula for our analysis, two remarks are needed in order to clarify the scope of this paper: (1) In this report, we focus on model curricula and will refer to accreditation[1] initiatives only if the issue of accreditation is mentioned in a model curriculum. (2) Concerning the relevant model curricula, the scope of our work lies on the 2-year /4-year undergraduate and graduate (M)IS study programs. Additionally, since we focus on the North-American IS discipline, we restrict our discussions to curricula developed within North-American initiatives.

Over time IS model curricula have been developed and published by different organizations. Two organizations, whose curricula have had strong influence in North-America, are the Data Processing Management Association (DPMA) and the Association for Computing Machinery (ACM).[2] Like the Information Systems curricula of the ACM, the curricula models of the Data Processing Management Association (DPMA) have been adopted completely or partly by a number of institutions (see section 5).

The process of model curricula development differs significantly for the ACM and the DPMA curricula. The DPMA model curricula are mainly based on practitioner input and targeted at preparing students for "practical preparation for entry into programmer or analyst jobs with some support for future advancement" ([Davi87] p. 138). Thus, they follow the objective of vocational training rather than academic long-term education. We, however, prefer an academic perspective; thus, we will not include detailed discussions on DPMA curricula but will take a closer look at the ACM model curricula. A list of all relevant model curricula analyzed in this report is given in Table 1. The following subsections provide a brief overview of the associations involved (section 2.1) and the diverse publication channels and conventions that foster discussion on IS teaching issues and curricula initiatives (section 2.2).

Year	Level	Organization(s)	Main author/editor	Source	Length
1972	Graduate	ACM	Ashenhurst, R. L.	[Ashe72]	36 p.
1973	Undergraduate	ACM	Couger, J.	[Coug73]	23 p.
1982	Graduate/ Undergraduate	ACM	Nunamaker, J. F.; Couger, J. D.; Davis, G. B.	[NCD82]	25 p.
1997	Undergraduate	ACM, AIS, AITP	Davis, G. B.; Gorgone, J. T.; Couger, J. D.; Feinstein, D. L.; Longenecker, H. E.	[DGC+97]	104 p.
2000	Graduate	ACM, AIS	Gorgone, J.; Gray, P.	[GoGr00]	61 p.
2002	Undergraduate	ACM, AIS, AITP	Gorgone, J.; Davis, G. B; Valacich, J. S.; Topi, H.; Feinstein, D. L.; Longenecker, H. E.	[GDV+03]	63 p.
2006	Graduate	ACM, AIS, Joint ACM/AIS Task Force	Gorgone, J.T.; Gray, P.; Stohr, E. A.; Valacich, J. S.; Wigand, R.T.	[GGS+06]	57 p.

Table 1: ACM/AIS model curricula for IS degree programs

[1] While accreditation is a process based on self-review and peer assessment for public accountability and continued program quality improvement [ImGo02], model curricula are generally produced by professional societies intended for usage as a starting-point from which individual curricula can be created. See Appendix A for an overview of accreditation agencies relevant for IS.

[2] Other IS model curricula were developed, for example, by the British Computer Society as IFIP/BCS information systems curriculum (see [BHL+87]). As noted above, however, we will restrict our discussions to the North-American initiatives.

2.1 Involved organizations

The Association for Computing Machinery (ACM) has played a major role in organizing the model curricula development, including the first efforts in the 1970s. Since the 1997 model curriculum other organizations, including AIS (Association for Information Systems) and AITP (Association for Information Technology Professionals) have also been involved in the development process. The target groups and purpose of ACM, AITP, and AIS can be characterized as follows:

ACM (Association for Computing Machinery), established in 1947, serves a membership of computing professionals and students in more than 100 countries in all areas of industry, academia, and government. Through its *Education Board* it supports a wide range of curriculum development processes in various IT related areas including computer science, information systems, and software engineering [http://www.acm.org].

AIS (Association for Information Systems), established in 1994, is a professional organization whose purpose is to serve as a global organization for academics specializing in IS. It is composed of faculty members in Information Systems. One explicated goal of AIS is to support the development of information technology education activities [www.aisnet.org/]. Its education-oriented special interest group is the *AIS SIGED: IAIM*, which was formerly the International Academy for Information Management. The objective of *AIS SIGED: IAIM* is to provide a forum in which interdisciplinary researchers and educators in IS can exchange ideas, techniques, and applications [http://www.iaim.org/].

AITP (Association for Information Technology Professionals), established in 1996 and evolved from the DPMA (Data Processing Management Association), is an international organization that focuses on education and professional development of its members [http://www.aitp.org/]. The not-for-profit *Foundation for Information Technology Education* was established in 1975 and serves as the research and development arm of the AITP representing practitioners, educators, and researchers. Its mission is to meet the changing educational requirements of the information profession and industry, and to address the long term educational efforts essential to support industry and AITP members. [http://www.edfoundation.org/]

In addition to these associations several endorsing organizations have continuously supported the development of the curricula since 1997 underlining the general intention of the model curricula to represent the interests and opinions of the IS profession and the academic IS discipline as a whole (see Table 2). Furthermore, the efforts for IS curricula design of the International Federation for Information Processing (IFIP) are mentioned as having had a sustainable influence on the early model curricula ([Ashe72], [Coug73], [NCD82]).

Although the organizations responsible for the curricula discussed in this work are – in part – worldwide organizations, the model curricula are not targeted for every country where IS is taught. Rather, the recommendations are based on common structures and degree programs in North-America, and are intended to "serve as a useful reference for designers of information systems degree programs inside and outside the USA and Canada" ([GDV+03], p. 4).

The normative weight of the selected model curricula is exemplified by the following statement, which is included in the foreword of the 2002 undergraduate curriculum:

> "This report represents the combined effort of numerous individuals and reflects the interests of thousands of faculty. It is grounded in the expected requirements of industry, represents the views of organizations employing the graduates, and is supported by other interested organizations." ([GDV+03], p. iii)

Organization	1997 (undergrad.)	2000 (grad.)	2002 (undergrad.)	2006 (grad.)
ACM	X	X	X	X
AIS	X	X	X	X
AITP (DPMA)	X	endors.	X	endors.
ACM SIG on Management Information Systems (ACM SIGMIS)	-	-	endors.	endors.
AITP SIG on Education (EDSIG)	-	endors.	endors.	endors.
Decision Sciences Institute (DSI)	endors.	endors.	endors.	endors.
International Academy for Information Management (IAIM)	endors.	endors.	endors.	endors.
International Association for Computer Information Systems (IACIS)	endors.	endors.	endors.	endors.
IEEE Computer Society	-	-	endors.	-
INFORMS Information Systems Society (INFORMS-ISS), formerly: College on Information Systems (INFORMS-CIS)	endors.	endors.	endors.	endors.
Society for Information Management (SIM)	endors.	endors.	endors.	endors.

"X": organization with leading role in the development process; "endors": endorsing organizations

Table 2: Organizations who have participated in model curricula development since 1997

2.2 Publication channels

For a comprehensive view on the efforts to shape and evolve the curricula continuously, it is insightful to have a look at the different publication channels that have been used to present and discuss the ongoing development. Over the last decades the efforts to involve the full IS community have been strengthened: besides personal taskforce meetings and e-meetings accompanying the compilation of the curricula, specific conference take place on a regular basis and journals are published to discuss curricula and other teaching issues; preliminary versions of model curricula and other discussions on teaching issues are published in dedicated journals.

Dedicated journals and conferences on IS education are published or conducted, respectively, by the special interest groups of AITP and AIS:

- Information Systems Educational Conference (ISECON) (http://isecon.org/) annually conducted by AITP-EDSIG,
- Information Systems Education Journal (http://isedj.org/) published by AITP-EDSIG,
- Journal of Information Systems Education (http://www.jise.appstate.edu/) supported by AITP-EDSIG,
- International Conference on Informatics Education Research (ICIER) (http://iaim.aisnet.org/) annually conducted by AIS SIGED: IAIM.

Additionally, education and curricula related tracks are usually integrated at the annual IS conferences (AMCIS, ICIS, HICSS) and have been regularly published in the electronic journal Communications of the AIS (CAIS). Other occasions to debate model curricular issues include meetings of the Decision Sciences Institute (DSI) of the International Association of Computer Investigative Specialists (IACIS), the ACM Special Interest Group on Computer Science Education (SIGCSE), and the of the Society for Information Management (SIM) (see e.g. [DGC+97] pp. 36 ff. and [GGS+06] pp. 54 ff.).

3 Overview of Issues addressed in Model Curricula

IS model curricula typically do not only provide guidelines on courses and topics to be covered, but – in some cases – also related information on the academic IS discipline, on prospective job positions, or the status of the IS profession. Table 3 provides a differentiated overview of the contents of each model curriculum selected for this analysis: Only the two most recent bachelor model curricula explicitly discuss the characteristics of IS as an academic discipline. However, all but these two model curricula include information about prospective job positions and the IS profession.

	[Ashe72]	**[Coug73]**	**[NCD82]**	**[DGC+97]**	**[GoGr00]**	**[GDV+03]**	**[GGS+06]**
Degree level	master	bachelor	master / bachelor	bachelor	master	bachelor	master
Related context information:							
IS as academic discipline	-	-	-	X	-	X	-
Job descriptions / career paths / IS profession	X	X	X	-	X	-	X
Guidelines on courses and topics							
Mapping to prior model curricula	n.a.	-	-	-	-	X	X
Input characteristics (prerequisites)	X	X	X	X	X	X	X
Output characteristics (learning objectives)	X	X	X	X	(X)	X	X
Course specifications	X	X	X	X	X	X	X
Course bibliographies	X	-	X	-	-		X
Course relationships	X	X	X	X	(X)	X	X
Program schedules (semester hours)	X	X	X	X	X	-	X
Required Resources	-	-	X	X	-	X	X
Shared courses / contents with other disciplines	-	-	-	X	-	X	-
Additional teaching guidelines (teaching methods)	X	X	-	(X)	X	(X)	-
Suggested institutional integration, coordination	X	X	-	-	-	-	-

Table 3: Overview of issues addressed in model curricula

All model curricula include prerequisites, learning objectives, course specifications, as well as information on the relationships between courses. Additionally, all – but the latest bachelor model curriculum – provide specific information on the suggested semester hours per course and a program schedule. The two most recent model curricula include an explicit mapping of courses to prior model curricula. Resources necessary for establishing a viable IS program are discussed in various model curricula, including the most recent. Guidelines on teaching methods and course bibliographies are included in the first model curricula and to a limited extend in the more recent model curricula. The institutional integration of IS study programs is discussed only in the first model curricula from 1972 and 1973.

4 Analysis of Model Curricula

Every profession or academic field depends on student demand for their study program. Students, however, usually select a field of study if they perceive a certain demand from industry in the respective profession. Thus, the job market is very likely to have a considerable influence on the development of degree programs in an academic field. Thus, we start our analysis with investigating the development of IS teaching over time by analyzing indicators on the *job market for IS graduates* as documented in the model curricula (section 4.1).

A young and emerging academic discipline is likely not – yet – to provide a coherent set or picture of job positions for its future graduates. However, in general, we can assume, that a set of typical and well-known job title for prospective graduates is established when the field matures. In the second part of our analysis we evaluate the development of *prospective job positions* for IS graduates as recommended in the model curricula (section 4.2).

Analogous to the expected consolidation of prospective job positions, it seems reasonable to assume that a maturing discipline develops a more and more coherent set of teaching contents and courses, particularly representing the discipline's specific knowledge areas. Thus, the third part of the analysis investigates the developments in *course structure* over time. Since information technology and information systems application opportunities have gone through a rapid development during the last 60 years it is rather likely that IS teaching contents as well have not developed predictably and straightforward throughout the past 40 years. Thus, we take a particular look at the issue of (dis-)continuity of course contents and curricula structures over time. Additionally, we want to analyze the denomination of IS specific topical or knowledge areas (section 4.3).

Confronting students with real world situations and providing them with practical experience in solving real world problems is generally important for all applied fields and professions. This however, comes along with the challenge to incorporate and balance educational requirements from academia and practice. Hence, in the last part of our analysis we want to investigate the *role of practice experience* in the model curricula. Specifically we discuss the instruments that are suggested to support practice alignment of the study program and students' experience in real world problem solutions (see section 4.4).

4.1 Job market for IS graduates

The recent – quite anxious – discussions by IS faculty on the negative effects of IT offshoring on the IS job market ([DMB05], [HLN+05], [GVV05]) suggest that job markets have a crucial influence on IS teaching programs. Hence, we being our analysis by investigating the model curricula with respect to statements made concerning industry demand for IS graduates over time.

Graduate curriculum 1972 [Ashe72]

Ashenhurst motivates the development of the first model curriculum for IS as follows:

> "Many individuals currently being hired for entry level positions [...] have an educational background inadequately suited to the job requirements." ([Ashe72], p. 369).

While he does provide an overview on his perception of job positions in industry, such as programmer, systems analyst, project leader, system design, and consultant, he does not comment on the general job market situation more specifically.

Undergraduate curriculum 1973 [Coug73]

In the 1973 model curriculum the need for more IS programs is justified with reference to a forecasted significant increase in job positions. The presented table about growth in selected occupations indicates that, compared to physicians, engineers or accountants, the number of IS graduates needed each year is "approximately the same" ([Coug73], p. 729, see Figure 1); where the occupations "Programmers" and "Systems Analysis" are counted as IS occupations. Couger's conclusion that "many more graduates with BS degrees will be needed than graduates with MS degrees" ([Coug73], p. 729), however, cannot be derived from the data provided.

Occupational group	1968 Employment	Percent Growth Forecast 1970–1980	Net increase in occupation	Average annual openings not including transfers
All occupational groups	75,920,000	25.3	19,100,000	
All professional and technical	10,325,000	50.1	5,175,000	
Programmers	175,000	129	200,000	23,000
Engineers	1,100,000	40.2	400,000	73,400
Accountants	500,000	43.4	220,000	33,200
Systems Analysis	150,000	183	275,000	27,000
Physicians	295,000	53.1	155,000	20,000

Figure 1: Growth in selected occupations 1968-1980 ([Coug73] p. 729)

Graduate / undergraduate curriculum 1982 [NCD82]

The authors of the 1982 model curriculum express the need for graduates who can handle not only the complexities of IS design and programming applications, but also the increased complexity of related organizational issues.

Nunamaker et al. also point out that "positions needing heavy organizational skills are being filled with persons having heavy technical but very low organizational training" ([Nuna81], p. 128). It is even stated that "the interest in information systems solutions to business problems is growing at a rapid rate, well exceeding the capabilities of the information systems community to satisfy these demands" ([NCD82], p. 783). This situation is underlined by referring to a study of computer manpower supply and demand in 1979. The study results indicate a ratio of almost five computer science degree programs for every information systems/data processing degree program.

Undergraduate curriculum 1997 [DGC+97]

In the 1997 model curriculum it is emphasized that the future job expectations for graduates are very attractive. Based on the U.S. Bureau of Labor Statistics the authors report that the predicted increase in demand for system analysts is 110 percent for the period 1992-2005, averaging over 8 percent annually; of all occupations analyzed, the systems analyst position is projected to have

one of the highest demands. However, the authors also state that "some IS academic departments have been under downsizing pressure from other academic disciplines in their own institutions, citing a decline in employment in central IS organizations" ([DGC+97], p. v).

Graduate curriculum 2000 [GoGr00]

The 2000 graduate model curriculum emphasizes the general high demand for MSIS graduates and reports that "students find highly remunerative jobs upon graduation from the MS programs" ([GoGr00], p. 3). The authors of the model curriculum note, however, that there is a supply shortage of skilled IS personnel and there is a lack of "talented people with advanced knowledge in managing information systems" ([GoGr00], p. 3). Furthermore, it is argued that the differences in terms of entrance-requirements and teaching contents across the U.S. lead to uncertainty of employing organizations about the actual qualification of master-level IS graduates. Thus, the objective of the 2000 graduate curriculum is to offer a standard that helps IS professionals and managers to understand the qualifications and skills they could expect from new graduates by specifying a common minimum body of knowledge that all MSIS graduates should know.

Undergraduate curriculum 2002 [GDV+03]

The 2002 undergraduate curriculum does not contain information regarding the demand for graduates, except a general statement pointing out an increase in demand: "It [i. e. the model curriculum] responds to industry requests for both increased emphasis in technical orientation and improved skill in individual and group interactions" ([GDV+03], p. vi).

Graduate curriculum 2006 [GGS+06]

The statements related to the job market in the latest model curriculum reflect a rather pessimistic attitude. The authors do not speak of a general high demand, but cautiously remark that there is a "strong, increasing demand for university-trained graduates who can meet the changing needs of the information economy" ([GGS+06], p. 4).

They provide an outlook of future career paths for IS graduates by referring to a study sponsored by the Society for Information Management in 2005 [Whit05]. The study is based on interviews with 95 executives within 82 business organizations conducted by a team of senior faculty. The study results relate specifically to the question of outsourcing of the IT function and IT services:

> "[…] understanding business domains, functional area industry knowledge, and client-facing skills will be more critical for in-house IT personnel in the years ahead whereas programming, operations, and help-desk skill requirements will decline in demand. Project planning, budgeting, and scheduling are important skills in the near term as are knowledge of ERP, integration, wireless, and security. MS students with work or internship experience are expected to have a competitive advantage in the job market" ([GGS+06], p. 12, see also [Whit05]).

Furthermore, the authors emphasize that it is important for students to concentrate in their IS studies on "a specific area for which there is demand and to achieve breadth across a topic area", ([GGS+06], p. 12). This approach is supported by the instrument of "career tracks" in the curriculum.

Development of job markets over time

Table 4 provides an overview of the statements concerning graduate demand by industry over time. While the very first model curriculum from 1972 speaks only of a general need for graduates in the area of IS, the model curriculum from 1973 emphasizes that there is a particular need for IS graduates and IS programs as indicated by forecasts. Although Nunamaker et al. in 1982 do not

refer to specific forecasts related to IS graduate demand they perceive a high demand for students with IT and organizational skills due to the increased pervasiveness of IT in organizations.

Since 1997 the model curricula include less euphoric statements concerning the demand for IS graduates. In the 1997 undergraduate model curriculum downsizing pressure from other disciplines is mentioned as a problem in some institutions. No empirical studies or forecasts are cited to support the authors' perception that there is a high demand for graduates and that "students find highly remunerative jobs". In 2006 the authors formulate – rather cautiously – that there is (only) high demand for those students who "can meet the changing needs" ([GGS+06], p. 4). A supporting study is referenced that points out that only certain IS skills will be needed in-house in the future.

Curricula	Demand	Basis for demand forecast	Specific situation
1972 (graduate) [Ashe72]	General need	Perception	"educational background inadequately suited to the job requirements"
1973 (undergrad.) [Coug73]	Significant increase in job positions Need for more IS programs	Forecasts showing high increase in job openings for "Programmers" and "Systems Analysis"	-
1982 (grad./undergrad) [NCD82]	High demand for students with IT and organizational skills	Perception; Study: 5 Computer Science programs for every IS program	"increased dispersal and complexity of information systems"
1997 (undergrad.) [DGC+97]	Very attractive expectations	Perception; Study: increase in demand for systems analysts (110 %, 1992-2005)	"some IS academic departments have been under downsizing pressure"
2000 (graduate) [GoGr00]	High demand, "students find highly remunerative jobs upon graduation"	Perception	lack of "talented people" with knowledge in managing information systems uncertainty of employees concerning the actual qualification of master-level IS graduates
2002 (undergrad.) [GDV+03]	-	-	-
2006 (graduate) [GGS+06]	Increasing demand for graduates who can meet changing needs	Perception; Study: only particular skills still needed in-house	Offshoring-debate has changed the demand for graduates and decreased student demand

Table 4: Development of demand for IS graduates over time as documented in model curricula

4.2 Prospective job positions

The objective of university education is to prepare students for a career in business or academia. Hence, model curricula are targeted at providing students with the opportunity to acquire necessary skills and knowledge. Since IS is still an emerging field of study and located at the interface of information technology (Computer Science) and business administration, possible job descriptions for IS graduates are also discussed as part of the curricula recommendations. Hence, in this section we take a closer look at the model curricula's objectives in terms of recommended job positions for future graduates.

Graduate curriculum 1972 [Ashe72]

The 1972 graduate curriculum is intended for the education of individuals who will "develop complex information systems" ([Ashe72], p. 365). Ashenhurst states that IS graduates may fill positions within the systems development group as an "Information Analyst" (or "MIS-Analyst"), who is more organization-oriented or as a "System Designer" (or "System Developer/Computer Specialist") who is more technology-oriented. It is argued that in smaller companies the combination of both is needed and in bigger ones, it is necessary to combine the knowledge in order to achieve positions on a supervisory level, such as Project Leader.

Within the generally more technology-oriented information processing department the graduates can fill positions like "Computer Systems Analyst" who deal with hardware and software, or they fill in more advanced positions such as "Specialists for Planning and Procurement" (Configurator). Within other functional departments that interact more actively with information systems, IS job positions require more organizational knowledge while "an appreciation of technological considerations is [still] a practical necessity for them" ([Ashe72], p. 368). Within those areas the entry-level position is an "Assistant to various line and staff managers", which can advance to a supervisory position later on. Other advanced positions for graduates that reflect the ongoing information systems activity and the increasing integration of information systems into the organizational context are the "Data Base Administrator" and the "Information Security Officer". Furthermore, long-term positions as "Manager" of systems development group or information processing centre (line managerial position) after several years of experience as an Assistant or an Associate Manager in technological and organizational areas are reachable. The increasing demand for "Consultants", who are Information Analyst or System Designer with extra-knowledge about auditing procedures and legal requirements, provides another job option. Ashenhurst also mentions more technology-oriented positions in the computer industry, with abilities in "Technical Marketing" involving the supervision of diverse projects with various organizations. According to Ashenhurst the future needs within government and other non-commercial organizations will extent the range of entry positions for graduates even further.

Undergraduate curriculum 1973 [Coug73]

The career paths mentioned in the 1973 undergraduate curriculum are explicitly related to the structure of the information systems development process. Couger explains that the IS development process is based on four phases: information analysis, system design, and implementation, followed by the operation phase. The information analysis consists of systems specification (analysis of information needs) and feasibility testing (how the needs can be satisfied depending on the requirements). The system design consists of physical (Hardware) and logical (Software) Design.

The 1973 model curriculum recommends that students are capable of working as a "Computer Operator" or "Application Programmer" within 2 years. Advanced education and experience of a student may qualify him/her to be a System Designer, but in general advanced education within the graduate studies is required in order to qualify for an "Information Analyst" or "System Designer" position in medium to large size companies.

An interesting note is Couger's assessment that until then a university degree had not been necessary for a position in IS, but would now be required for medium to large sized companies ([Coug73], p. 729).

Graduate / undergraduate curriculum 1982 [NCD82]

The 1982 curriculum prognoses, that bachelor and master graduates may fill mainly three entry-level positions. Their first option is to start as a "Systems Analyst", working primarily with users to define information requirements or developing designs for information system applications.

Whereas the bachelor graduates are more likely to design application programs, the master graduates are more likely to be assigned the task of network design. Because some organizations and some graduates feel it desirable to obtain experience in applications programming prior to becoming a system analyst, the second opportunity is to start as an "Application Programmer" with on-the-job training and to become a "Systems Analyst" after one or two years. The third option is to start as an "Information Systems Specialist", working on areas such as information systems planning, administration, or resource management.

Undergraduate curriculum 1997 [DGC+97]

In the 1997 undergraduate curriculum information about characteristics of IS professionals and IS career paths is not explicitly provided, but some information concerning these issues is given within the course description of the "Fundamentals of Information Systems-Course" (IS '97.1). Basically this course provides an introduction to systems and development concepts, information technology, and application software; one of the course topics relates to characteristics of IS professionals and IS career paths ([DGC+97], p.18).

Graduate curriculum 2000 [GoGr00]

The authors of the 2000 graduate curriculum emphasize that in the meantime over 80 Master of Science in Information Systems (MSIS) programs in the United States have been established (see Appendix 5 in [GoGr00]). They point out that the Master of Science in Information Systems graduates are in high demand and provide a list of representative career tracks. The authors state that rather than being concentrated almost exclusively in large information systems groups in major and midsized corporations, job opportunities also exist in virtually all organizations and in all industries.

The following job objectives typically pursued by MSIS graduates – besides advancement in their current job – are listed:

- Outsourcer / Systems Integrator,
- First or middle IS management,
- Project Manager,
- Management Consultant,
- Systems Analyst/Designer,
- Internal Consultant/Senior Staff,
- Technical Specialist,
- CIO,
- IT Liaison,
- Business Analyst.

Lee et al. identify a perception gap between IS academics and practitioners with respect to the desired knowledge requirements for IS graduates [LKYT02]. In this context the authors remark on an increasing diversity of possible job positions for IS graduates: "The old promise of a single career path, programmer – analyst – project manager – IS manager, is being replaced with a new reality in which there are a diversity of IS career paths" ([LKYT02], p. 52).

It should be noted that the 2000 graduate model curriculum is the first to emphasize the increasing relevance of Ph.D. programs. Prior curricula focused on educating graduates for business practice only, i.e. on producing new employees for the increasing IT-sector. The 2000 curriculum aims at combining practical and theoretical elements in order to allow preparing students also for an academic career. A remarkably high need for IS faculty is indicated by the AACSB Survey of Faculty Demand from 1999 [AACS00]. Its results show a particularly high growth forecast for the fields Computer Information Systems (CIS) and Management Information Systems (MIS) (see Figure 2).

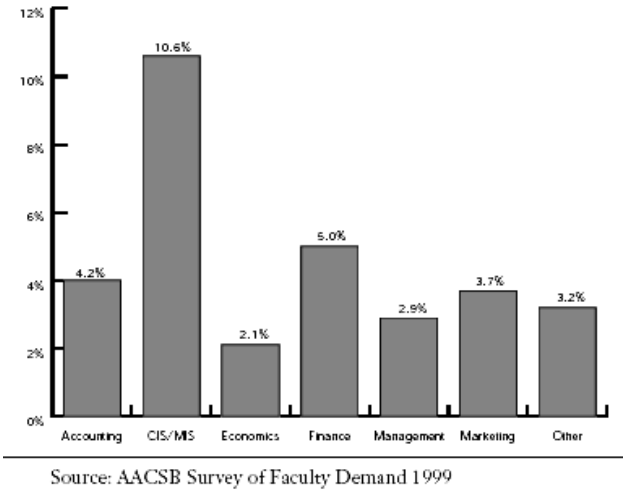

Figure 2: Planned growth in faculty positions ([AACS00], p. 2)

Undergraduate curriculum 2002 [GDV+03]

Similar to the 1997 model curriculum, information about career paths and jobs of IS professionals is not mentioned explicitly in the 2002 undergraduate curriculum, but is included within the description of the "Fundamentals of Information systems – Course" (IS 2002.1). The authors formulate the objective that graduates of programs following the model curriculum are prepared to "develop technology-enabled business" ([GDV+03], p. 13). Compared to the general job objective formulated by Ashenhurst in the 1970s ("to develop complex information systems", [Ashe72], p. 365) the new statement indicates a significant change in the job objective for IS graduates: Earlier IS had been seen as a primarily technological function supporting existing business tasks and processes, whereas now the technology is used to generate new business models ("enabler").

Graduate curriculum 2006 [GGS+06]

Similar to the 2000 graduate model curriculum the 2006 graduate curriculum points out the increased complexity of potential career paths for information systems graduates. The different career paths suggested require students to know both the technology and the business environment. The list of job objectives from the earlier graduate curriculum has been extended to include the following (besides advancement in current job):

- Business analyst
- Chief Information Officer
- Chief Technical Officer
- Database Administrator
- Entrepreneur
- Internal consultant
- IT Infrastructure Specialist
- Liaison between IT and Business Functions
- Management consultant
- Network manager/analyst
- Ph.D. program leading to teaching/research
- Project manager
- Promotion within IS management
- Sourcing manager
- Specialist (technical, web)
- Systems analyst/designer
- Systems integrator

Development of job positions over time

Table 5 outlines the job objectives as recommended in the different graduate model curricula ([Ashe72], [NCD82], [GoGr00], [GGS+06]). The table is structured according to general job categories in order to point out the changes in terminology and diversity of job objectives over time.

In order to point out the changes over time, a specific syntax is used denoting the job positions, which are not any more included in subsequent curricula (*red, italics*) or which are new to the list (blue, underlined); the position of an "Application Programmer" in [NCD82] has a colored background, because this position is recommended only as entry-level position for MSIS graduates.

Categories	[Ashe72]	[NCD82]	[GoGr00]	[GGS+06]
Information Analyst	Information Analyst, MIS Analyst	Information Analyst (Liaison between User and IS Department)	IT Liaison	Liaison between IT and business functions
Systems Analyst	Computer Systems Analyst	Systems Analyst	Systems Analyst	Systems Analyst
System Designer / Developer	System Designer System Developer	System Designer *Network Designer* *(Application) Programmer / Analyst*	Systems Designer	Systems Designer
Administrator	Database Administration *Information Security Officer*	-	-	Database Administrator Network Manager / Analyst
Integrator	-	-	Outsourcer / Systems integrator	Systems Integrator
Project Management	Project Leader	-	Project Management	Project Manager
Management IT/IS	Manager of systems development group Assistant / Associate Manager *Technical Marketing*	-	Chief Information Officer (CIO) First or middle IS Management	Chief Information Officer (CIO) Chief Technology Officer (CTO) Sourcing Manager
Consultant / Business Analyst	Consultant	-	Business Analyst Management Consultant Internal consultant / senior staff	Business Analyst Management Consultant Internal consultant
Specialist	Specialist for planning and procurement	IS Specialist (IS planning, administration, resource mgmt)	Electronic commerce specialist Technical Specialist	Specialist (technical, web) IT-Infrastructure specialist
Academic Career	-	-	Ph.D. program leading to teaching	Ph.D. program leading to teaching / research
General Goals	-	-	Advancement in current jobs Entrepreneur	Advancement in current jobs Entrepreneur Promotion within IS management

Table 5: Comparison of typical job objectives as described in the graduate model curricula (1972–2006)

On a terminological and a categorical level we see an increasing diversity of job objectives since 1972. Specifically, since 2000 various consultant and specialists positions as well as Ph.D. programs leading to teaching or research have been added to the list of typical job objectives. In the area of management the job objective of a "Chief Information Officer (CIO)" is first mentioned in the 2000 model curriculum. In 2006 the job positions "Sourcing Manager" and "Chief Technology Officer (CTO)" are introduced.

With these new – presumably important – job positions the authors of the later model curricula obviously want to reiterate the vital role of IS and IS management notwithstanding the increasing tendency to outsource the IS function. However, the model curricula lack a description as well as a critical reflection of these terms. For example, the role and job description of a "Systems Integrator", a "Sourcing Manager", an "Electronic commerce specialist" or a "CIO/CTO" remains largely unspecified. Hence, particularly the authors of the more recent model curricula do not seize the chance to prescribe future job positions and task profiles, but they mainly apply the terminology which is – at the time of the curriculum development – current in business practice in order to describe prospective job positions.

4.3 Course structure: IS specific courses

Several ways to structure the courses of IS programs have been applied in the model curricula, including include course categories related to thematic areas, prerequisite courses, graduate/undergraduate courses, and the differentiation of elective and required courses. The following discussion will analyze changes in the curricula structure over time in order to investigate responsiveness to technological changes and changing demand concerning IS qualifications by industry.

Frequent discussions in the IS research literature have focused on the need to establish the discipline's identity and legitimacy (e.g. [Keen91], [BaMy02], [KiLy04], [GVV05]). One aspect in this discussion relates to the question of IS specific concepts, theories, or a "common body of knowledge" [HiKl03]. Hence, we specifically analyze the model curricula with respect to the role of IS specific knowledge ("IS knowledge core").

Graduate curriculum 1972 [Ashe72]

The two-year graduate curriculum in 1972 recommends a set of 13 courses divided into four topical areas plus general prerequisites.

- General prerequisites ((a) finite mathematics, (b) elementary statistics, (c) elementary computer programming, (d) elementary economics, and elementary psychology)
- (A) Analysis of organizational systems
- (B) Background for system development
- (C) Computer and information technology
- (D) Development of Information Systems

A normal load of five courses per semester is assumed, leaving space for one additional elective to select. The graduate program is seen as an integrated whole, allowing students to enter the program as a class and to proceed through the same set of courses and experiences.

The 1972 graduate curriculum does not explicitly identify IS-specific courses. The central IS related topic areas are discussed within the "Development of Information Systems" section ([Ashe72] p.376), which consists of the courses "Information Analysis", "System Design" and "Systems Development Projects".

With the first IS model curriculum, Ashenhurst intends to provide a basis for study programs, which combine "a body of knowledge for both organizational functions and information technologies", because "this knowledge is currently offered in diverse areas of graduate education" only ([Ashe72], p. 365). The difficulty of this task is illustrated by the fact that – at that time – for most of the courses no single text-book is available and, so far, only few of the courses that follow an integrated approach (Information Analysis and Systems Design) exist. As opposed to most subsequent model curricula, the pioneer character of this work [Ashe72] is underlined by an appendix with an extensive bibliography for all courses.

Undergraduate curriculum 1973 [Coug73]

In order to cope with the increasing number of institutions that integrate IS or parts of it into their curriculum, the 1973 model curriculum aims at being adaptable to several different university settings. It tries to fit the program not only in business and engineering schools but as well into arts and sciences programs [Coug73].

The 1973 undergraduate curriculum suggests 11 courses corresponding to the terms "information analysis" and "system design" used by [Ashe72]. Additionally, an organizational concentration with 7 courses for business schools and a technological concentration with 8 courses for engineering schools can be implemented. Both concentrations have four courses and the general prerequisites (see above a-d) in common. This overlap leads to the total of eleven courses that have to be taken for each concentration. The common courses are Operations Analysis and Modelling, Systems Concepts and Implications, Information Systems Analysis, and System Design and Implementation. The authors of this model curriculum use the same teaching blocks as the previous model curriculum, but change the courses slightly, adapting them to the needs of an undergraduate program: the coverage of the "advanced knowledge" courses like System Development Projects and of "integrating basic knowledge" courses such as Programming Structures and Techniques and Computer Ware is reduced.

Graduate / undergraduate curriculum 1982 [NCD82]

The advances in technology, improvements in information systems analysis and development processes, and an increased need for information system management skills are given as reasons for a revision of the model curriculum by Nunamaker et al. in 1982. The ten-year old model curriculum is extended; additionally, not only the naming of the main teaching blocks but also the naming of most of the courses is changed. Due to the changing industry needs, the authors express a demand for "a degree program which provides both technical and organizational knowledge. Operationally, this means that the IS curriculum must include subject matter from both the traditional disciplines of computer sciences and those of administration and management" ([Nuna81], p. 128).

The 1982 model curriculum is based on the view, that the direct and indirect influence of information technology is (now) a major aspect for productivity growth ([NCD82] p. 783). It thus, attempts to adapt the preceding curricula to the changed requirements. The concepts of data and resource sharing gain importance and new courses for Data Management and Data Communication are included. In addition, the 1982 model curriculum extends the general prerequisites of its predecessors by introducing two specific prerequisites for the information system curriculum. These two are Computer Programming and Quantitative Methods.

The suggested curriculum consists of:

- the general prerequisites (a-d)
- specific prerequisites (Computer Programming, Quantitative Methods, and the AACSB Common Body of Knowledge)

- Information Systems Technology
- Information Systems Concepts in Organizations

In addition to AACSB required courses the bachelor (4 semesters) includes 8 courses plus 2 prerequisite courses and the master (4 semesters) includes 10 courses plus 2 prerequisite courses. Hence, two courses are offered for the master program only: Modelling and Decision Systems and MIS Policy.

The authors strive to differentiate clearly between computer science and IS in order to emphasize the continuous need for an advanced IS curriculum: "The IS curriculum differs from a computer science curriculum in the environment, in which the program is taught, the employment environment for the graduate, and the depth of technical expertise required" ([NCD82], p. 784).

Undergraduate curriculum 1997 [DGC+97]

The 1997 undergraduate curriculum is aimed at high flexibility in order to be adaptable to most IS programs independent from the surrounding academic environment. This need is underlined by the results of a survey, which indicate that "almost 50 % of IS programs occur in schools of business, while the rest occur in a number of other areas" ([DGC+97], p. 36).

The 1997 undergraduate curriculum defines three levels of courses that require and deliver an increasing competency within specific topics in the IS field.

- Level 1 courses are targeted at all business school students and provide an understanding of the use and role of information systems in organizations.
- Level 2 courses are taken by both IS majors and students in functional areas who desire an IS specialist competency equivalent to a minor.
- Level 3 students are preparing for a career in the IS field. Level 3 topics are e.g. IS development, including Physical Design and Implementation with a DBMS / Programming Environment and IS deployment and Management Processes including Project Management and Practice.

Prerequisites include Communications (general and technical writing, oral communications, and listening skills), Quantitative and Qualitative analysis (discrete mathematics, introduction to calculus, and statistics) and Organization Functions (accounting, distribution, finance, human resources, marketing, production, and international aspects of business).

On the highest level of abstraction the curriculum of 1997 can be structured in five areas, which consist of one or more courses each. The areas are, Information Systems Fundamentals, Information Systems: Theory and Practice, Information Technology, Information Systems Development and Information Systems Deployment and Management Processes. The ten related courses are based on 127 learning units, which are "derived from elements in a body of information systems knowledge" ([DGC+97], p. 2).

Similar to the authors of the 1982 model curriculum Davis et al. reiterate that Information Systems and Computer Science are distinct areas of study, while both of them would require a common subset of technical knowledge: "[..] we believe the correct approach is for individual institutions to take the core requirements for IS as described in this report and those for CS as expressed in [the Computer Science model curriculum] CS'91 and then [..] to design a common core sequence, [taking into account] their own circumstance. [..] The opportunities for shared courses are particularly good in the curriculum area of information technology [(including hardware, software, programming, and networks)]" ([DGC+97], p. 25).

Graduate curriculum 2000 [GoGr00]

At the time of the development of the 2000 graduate curriculum the last model curriculum for graduates is more than 17 years old. The explicated objective of the new graduate model curriculum is to specify a common minimum body of knowledge that all Master of Science in Information systems (MSIS) graduates should know. Because of the varying institutional requirements for MS degrees among universities, the program has to accommodate degree programs ranging in length from 10 to 20 courses ([GoGr00], p. 4).

The graduate model program is designed around a set of five building blocks shown in Figure 3. The *IS Foundations* courses teach technical prerequisites for the program and include at least one programming course. The *Business Foundation* courses include a minimum of 3 courses on the basics of business: one on internal organizational considerations, one on external organizational considerations, and an elective course in one area of business, compatible with the career track chosen by the student.

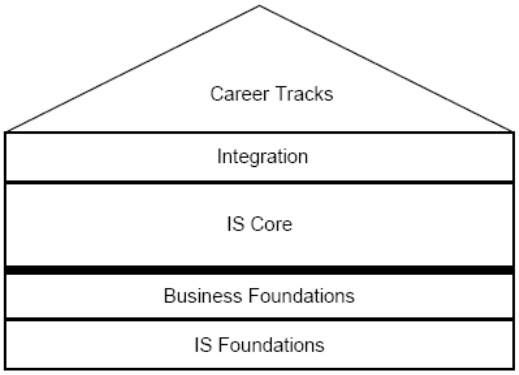

Figure 3: Recommended curriculum building blocks ([GoGr00], p. 8)

While the previously published curricula describe the IS-specific courses only implicitly, the 2000 graduate model curriculum defines a dedicated *IS Core Block*. Because this model curriculum is aimed at providing guideline for programs that could range from 10 to 20 courses, the definition of an IS Core Block is considered necessary, in order to accommodate the different requirements for MS degrees among universities. The IS Core Block consists of the courses Data Management, Analysis, Modeling and Design, Data communications and Networking, Project and Change Management, and IS Policy and Strategy.

Another major change is the so called integration component. The "Integrating Capstone Courses" are usually built around policy and strategy and are intended to foster the understanding of how the curriculum pieces integrate into a whole. The particular demand for course elements that foster integration of different knowledge areas is for example pointed out by Hildebrand: "Consequently, many students miss the unifying, vita piece of the IT puzzle: how to think strategically about technology across a company—an essential business skill for Information Age managers." ([Hild99], p. 5).

The *Career Tracks* block consists of elective courses organized around specific topical areas such as academia, electronic commerce, consulting, or system analysis and design.

Undergraduate curriculum 2002 [GDV+03]

The 2002 undergraduate curriculum updates the five year old model curriculum from 1997 and expands the body of knowledge, due to "rapid contextual and technological change" ([GDV+03], p. 37). The increasing role of the Internet, the raised computing literacy, and progress in accredita-

tion standards for IS undergraduate programs are given as reasons for the development of a new curriculum ([GDV+03], pp. 5 ff.).

Similar to the former undergraduate model curriculum, the 2002 model curriculum defines three levels. The courses on the highest level are Information Systems Theory and Practice[1], Networks and Telecommunication, Physical Design and Implementation with a DBMS, Physical Design and Implementation in Emerging Environments, Project Management and Practice.

A new course in E-Commerce (Electronic Business Strategy, Architecture and Design) is added, and course descriptions are adapted. Based on the improved computer literacy of entering students, two courses (Knowledge Work Software Tool Kit and Personal Productivity with IS Technology) are merged into a single course. Other than that, there are no major structural revisions.

Graduate curriculum 2006 [GGS+06]

The 2006 graduate curriculum was developed over a period of three years and can be seen as a major update of [GDV+03]. The number of required courses is increased from 10 to 12; the developing taskforce argues that it has been necessary to extend the number of required courses in order to compensate the increasing complexity and variety of IS topics. In order to enable institutions to implement the model requirements, if not full-scale, but partly it provides variations for 8 course and 10 course curricula, that reduce the depth to which the material is covered or the specialization.

Due to the constant growth of MSIS programs the 2006 graduate curriculum supports a two-phased implementation that facilitates the restructuring of already existing curricula. The names of the teaching blocks introduced in the 2000 model curriculum remain predominately similar, but the contents are adapted to changes in the IS field. In particular, the focus of the prior integration block has been broadened to include more management issues.

As another change, the number of prerequisite courses is reduced by deleting the IT Hardware and Software course, whereas a new alternative to the *Business Prerequisites* is introduced. The first alternative remains the same requiring three courses: one on internal organizational considerations, one on external organizational consideration, and a third course in one area of business of choice. The second alternative is a two-course graduate sequence on integrated business functions and processes, like e.g. the participation of students working in a simulated enterprise within a two-semester sequence, allowing them to achieve a deeper understanding of organizational issues.

Concerning the IS knowledge core the 2006 model curriculum extends the five core courses to eight and divides them into two categories:

> (1) technical courses: IT Infrastructure; Analysis, Modeling, and Design; Enterprise Models; and Emerging Technologies and Issues;
>
> (2) managerial courses: Project and Change Management; IS Policy and Strategy; the Integrated Capstone course; and Implications of Digitization or Human-Computer Interaction.

Development of course structure over time (undergraduate model curricula)

In order to point out relevant changes in the structure of undergraduate model curricula over time, Table 6 provides an overview of courses and topical areas of the four model curricula. The topical

[1] In this course students are "introduced to concepts and theories that explain or motivate methods and practices in the development and use of information systems in organizations. The concepts and theories will include systems, management, and organization, information, quality, and decision making. The relationship of information systems to corporate planning and strategy and concepts relating information technology to comparative advantage and productivity are explained. The concepts and practices underlying the use of information technology and systems in improving organizational performance are presented." ([GDV+03], p. 16).

areas presented in the first column are derived from the "curriculum presentation areas" that aggregate a number of courses related to a common topic. Changes related to topical areas as a whole are depicted by empty cells in the respective row. In order to denote changes inside a topical area on the level of course titles we use the following syntax:

- *Red font and italics (course name)*: A course with this name is not anymore included in subsequent model curricula.
- Green font (course name): Due to restructuring of courses this course is included in a different topical area in the subsequent model curricula.
- Underlined (course name): This course (or this wording) is new in this model curriculum.

On the level of course titles we see relatively minor changes in the topical areas of IS technology and IS Development. The term "Information Structures" is found in the 1973 curriculum only. "Database Management Systems" first appears in the 1982 curriculum; later on, it is classified in the area of IS development as "Physical Design and Implementation with DBMS". The course "Information Systems Projects" from 1982 has evolved to be part of a new topical area in the 1997 and 2002 model curricula.

Topical area	**[Coug73]**	**[NCD82]** + AACSB accreditation standards	**[DGC+97]**	**[GDV+03]**
Prerequisites	-	Computer Programming, *Quantitative Methods*	Knowledge Work Software Tool Kit	Personal Productivity with IS Technology
Computer & IT / **IS Technology /** Information Technology	*Information Structures*, Computer Systems, File and Communication Systems, Software Design, Programming Structures and Techniques, Computer Ware	Computer Concepts and Software Systems, Program, Data, and File Structures, Database Management Systems, Data Communication Systems and Networks	Information Technology Hardware and Software, Programming, Data Files and Object structure, Networks and Telecommunications	Information Technology Hardware and Software, Programming, Data Files and Object structure, Networks and Telecommunications
IS Development / IS Concepts in Organizations (only 1982)	Information system Analysis, System design and Implementation	*Information Systems in Organizations*, Information Analysis, Systems Design Process, Information Systems Projects	Analysis and logical Design, Physical Design and Implementation with DBMS, Physical Design and Implementation with a programming Environment	Analysis and logical Design, Physical Design and Implementation with DBMS, Physical Design and Implementation in Emerging Environments
Background for Systems Development	Operations Analysis and Modeling, Human and organizational behavior	-	-	-
Analysis of organizational Systems	Systems Concepts and Implications	-	-	-
Information Systems Fundamentals	-	-	Fundamentals of Information Systems, Personal Productivity with IS Technology	Fundamentals of Information Systems, E-Business Strategy, Architecture & Design
Information Systems: Theory and Practice	-	-	Information Systems: Theory and Practice	Information Systems: Theory and Practice
Information Systems Deployment and Mgmt. Processes	-	-	Project Management and Practice	Project Management and Practice

Table 6: Changes in course structure of undergraduate model curricula

There are two topical areas, which are only found in the first model curriculum: "Background for system development" and "Analysis of organizational systems" [Coug73]. Later on, the respective contents were apparently integrated into other topical areas and courses. Since 1997 there are three new topical areas representing IS specific courses. Within these we see a change concerning the course "Personal Productivity with IS Technology", which is classified as "Prerequisite" in 2002. Additionally, there is a new course named "E-Business Strategy, Architecture & Design" in the latest undergraduate model curriculum [GDV+03].

Development of course structure over time (graduate model curricula)

A similar development towards more IS specific courses and a higher variety of topics can be derived from a comparison of the graduate model curricula. Analogous to the undergraduate model curricula, the topical areas "Background for system development" and "Analysis of organizational systems" are only recommended in the 1972 model curriculum (see Table 7). In 1982 the topical area on IS development is broadened to include courses on "Information Systems in Organizations" and "Information Systems Policy". Later on, this topical area is integrated in the "IS core" (see Table 8) with additional courses on IS management topics.

The marking of the topical areas in the left column of Table 8 reflects the extensive structural changes in the 2000 and 2006 model curricula compared to the earlier curricula from 1972 and 1982. Specifically, there are the new topical areas "Business Foundations", "IS core", "Integration" and "Career Electives".

Topical area	[Ashe72]	[NCD82] + AACSB accreditation standards
Prerequisites	-	Computer Programming, *Quantitative Methods*
Computer & IT / IS Technology	*Information Structures*, Computer Systems, File and Communication Systems, Software Design	Computer Concepts and Software Systems, Program, Data, and File Structures, Database Management Systems Data Communication Systems and Networks, Modeling and Decision Systems
Background for system development	Background for system development, Human and Organizational Behavior	-
Analysis of organizational systems	Introduction to Systems Concepts, Organizational Functions, Information Systems For Operations and Management, Social Implications for IS	-
IS Development / IS Concepts in Organizations (only 1982)	Information analyses, System Design, System Development Projects	*Information Systems in Organizations*, Information Analysis, Systems Design Process, Information Systems Policy, Information Systems Projects

Table 7: Changes in course structure of graduate model curricula from 1972 and 1982

On a terminological level of course titles a number of changes can be identified: the term "Object structure" is first introduced in 2000, presumably reflecting the increasing role of object-oriented programming. The courses included in the "IS core" stem mainly from the former category "IS Development" plus the "Data(base) Management" course. In the most recent model curriculum three new courses have been added to the "IS core": "Enterprise Models", "Emerging Technologies and Issues", and "Implications of Digitization on Human-Computer Interaction". At the same time there is not any more a separate course for "Data(base) Management", but the respective contents are integrated in the "Analysis, Modelling, and Design" course. Also, the course on "Information Tech-

nology Hardware and Software" has been deleted in the latest graduate model curriculum. While there are already 16 career electives recommended in the 2000 model curriculum, the 2006 model curriculum has added 8 electives including "Computer Forensics", "Data Warehousing and Data Mining", "Database and Multi-tiered Systems", "Security" and "Mobile Computing".

Topical area	[GoGr00]	[GGS+06]
IS Foundations (Technical Prerequisites) (former "IS Technology")	Fundamentals of IS, Information Technology Hardware and Software, Programming, Data and Object Structures	Fundamentals of IS, Programming, Data, File and Object Structures
Business Foundations (Business Prerequisites)	Free choice of one area of business: e.g. Financial Accounting, Internal organizational considerations: e.g. Organizational Behavior, External organizational considerations: e.g. Marketing	**Alternative 1:** Free choice of one area of business: e.g. Financial Accounting, Internal organizational considerations: e.g. Organizational Behavior, External organizational considerations: e.g. Consumer-Oriented Marketing **Alternative 2:** Two course graduate sequence on integrated business functions and processes
IS Core (includes former "IS development")	Data Management, Analysis, Modeling and Design, Project and Change Mgmt, Data Communications and Networking, IS Policy and Strategy	**IS Technology:** IT Infrastructure (includes networking) Analysis, Modeling, and Design (includes Human-Computer Interaction and Data) Enterprise Models Emerging Technologies and Issues **IS Management:** Project and Change Management Strategy and Policy Implications of Digitization on Human-Computer Interaction
Integration	Integrating the Enterprise or IS Function and IS Technologies	Integrated Capstone
Career tracks / electives	For each specific area four courses are recommended (see [GoGr00], p. 13) • Academia (path to Doctorate) • Consulting • Data Management and Data Warehousing • Decision Making • Electronic Commerce • Enterprise Resource Planning • Global IT Management • Human Factors • Knowledge Management • Managing the IS function (internal to IS) • Managing the IS function (external to IS) • New ways of working • Project Management • Systems Analysis & Design • Technology Management • Telecommunication	For each specific area four courses are recommended (see [GGS+06], p. 49 f.) • Academia (path to Doctorate) • Computer Forensics • Consulting • Data Management and Data Warehousing • Data Warehousing and Data Mining • Database and Multi-tiered Systems • Decision Making • Electronic Commerce (2 alternatives) • Global IT Management • Human Factors • Knowledge Management • Managing the IS function (internal to IS) • Managing the IS function (external to IS) • Mobile Computing (Technical) • Mobile Computing (Managerial) • New ways of working • Project Management • Security • System Analysis & Design • Technology Management • Telecommunication (2 alternatives)

Table 8: Changes in course structure of graduate model curricula from 2000 and 2006

4.4 Role of practice experience

Since the late 1990s business schools in general – where most IS degree programs are hosted – have been criticized for teaching (MBA) programs not being targeted at the needs of industry practice ([BeO'T05], [StTe05]).

Information systems in an organizational and business context are the general subject of interest in the IS discipline (e.g. [Keen80] p. 12, [IHD80] p. 910, [ASB99] p. 136, [KiLy04] p. 541). IS, therefore, is an applied field (e.g. [Hirs84], [AvPr05]) and its topics strongly correlate with technological advances and new ways of applying information technology in enterprises. Moreover, there have been extensive discussions in various publications and informal communication outlets (such as *isworld*) concerning the role of relevance to practice for IS research and teaching (e. g. [BeZm99], [DaMa99], [Lee99], [KGH+02]). The so called relevance debate in the IS discipline is documented in a number of publications, including a special issues of the Information Resource Management Journal (IRMJ, Winter 1998), a discussion with several articles in MIS Quarterly (MISQ, March 1999), and a special issue in Communications of the AIS (CAIS, March 2001).[1]

Against this background we want to analyze the model curricula in terms of alignment with practice. To this end the following discussion focuses on (1) suggested ways for interacting with practitioners in order to better align the qualification of IS graduates with practice expectations, and (2) specific course types and teaching methods targeted at offering practice experience to students

Graduate curriculum 1972 [Ashe72]

The 1972 graduate model curriculum recommends a number of prototypical work situations that should provide students with practical experience. The prototypical work situations are described as follows:

> "Graduate students should have gathered information in a 'real' organization, worked with an operations research specialist to model a complicated situation, served as a member of a project team developing a specified programming system, and should have participated in planning and conducting an oral presentation (and selling) of the results of a team project" ([Ashe72] p. 371).

Specifically, a "Systems Development Project" course is recommended, in which students should gain practical experience in the development of a small application system. Furthermore the 1972 model curriculum recommends strengthening the relation to practice by directly addressing practitioners and offering a professional program tailored to those with a few years of job experience. It is proposed that condensed and tailored courses increase the attractiveness for practitioners to return to university. The proposed actions aim at upgrading the knowledge of already working technicians and IS managers, reflecting the – then – urgent demand for qualified IS professionals.

Undergraduate curriculum 1973 [Coug73]

Within the 1973 undergraduate model curriculum Couger also mentions the importance of prototype working situations for undergraduate students in order to gather real world experiences [Coug73]. But he remarks that undergraduate programs typically do not provide as much "exposure to 'real world' situations" ([Coug73], p. 732) as graduate programs.

[1] An additional research report provides an analysis of the arguments of the relevance debate in IS [Scha07b].

Graduate / undergraduate curriculum 1982 [NCD82]

Like its predecessors the 1982 model curriculum refers to the importance of the above mentioned prototype working situations [NCD82]. Additionally, an "Information Systems Project" course is recommended, which should "provide the student with experience in analyzing, designing, implementing, and evaluating information systems." ([NCD82], p. 805). Three alternative types of projects for this course are suggested: development of a system for a "local firm", for a "University/College", or for a "hypothetical firm" ([NCD82], p. 805).

Undergraduate curriculum 1997 [DGC+97]

The 1997 undergraduate model curriculum underlines the importance of a close relationship between academia and practice. Practitioners were integrated into the development process from the beginning. The importance of a "strong link between educational programs and the professional community of IS practitioners" is emphasized ([DGC+97], p. 6). Specifically, the 1997 undergraduate curriculum suggests that IS practitioners may, for example, serve on industrial advisory boards at local colleges and universities or help provide industrial experience for IS students and faculty. It is stated that advanced levels of IS undergraduate education require participative learning. It is recommended that practitioners play a supportive role in these activities by providing case studies on which a student can work as well as serving as outside evaluators for student projects [DGC+97].

Graduate curriculum 2000 [GoGr00]

Supplementing the earlier introduced desired prototype working situations, the 2000 graduate model curriculum recommends the realization of a "practicum", which is defined as a "term-long project solving a real problem for a real client against a time deadline" ([GoGr00] p.7). Different options for the implementation of a practicum are recommended for full-time and part-time students:

> "For full-time students, it is recommended that they work in teams and that industry supports the project by providing stipends to the students for their work because the financial incentive has been shown to improve the relevance of the project topic and the quality of the student output." ([GoGr00], p. 7)
>
> "For part-time, working students, a project for their employer is usually appropriate as a practicum." ([GoGr00], p. 7)

Undergraduate curriculum 2002 [GDV+03]

Unlike the other curricula the 2002 undergraduate curriculum does not explicitly mention the necessity of a tight connection to real world work situations.

Graduate curriculum 2006 [GGS+06]

Similar to most of its predecessors, the 2006 graduate curriculum points out the importance of students' interaction with practice. The authors argue that because the requirements for specific knowledge have increased with growing information systems application areas, students nowadays need to concentrate on certain career tracks and gain practice knowledge within the chosen area. Furthermore, it is recommended that a practicum should be supported financially by industry.

Development of the role of practice experience over time

The need for students to have experience in typical work situations is already emphasized in the first model curriculum [Ashe72]. Since then, the graduate rather than the undergraduate model curricula have discussed this issue. However, the early recommendations have not been revised or extended significantly until the 1997 model curriculum. Here, the authors recommend that practitioners should

be involved in teaching through participation on advisory boards or by providing students and faculty with real world practice experience (e.g. through case studies). Not before 2000 a "practicum" is explicitly recommended which should allow every student direct experience in a real-world business context.

5 Adoption of Model Curricula

The previous discussion has summarized various selected normative issues concerning the model curricula, including prospective IS job positions and IS teaching contents. As described earlier, these recommendations reflect the opinion of various organizations and associations representing the professional and academic IS community. However, there is – of course – a difference between the description of what "should be" and what "is" in terms of IS teaching programs. Hence, in order to complement the picture of IS teaching, this section attempts to provide a descriptive view focusing on the size of IS teaching in terms of the number of IS study programs and the adoption of model curricula. The subsequent discussions are based on available empirical studies related to the respective historical time frames.

5.1 Adoption of the 1972 graduate curriculum

An article by Nunamaker presents the results of a survey and analysis of the actual usage of the ACM model curriculum from 1972 at American universities [Nuna81]. The author lists 70 IS programs at the bachelor's level and 54 IS programs at the master's level. The analysis results show, that at that time only very few of these programs fulfill the complete requirements of the model curriculum. Restricting the requirements to a core of 9 courses, 34 (ca. 63 %) master's degree programs and 53 (ca. 76 %) bachelor's degree programs comply with the requirements.

The study results provide additional information on the different names of degree programs – including IS, MIS, Business Information Systems, Business Data Processing – and on the organizational integration: At that time IS programs are mainly located at schools of business (42 of 53 programs at the bachelor's level and 25 of 34 programs at the master's level) [Nuna81].

5.2 Adoption of model curricula in the 1990s

Referring to master programs listed in "Peterson's guide to Graduate Programs" (1994) Towell and Lauer identify 79 IS master programs. Based on a survey sent to the directors of these IS programs – resulting in 31 responses – it is stated that 10 of the schools followed the ACM curriculum guidelines and 8 adopted the DPMA curriculum guidelines; the remaining schools (13) adopted a combination of both models or an individually developed curriculum ([ToLa95], p. 3).

As a preliminary step to propose the next model curriculum for a Master of Science in IS Gorgone and Kanabar identify 57 specialized master degrees in IS (based on public directories and Web sites). They describe the different program titles – including IS, MIS, CIS and others ([GoKa97], p. 6) – and the frequency of IS courses of the 1997 undergraduate curriculum offered in master programs. The courses offered by at least ten universities are suggested as basis for a new graduate curriculum (see Figure 4):

- IS97.01 Fundamentals of Information Systems,
- IS97.04 Information Technology Hardware and Software,
- IS97.05 Programming, Data, File and Object Structures,
- IS97.06 Networks and Telecommunications,

- IS97.07 Analysis and Logical Design,
- IS97.08 Physical Design and Implementation with DBMS,
- IS97.09 Physical Design and Implementation with Programming Environments,
- IS97.10 Project Management and Practice.

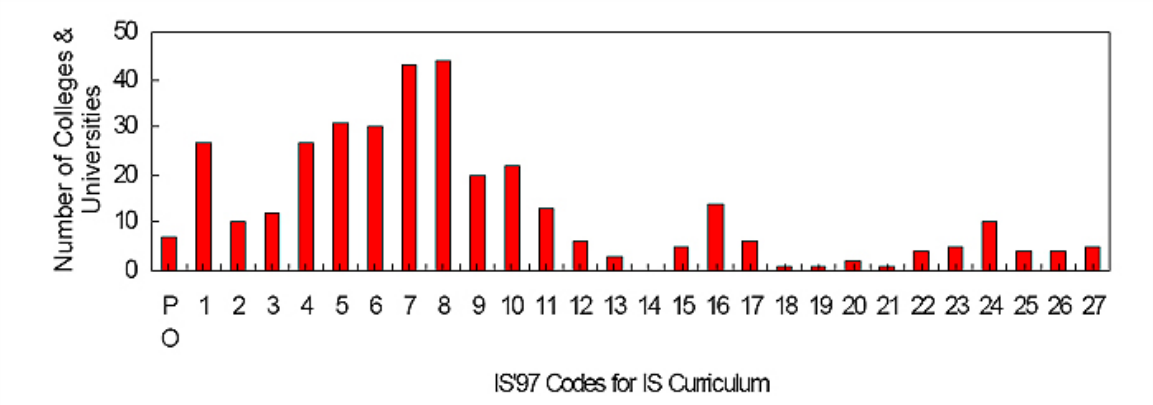

Figure 4: Frequency distribution of the 1997 undergraduate curriculum courses in master's programs ([GoKa97], p. 7)

Based on course catalogue data of 85 schools providing dedicated CIS or MIS Master degrees – schools identified using "Peterson's guide to Graduate Programs" from 1996 – Maier and Gambill analyze the diversity of course titles and common topical areas of "IT-related courses" ([MaGa97], p. 27). The authors state that the review of course catalogues "revealed a great diversity in course titles and descriptions" ([MaGa97], p. 27). Hence, they suggest topical categories of courses. The highest number of courses (130) relates to Management of IT, followed by Database I (81 courses) and Systems Analysis & Design I (71). It should be noted, though, that only in the categories "Database I" and "Systems Analysis & Design I" there is a higher number of a required than elective courses (45 / 36 and 46 / 25, respectively). The authors conclude from their study results that there is a certain convergence of courses offered for selected topical areas. However, it appears noteworthy that 40 % (or more) of the schools do not offer such basic courses as Management of IT, Database and Systems Analysis & Design as required courses in their CIS/MIS master degree program.

5.3 Adoption of the 2000 graduate model curriculum

Vijayaraman and Ramakrishna analyze the match of courses offered in the master's programs (of 86 schools) with the MSIS 2000 model curriculum [ViRa01]. The study yields mixed results (see Figure 5): While most of the schools (94%) fulfill the requirements of the model curriculum in terms of credit hours (if foundational requirements are not considered), "there is considerable deviation in the required courses": of the five IS core courses only two are offered by the majority of the programs ("Data Management" 72 % and "Analysis, Modelling and Design" 80 %).

A study performed by Duggal and Mastruserio is also aimed at analyzing conformance to the MSIS 2000 model curriculum [DuMa03]. Even though the applied research method is not very well documented[1] results of this study indicate that there is only a very limited set of model curriculum courses taught at the majority of the responding universities. Only the courses "Data Management",

[1] Only 20 US universities were selected, criteria for university selection and course comparison are not available [DuMa03].

"Analysis, Modeling and Design", and "Communication and Networking" are offered by more than 50 % (10) of the schools ([DuMa03], p. 1390).

Area	Courses	Percentage of Programs Requiring (Average Hours)
IS Foundations	Fundamentals of IS	**17% (2.90)**
	IT Hardware and Software	**9% (3.00)**
	Programming, Data and Object Structures	**36% (4.40)**
IS Core	Data Management	**72% (3.05)**
	Analysis, Modeling, and Design	**80% (3.88)**
	Data Communications and Networking	**41% (3.07)**
	Project and Change Management	**34% (2.85)**
	IT Policy and Strategy	**13% (3.00)**
Integration		**14% (4.00)***

*** The numbers in the parentheses are the average number of semester hours**

Figure 5: Match of required courses from model curriculum MSIS 2000 ([ViRa01], p. 27).

5.4 Development of model curricula adoption

Table 9 provides a concise overview of empirical results related to the adoption of model curricula and the commonality of IS graduate programs as discussed in the previous subsections.

Study	Model curriculum / reference	Conformity / Adoption
[Nuna81]	1972 (graduate) – [Ashe72]	Very few comply to complete requirements, Restricted to **9 courses** 76 % of bachelor's and 63 % of master's program fulfill the requirements
[ToLa95]	1982 (graduate) – [NCD82]	Response rate: 39 % **10 schools** follow ACM model curriculum, (8 follow DPMA model curriculum, 13 follow a combination)
[GoKa97]	1997 (undergrad.) – [DGC+97] (focus on existing graduate programs)	10 (37 %) courses of the undergrad. model curriculum are offered by graduate programs of at least 10 universities
[MaGa97]	General: common courses and topic areas of CIS/MIS master degree programs	Certain convergence in some topical areas, However, there is a **high variance in required courses**, e.g. "Systems Analysis & Design" is not a required course in (at least) 40 % of the programs
[ViRa01]	2000 (graduate) – [GoGr00]	**High variance in required courses**: of the five IS core courses **only two** are offered by the majority of the programs
[DuMa03]	2000 (graduate) – [GoGr00]	**Only three courses** are offered by more than 50 % of the 20 IS programs analyzed.

Table 9: Studies indicate rather low level of conformity to model curricula

The comparative overview shows that all studies indicate that IS (CIS/MIS) graduate programs do not entirely comply with the model curricula requirements. Nevertheless, the level of conformity seems to have been relatively high until the middle of 1990s compared to later studies. For example, more than 60 % of all IS programs in the early 1980s did fulfill the requirements of the 1972

graduate model curriculum, if restricted to 9 courses. Studies conducted in the late 1990s and in more recent years point out that there is a high variance, particularly in required courses: only two or three courses of the IS core, respectively are offered by the majority of IS programs analyzed ([ViRa01], [DuMa03]).

5.5 Number of IS teaching programs over time

The studies introduced in the previous subsections supply some numbers on IS programs. Table 10 lists all studies available that aimed at identifying the number of Bachelor/Master of Science programs with IS/CIS/MIS majors in the US.

Source	**Year**	**Study programs** (% at Business Schools)			**Empirical basis**
		Undergraduate	Graduate	Doctoral	
[Nuna81]	1977-79	70 (60 %)	54 (46,3 %)	(28)	Collection of information on university study programs (IS programs are identified based on particular courses which have to be included)
[JID91]	1988/ 1989	-	-	51	Survey based on 1989 Directory of MIS Faculty and MIS Interrupt's List of MIS Doctoral Programs Response: 85 %
[LoFe91]	n.a.				
[ToLa95]	1994	-	79	-	Peterson's guide to Graduate Programs 1994
[GoKa97]	1996	-	57 (51 %)	-	Peterson's Guide to Graduate Programs in Business, Education, Health and Law (1996), Directory of MIS Faculty (1995), and the World Wide Web.
[GiHu98] [GiHu99]	1996	151 (institutions)	-	-	MIS Research Center Directory, Questionnaires mailed to IS faculty at 442 institutions, response was received from IS faculty from 193 different institutions
[SiWa99]	1998 (?)	233 (only Business Schools)	127 (only Business Schools)	60 (only Business Schools)	Survey sent to IS department heads in North-American business schools (675 institutions). Response: 523 (58,2 %) Numbers relate to IS major programs.
[ViRa01]	2000 (?)	-	86 (70 %)	-	Web sites including petersons.com, gradschools.com, bschool.com
[KYZ06]	2003	232 (only Business Schools) (60 % public, 40 % private)	-	-	The College Blue Book, 30th ed., 2003
Research by authors	2007	-	398 (apparently includes MBA programs with IS electives)	102	Search for "Management Information Systems"- programs on petersons.com (country: USA, query on February, 8th, 2007)
Research by authors	2007	34 (47,06 %)	136 (63,24 %)	101 (47,52 %)	Entries in ISWorld data base: „information related" undergraduate programs, master programs in "information systems", and Ph.D programs in „information sciences" (from www.isworld.org/programs, country: USA, query on May, 11th 2007)

Table 10: Studies identifying (M)IS study programs (Bachelor/Master of Science with IS/CIS/MIS majors)

The studies available provide only sporadic insights concerning the development of the size of the IS field in terms of the number of IS study programs, because they focus on different levels (undergraduate, graduate, doctoral) and use different empirical bases. Nevertheless, the study results do indicate a considerable increase in the number of IS degree programs since the 1980s. However the data available is not sufficient to analyze the effect of events in industry, such as the dot-com burst or the more recent outsourcing/offshoring debate, on IS study programs.

6 Conclusions and Future Work

Model curricula are aimed at forming a common basis and reference for IS teaching programs tailored to better fulfill requirements from industry and academia. Since the 1970s various IS model curricula have been published by ACM, AIS, and AITP. The number and size of model curricula shows that extensive work has been invested in order to assemble appropriate courses and teaching instrument. The breadth of participating academic and professional organizations signifies the normative weight of the model curricula for IS degree programs at North-American universities (see section 2).

Our analysis indicates that the job market for IS graduates was euphorically positive from the middle of the 1970s until the middle of the 1990s; since then, however, the statements related to the job market have become more reserved: Accordingly, job positions for IS graduates nowadays require different skills due to the pervasive nature of IT in businesses and the tendency in business practice to foster IT outsourcing and offshoring (see section 4.1).

The analysis of the development of normative issues discussed in the model curricula indicates a growing diversification and breadth of topical areas, career tracks and prospective job positions over time (particularly considerable since 2000). We see an increased emphasis on IS specific courses ("IS core") in model curricula since 2000 (see section 4.3).

The IS discipline – as probably business schools in general – seems to have put a growing emphasis on practice experience in teaching: Model curricula since the middle of the 1990s reiterate the role of experience with industry practice for students in graduate programs; the suggested instruments are a practicum and the involvement of practitioners in teaching and on faculty boards (see section 4.4).

Our analysis of the compliance of IS degree programs with the model curricula shows that – corresponding to the particular increase in diversification and breadth of topical areas since the late 1990s – there have been only very few programs following the requirements of the model curricula since 2000. Results of several empirical studies indicate that even of the "IS core" courses, which are emphasized as central for an IS education, there are at most three courses which are offered by the majority of all IS degree programs (see section 5).

The analysis of model curricula and existing empirical studies do not suffice to answer all relevant questions concerning the actual profile, development, and status of IS teaching. Hence, we suggest that future studies in this area should address the following issues:

Actual role of practice experience in IS teaching: While model curricula indicate an increased emphasis on practice experience for students, further studies are required to investigate the actual usage of the suggested instruments (practicum, practitioners involvement in teaching etc.) in IS graduate and undergraduate programs.

Affect of market events on IS teaching size: Some IS faculty reported an increasing pressure on IS programs after the dot-com-burst in 2001. Recent developments in industry indicate considerable improvements in the IT job market. While relatively precise data is available to follow the ongoing changes in the job market, additional empirical studies are needed to ana-

lyze the size of IS teaching in terms of programs and students related to events in (IT) markets and, specifically, related to the most recent debates and developments.

Reasons for low level of conformity with "IS core": Our analysis shows a considerable disparity between the (prescriptive) emphasis on the need for "IS core" courses in IS model curricula and the conformity of actual IS degree programs with the "IS core" courses. Hence, future research should investigate the reasons why IS programs are diverse to such a great extent and should reflect on the possible consequences for the profile and status of IS teaching (and research) programs at universities.

7 References

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8 Appendix A - Accreditation Agencies

CHEA – Council on Higher Education Accreditation

Established in 1996, CHEA is a private, not-for-profit national organization that coordinates accreditation activities in the United States. Each of the following accreditation agencies reports to the CHEA.

AACSB – The American Association of Collegiate Schools of Business

AACSB International is the accrediting agency for undergraduate and graduate degree programs in accounting and business administration. Created in 1916, AACSB's motivation is to assure and improve the quality in accounting, business administration, and management. Its membership consists of 899 educational, government, corporate, and non-profit organizations, including 411 accredited institutions. [http://www.aacsb.edu/]

ABET – The Accreditation Board for Engineering and Technology

ABET is a federation of 31 professional engineering and technical societies and is responsible for accreditation of more than 2500 universities in the United States. Since 2001 ABET accreditation efforts include IS programs. ABET's motivation is to assure and improve quality in its field. Beginning in 2001, its responsibilities include information systems programs. With the help of the International Activities Committee (INTAC) that manages ABET's international activities, a chance to access a "substantially equivalent" accreditation status for programs outside the U.S is provided. [http://www.abet.org/]

CSAB – The Computing Sciences Accreditation Board

The ACM and the IEEE Computer Society (IEEE/CS) founded the CSAB in 1985. CSAB's motivation is to assure and improve quality in the field of computing sciences. CSAB became an member of the ABET board in 2000. [http://www.csab.org/]

For further information on accreditation initiatives in the IS field see [ImGo02].

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