A Contribution to Information Systems Courses Taxonomy

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Abstract. *Information systems curriculum must be continually considered, re-evaluated and revised. The paper presents a view on the problem of classification of information systems teaching units into a set of courses. The classification is based on the decomposition of information systems and the Zachman Framework for IS architecture. It yields in an information system cube, which can be used as a tool for supporting the process of understanding, re-evaluating and re-modelling the existing curriculum or modelling the new curriculum.*

Keywords. *information systems, information systems courses, taxonomy, Zachman framework, information systems architecture*

1. INTRODUCTION

Educational programs in information systems (IS) must be continually re-evaluated and revised. The composition of IS courses, i.e. IS curriculum, has to be permanently considered, understood and finally revised. The paper presents a view on the problem of classification of IS teaching units into a set of courses. The classification is based on two principles: the decomposition of information systems, and the Zachman Framework for information systems architecture.

2. INFORMATION SYSTEM

The information system is a system, whether automated or manual, that comprises the entire infrastructure, organization, people, machines, and/or methods organized to collect, process, transmit, and disseminate data that represent user information. The information system is a complex system that has to cover all informational tasks needed to service operational, management, decision-making [1] and collaboration activities of the enterprise. Moreover, the information system is an information-based model of the enterprise, which describes the enterprise's business through data.

2.1 DECOMPOSITION OF INFORMATION SYSTEMS

Information systems in function may be decomposed into three information subsystems:

- Transactional or operational subsystem
- Analytical subsystem, and
- Collaborative subsystem

The *transactional subsystem* is part of the information system responsible for the executing of transactions of the enterprise's business processes. In the transactional system [5], many transactions are executed, most of them concurrently. A transaction inserts, updates, or in any other way processes the data in a database. In many occasions, a transaction is an integral part of the business process (e.g. a bank transaction is a business transaction and at the same time a transaction of the transactional part of an information system).

The *analytical system* is part of the information system responsible for the decision support functions or the data warehousing functions. It assists decision support functions by supplying information to decision makers.

The *collaborative subsystem* is a part of the information system supporting various communication tasks (e-mail, videoconferencing, etc.), collaboration tasks (group collaboration, group decision, voting, etc.), and individual tasks (preparing, storing and retrieving documents, spreadsheets, presentations, small databases, etc.).

2.2 ZACHMAN FRAMEWORK FOR INFORMATION SYSTEMS ARCHITECTURE

The previously mentioned decomposition of information systems does not seem to be sufficient for teaching methods and techniques of information systems development. Purposely, we find the *Zachman framework for information systems architecture* [2, 7, 8] helpful. The Framework is suitable for developing and/or documenting an enterprise-wide information systems architecture. Its purpose is to provide a basic structure that supports the organization, access, integration, interpretation, development, management, changing of a set of architectural representations of the enterprise's information system, which are called *artefacts*. The Framework enables focused concentration on the selected aspects of the information system keeping in mind the contextual or holistic perspective. We shall investigate its possibilities in developing IS curriculum [3].

The first view [4] on design artefacts is through *product characteristics* or product abstractions, which include the *what*, *how*, *where*, *who*, *when* and *why* characteristics. They are explained as *what* it is made of (structure), *how* it works (processes), *where* the components are (flow, locations), *who* does what work (people, operations), *when* things happen (dynamics, time) and *why* various choices are made (motivation). In the other words some *things* (structure) transformed by some *processes* (transform) in some *locations* (flow) by some *people* (operations) at some *time* (dynamics) for some *reasons* (motivation). Fig. 1 shows some artefacts for product characteristics in information systems development.

Product characteristics	Description	Question	Artefacts in information systems development
Structure **Data**	Material description	What	Data entity
Transform **Process**	Functional description	How	Computer program, manual procedure
Flow **Network**	Spatial description	Where	Network of locations
Operations **People**	Operational description	Who	User, organization
Dynamics **Time, Events**	Timing description	When	Event
Motivation **Goals**	Motivation description	Why	Business goal, business rule

Figure 1. Product characteristics of the Framework

The other view on design artefacts is through *perspectives* or *roles* in the product development process. Perspectives or roles include the *contextual* perspective (*planner* role), the *conceptual* perspective (*owner* role), the *logical* perspective (*designer* role), the *physical* perspective (*builder* role), and the *component* perspective (*sub-contractor* role). Fig. 2 shows these perspectives; and models produced in each perspective in business and development terms.

Perspective (role)	Enterprise model (development model)	Description
Context (planner)	Scope (contextual model)	Definition of the product's direction and purpose
Concept (owner)	Business model (conceptual model)	Definition (in business terms) of the product
Logical (designer)	System model (logical model)	Definition (in designer's term) of the product
Physical (builder)	Technology model (physical model)	Definition (in technology term) of the product
Component (sub-contractor)	Component model (physical component model)	Specification of the product's components

Figure 2. Perspectives (roles) of the Framework

The Framework for information systems architecture, graphically depicted in Fig. 3, shows the artefacts that constitute the intersection between the perspectives or roles in the design process, shown in rows, and the product characteristics or abstractions, shown in columns. It is comprehensive while it addresses the information system in its entirety. It enables to work with abstractions to isolate simple elements without losing sense of the complexity of an information system as a whole. Finally, it is independent of methods and tools. It is intended to be a thinking or analytical tool in dealing with complexities and dynamics of an information system.

Each row in Fig. 3 represents the view on IS from specific *perspective* that belongs to a unique *role.* The role of a *planner* in the contextual perspective is to set the scope (contextual model) or the strategy of an information system. The role of a business *owner*, business people or a system analyst in the conceptual perspective is to define the business in a formal way (enterprise model, business model, conceptual model). The role of a *designer* in the logical perspective is to design the IS model (logical model). The role of a *builder* in the physical perspective is to design the technology model (physical model). A *sub-contractor* is responsible for components of the system (component model). Finally, the information system is built in concordance with all the mentioned models.

The columns in the Framework represent the different information system's characteristics or abstractions. Each row in the *data* column addresses understanding of and dealing with enterprise's data (what are things of interest). The rows in the *process* column describe the various aspects of operations of the information system (how are things processed). The *network* column is concerned with locations (where the operations are done). The *people* column describes who is involved in the information system. The *time* column describes the effects of time on the information system. The artefacts of this column are difficult to address in isolation from others, especially from function artefacts. Usually, it describes when the function is executed. The *motivation* column is concerned with the conversion of business goals and strategies into specific business rules.

Perspective (model) *Role* ↓	*What* **Data** (entities)	*How* **Process** (activities)	*Where* **Network** (locations)	*Who* **People**	*When* **Time**	*Why* **Motivation**
Context (Scope) *Planner*	Class of business things	Class of business processes	Major business locations	Major organization units	Major business events	Major business goals
Concept (Enterprise model) *Owner (analyst)*	Semantic data model, conceptual data model	Business process model	Business logistics system	Workflow model	Master schedule	Business plan
Logical (System model) *Designer*	Logical data model	Application architecture	Distributed systems architecture	Human interface architecture	Processing structure	Business rules
Physical (Technology model) *Builder*	Physical data model	Systems design	Technology architecture	Presentation architecture	Control structure	Rule design
Component (Component model) *Sub-contractor*	Data definition	Programs	Network architecture	Security architecture	Timing definition	Rule specification
Function (Functioning Enterprise) *User*	Data	Function	Network	Organization	Schedule	Goals

Figure 3. The Framework of information systems architecture

3. INFORMATION SYSTEMS COURSES TAXONOMY

The decomposition of information systems into three subsystems (transactional, analytical and collaborative) in combination with the Framework for information systems architecture result in an information systems cube shown in Fig. 4. The cube has three dimensions: IS aspect (data, processes, locations, people, time, and motivation), IS development perspective (context, concept, logical, physical, component, and IS in function) at IS development stage (planning, analysis, design, and construction); and IS type (operational, analytical and collaborative subsystem). The artefacts, belonging to an aspect of an information subsystem developed at some development stage, make the content of each subcube.

The top level of the information systems cube, shown in dark grey, depicts information systems in function. The lower levels of the cube, shown in light grey, depict information systems development areas.

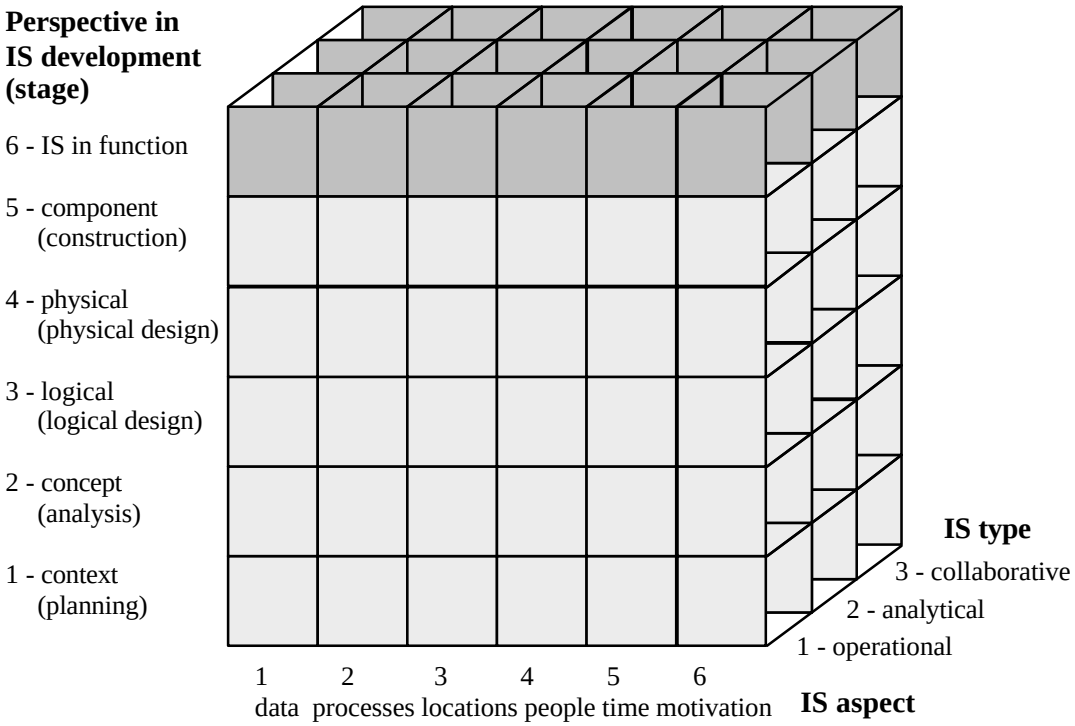

Figure 4. The information systems cube

The information systems cube may be a starting point in designing an IS curriculum. Some possible IS courses are indicated in Table 1, showing the cube coordinate value, the IS aspect, the IS development stage and the information subsystem. The asterisk (*) indicates that all possible values of the dimension are included.

Courses	Cube value	IS aspect	IS development stage	Information subsystem
Courses covering IS aspects				
Data management	[1;*;*]	Data	*	*
Process management	[2;*;*]	Process	*	*
Network Management	[3;*;*]	Network	*	*
Organisational and human resources	[4;*;*]	People	*	*
Event Management	[5;*;*]	Time	*	*
IS Motivation	[6;*;*]	Motivation	*	*

Courses covering IS development stage				
IS planning / strategy	[*;1;*]	*	Context	*
IS analysis	[*;2;*]	*	Concept	*
IS logical design	[*;3;*]	*	Logical	*
IS physical design	[*;4;*]	*	Physical	*
IS component design	[*;5;*]	*	Component	*
IS in function	[*;6;*]	*	Function	*
Courses covering information subsystems				
Operational / transactional systems	[*;*;1]	*	*	Operational
Analytical systems / Data Warehousing	[*;*;2]	*	*	Analytical
Documental systems / Content management	[*;*;3]	*	*	Collaborative
Courses covering IS cube dimensions combinations				
Databases	[1;*;1]	Data	*	Operational
Data warehouses	[1;*;2]	Data	*	Analytical
Document bases	[1;*;3]	Data	*	Collaborative
Transactional (Operational) processes	[2;*;1]	Process	*	Operational
Analytical processes	[2;*;2]	Process	*	Analytical
Collaboration processes	[2;*;3]	Process	*	Collaborative
Data mining	[1;*;2]	Data	*	Analytical
Systems analysis	[*;2;*]	*	Concept	*
Algorithms	[2;3;*]	Process	Logical	*
Programming	[2;4-5;*]	Process	Physical, Component	*
Networking	[3;*;*]	Locations	*	*
Business rules	[6;3;*]	Motivation	Logical	*
User documentation	[*;6;*]	*	Function	*
Implementing IS	[*;5;*]	*	Component	*

Table 1. Some courses of IS curriculum

The University of Zagreb, Faculty of Economy, offers an Undergraduate Degree Programme in business administration specializing in *Information technology in Business*. The programme offers a mix of classical courses in business administration (such as accounting, finance, etc.) and courses on information systems. The information systems curriculum is shown in Table 2. Each course is

classified according to its cube value, the IS aspect, the IS development stage, and the information subsystem.

Courses	Cube value	IS aspect	IS development stage	Information subsystem
Information systems	[*;1,6;*]	*	Context, Function	*
IS management	[6;1,6;*]	Motivation	Context, function	*
Software Engineering	[2;*;*]	Process	*	*
Databases (including data warehouses)	[1;*;*]	Data	*	*
Data mining	[1;*;2]	Data	*	Analytical
E-business	[1-5;6;1-2]	Data, Process, Network, People, Time	Function	Operational, Analytical
Business process reengineering	[2;1-2;1] and [6;1-3;1]	Process, Motivation	Context, Concept, Logical	Operational
Office automation	[*;*;3]	*	*	Collaborative
Expert systems	[1-2; 2-3;1]	Data, Process	Concept, Logical	Operational
Simulation	[*;2-3;1]	*	Concept, Logical	Operational
Telecommunications	[3;3-6;*]	Network	Logical, Physical, Component, Function	*
IS security	[1-4;4-5;1]	Data, Process, Network, People	Physical, Component	Operational

Table 2. An example of information systems curriculum

It is obviously that the information systems cube is not completely covered by the existing courses. Some cube regions are less covered or not at all covered by courses. Some questions may be raised. Does the curriculum need new courses to cover the holes? What are the consequence of the missing courses? Those issues have to be considered in order to re-evaluate and eventually re-model the curriculum.

4. CONCLUSION

Educational programs in information systems must be continually re-evaluated and revised. A serious problem is understanding and classifying IS topics in a methodical way. The very first task in analysing an existing information systems curriculum is to find the coverage level of the curriculum to IS areas of interest.

The paper presents the information systems cube. The cube may be considered as a tool that may facilitate understanding the existing information systems curriculum, identifying the coverage level of the information systems curriculum to IS areas, and finally supporting the process of re-evaluation and re-modelling the curriculum.

5. REFERENCES

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