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Adding value to information systems: A new model

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Abstract
In information systems, data are processed in various stages, and at every stage value is added in order to make the data useful for end users. Experts from different fields can assist these value-adding processes in various ways. This article discusses a theoretical model for determination of value-added processes in information systems. In this model, vital elements of every information system, that is, its goals, users, services and data, form a three-dimensional space. Each of these dimensions and the possible processes to add value in each dimension are discussed.

Keywords
Information systems, information systems design, Taylor's model, TEDS model, user environments, value-added model, value-adding processes

Introduction

As Kielgast and Hubbard (1997) said 'in today's world we are drowning in data but starving for knowledge'. Taylor (1982) believed that many information sources are useless without further processing of their content, that is, the addition of value. For Taylor an information system is a series of value-added processes that move the data to its final destination – in Taylor's mind this destination is action. An information environment is one in which problems and tasks arise for the end user, which require information for their resolution.

Experts in information-related fields such as computer engineers, information technology (IT) experts, and library and information professionals can and do use their experience to add value to information. Information has several specific characteristics such as the ability to be processed, used and reused repeatedly, shared, purchased and sold, transferred through time and space, reproduced, refined, interpreted, inferred, adapted, synthesized and converted to knowledge (Fattahi and Afshar, 2006). How can we think about the ways to exploit these characteristics in information systems in order to add value to information and better serve its users?

Several experts have already proposed distinctive models or frameworks for adding value to the content in information systems (Cisco and Strong, 1999; Eisenberg and Dirks, 2008; Scholl et al, 2011; Taylor, 1982, 1986). Others have focused on mechanisms and strategies for information system improvement which can also be regarded as adding value, and this latter group of studies can be frequently found in the fields of computer sciences and IT. Other studies include comparative or evaluative studies on different versions of specific databases or different ways for processing information entities in different information systems (e.g. Anagnostelis and Cook, 1997; Groote, 2000; Jatkevicius and Sebold, 2000; Kottai, 1993; Notess, 1998; Schopfel, 2013; Tenopir and Hover, 1993). The results of these studies indicate the different ways in which value can be added to information in information systems to increase its usefulness.

During a study on appropriate value-added models for a national scientific information system (Iranian National Current Research Information System, Software Engineering Method and Theory, Khoshroo and Fatemi, 2010), we noticed that there is no comprehensive model that can act as a road map for selecting value-adding processes in information systems and determining the roles that different subject experts could have in these processes. Existing models such as Taylor's have only focused on enrichment of the information environment to meet user needs.

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However, not enough attention has been paid to the functional aspects of information systems, for instance, the provision of interactive environments. This article proposes a theoretical model for studying added value in information systems and determining how experts from different fields can contribute to the value-adding process. In the subsequent sections, existing value-adding models are discussed and a new model is then proposed.

Literature review – The frameworks exploring added value

Taylor's model

Taylor's model (1982) was one of the first to provide an overarching theory and approach for addressing how information systems meet user needs through adding value. In his later book, *Value Added Processes in Information Systems*, Taylor (1986) explained that the process of transforming meaningless data into useful information can be described as a process of adding value and therefore usefulness. Basically, Taylor described a model that can be applied to many situations, from libraries to research centres, specializing in information management. The particular context is less important than the process that provides information, which enables the user to make choices, decisions, clarify problems or make sense of a situation (Kielgast and Hubbard, 1997). This process is represented as a value spectrum as shown in Figure 1. It begins with data and ends with action. Different values are added to data during this transformation.

Taylor's value-added model is user oriented. He considers that to develop systems that are more responsive to users, we must focus on the information use environment – the context in which people use information systems. Information systems either help users to perform better or not, but 'better performance' is defined according to the user's need. The model is presented in a three-column table (see Table 1). The first column contains six criteria that a user would consider in evaluating his/her reactions to an information system. The second column shows properties (values) that can be added by/to the information system to enable users to better meet their criteria and therefore their information needs. The third column presents activities that can be regarded as providing the means for delivering the added value needed in an information system (Eisenberg and Dirks, 2008). Taylor's model is generic and an information system for him can be human or mechanical (Pimentel, 2009).

Other researchers in information science have modified Taylor's model or proposed new models based on his. Pimentel (2009) has discussed the potential of the value-added model for knowledge organization. Palmquist (2005) argues that there is a lack of empirical studies for testing the value-added model.

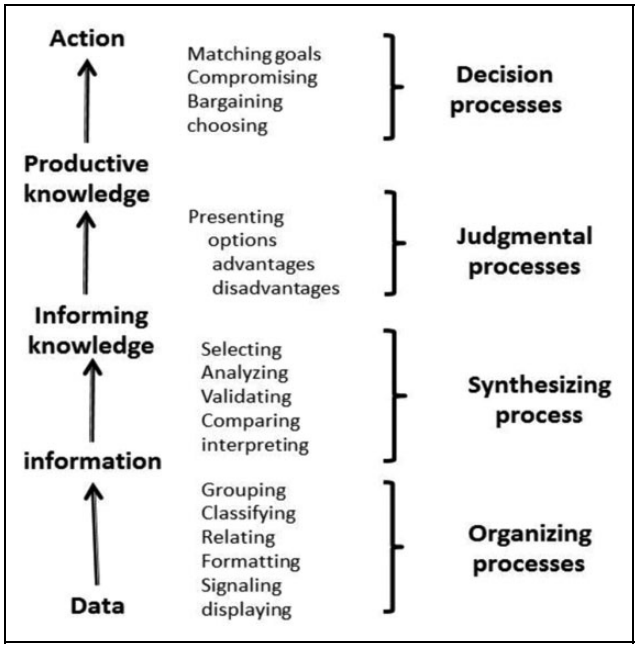

Figure 1. Value chain spectrum (Taylor, 1982).

Table 1. Taylor's value-added model (Pimentel, 2009).

User criteria of choice	Interface (value added)	System (value-added process: examples)
Ease of use	Browsing	Alphabetizing
	Formatting	Highlighting important terms
	Interfacing I (mediation)	
	Interfacing II (orientation)	
	Ordering	
	Physical accessibility	
Noise reduction	Access I (item identification)	Indexing
	Access II (subject description)	Vocabulary control
	Access III (subject summary)	Filtering
	Linkage	
	Precision	
	Selectivity	
Quality	Accuracy	Quality Control
	Comprehensiveness	Editing
	Currency	Updating
	Reliability	Analysing and comparing data
	Validity	
Adaptability	Closeness to problem	Provision of data manipulation capabilities
	Flexibility	
	Simplicity	
	Stimulatory	Ranking output for relevance
Time-Saving	Response speed	Reduction of processing time
Cost-Saving	Cost saving	Lower connect time price

Studying the value-added model shows that based on the user's information use environment, a set of criteria can be defined that users can use for choosing an information system. Properties that contribute to each criterion are then presented. Users are the core element of this model, and added value is determined based on what users want. In Taylor's model there is no clear borderline between content (data) and services. Added value is obtained only through data/information manipulation or system algorithm refinement. Moreover, the goals of an information system, which are the starting point for designing and developing every information system, are neglected in this model. Therefore, it can be argued that Taylor's model is not suitable for system design and is only useful for adding value to information systems that already exist. Pimentel (2009, p. 66) argues that the 'value-added model offers us a vocabulary grounded in the analysis and evaluation of Knowledge Organization (KO) practices; it is explicitly designed to assess value in a way that transcends the particularities of any one technology platform or use environment'.

The TEDS framework

Updating Taylor's model, Eisenberg and Dirks (2008) sought to accommodate the world-changing advances in IT. They believed that Taylor's model was still applicable particularly for the basic framework it provides. They also considered that their adaptation made their version of the model suitable for developing new systems and tools, refining and improving tools, and comparative assessment. They offer a number of additional ways to meet user criteria. A detailed explanation of their models is published as the TEDS framework (TEDS is an acronym for the authors (Taylor, Eisenberg, Dirks, & Scholl) in Scholl et al., 2011). Taylor's model and the TEDS framework (Table 2) have been applied to evaluating information systems, for example, the evaluation of professional sports team websites (Scholl et al., 2011).

Table 2. TEDS framework (Scholl et al., 2011).

Criteria	Values added
Ease of use	Browsing/browsability/searchability
	Formatting/presentation
	Mediation
	Orientation
	Order/consistency
	Accessibility
	Simplicity
Noise reduction	Item identification
	Subject description/classification/ controlled vocabulary
	Subject summary/summarization
	Linkage/referral
	Precision/(relevant retrieved) over (retrieved
	Selectivity
	Order
	Novelty
Quality	Accuracy
	Comprehensiveness
	Currency
	Reliability
	Validity
	Authority
Adaptability	Contextuality/closeness to problem
	Flexibility
	Simplicity
	Transaction
	Trust
	Feedback
	Community/social networking
	Individualization
	Localization
	Privacy
Performance	Cost saving
	Time saving
	Security
	Safety
Affection	Aesthetics
	Entertainment
	Engagement
	Stimulation
	Satisfaction/rewarding/incentivising

Value chain-based model

The information management value chain matrix has also been proposed for specifying how value can be added to information in information management processes. This model is based on Michael Porter's value chain concept (Cisco and Strong, 1999) and is presented in Table 3. The underlying assumption for this model is that information management is a process. In other words, the flow of information is a production line converting raw data into knowledge for decision-making. Conversion of information into knowledge requires the input, capture, filtering, organization, sharing and use and synthesis of many forms of information, data and documents (Cisco and Strong, 1999).

The value-added model presented by Taylor is also based on a value chain (from data to action), but it is user oriented rather than process oriented. In other words, in the Cisco and Strong value chain model, processes determine the values, whilst in Taylor's model, users' needs and preferences determine the values. The value chain model only considers information management and does not consider information system users. This model is best suited for answering questions such as 'which processes are behind information/document management?' but it is not applicable for customization of information management processes based on user preferences. In addition to users, functions and services are absent in this model. Generally speaking, this is a model for describing information and document management and it cannot be applied for adding value to information systems.

Table 3. Value chain matrix (Cisco and Strong, 1999).

Value chain activity	Records management Knowledge management	Document management
Capture	Provide service	Acquire
	Control costs	Create
	Select sources	Production process
	Tacit to explicit	
	Integrated process	
	Forms/formats	
Transform	Filter for value	Work management
	Classify/index	Profile
	Organize	Summarize
	Categorization	
	Format/aggregation	
Store	Inventory	Control/security
	Media/protection	Metadata
	Retain/dispose	Infrastructure
	Meta 'levels'	
	Relationships	
	Media/formats	
Transfer	Access/navigate	Share/collaborate
	Presentation	Push/pull delivery
	Modelling tools	Content/context
	Decision tools	
Apply	Human and automated	Human and automated
	Decisions and actions	Decisions and actions
	Integrated feedback	Integrated feedback
	Process	Process
	Human and automated	
	Decisions and actions	
	Integrated feedback	
	Process	

Value added in information systems

Value determines usefulness and importance (Cisco and Strong, 1999) and 'added value is one of those terms that we all too often hear being used in presentations and press releases to convey the idea that a firm is doing something worthy of attention' (Piccoli, 2007: 201). The concept of added value is featured frequently in an economic context; value-added tax is a well-known example. In this context, the value added to a good or service is reported through a numerical value and the processes that add value to a product are neglected.

For adding value, the first step is value detection, and Piccoli (2007) argues that value is in the eye of the customer. From the perspective of the information system's user, the facilities or actions that accelerate his/her access to information can be described as adding value, and the information system that offers better services and facilities will attract more users. Regardless of competitive values and capabilities that every information system includes, there are several ways by which value can be added to information in organizational contexts and, therefore, enhance decision support and the manager's decision-making process (Cisco and Strong, 1999). Adding contextual and competitive values to information systems, however, requires a more comprehensive model for studying value-added process. Existing models for adding value are not comprehensive and a common deficiency is their lack of consideration to the services which can be offered to users of information systems.

A new value-added model for information systems

Developing an information system requires thorough studying of the user community for which the information system is designed. Users' information needs are met through system content and services. Therefore, we could say that developing an information system requires careful consideration of four elements, namely, goals, users, content (data) and services.

Setting clear goals is essential and leads to the determination of users, content and services delivered by the information system. According to Bailey and Pearson (1983), if users perceive better provision of information, then a system is considered successful. An information system may offer a variety of information services to its users. These services can be delivered directly using human resources (like librarians, IT support stuff and so on) or using computer software or applications. These elements and their relationships can be represented as a three-dimensional (3D) space as shown in Figure 2.

This model consists of four elements, namely, goal, user, data and service. The three dimensions identified for studying value addition are based on the relationships of elements in each dimension:

1. goal–user–data
2. goal–user–service
3. goal–service–data

Information developers can consider added value either in one dimension only or take a comprehensive view that embrace all three dimensions simultaneously.

Dimension 1: Goal–user–data

Clear and obvious goals lead to precise definition of users and data requirements. Without clear goals, further value-adding processes will be obscure. Goal analysis is therefore the first step for adding value in every information system. The target users and content (data) of every information system must be specified. Data can be in various formats (text, image or video), various types (e.g. article, book or thesis) and in various forms (digital, analogue or hybrid).

In the first dimension, value is added through paying attention to both user and data. The goal of this dimension

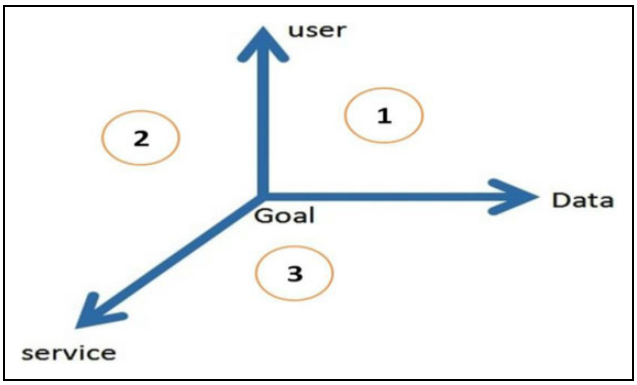

Figure 2. New three-dimensional model for adding value in information system.

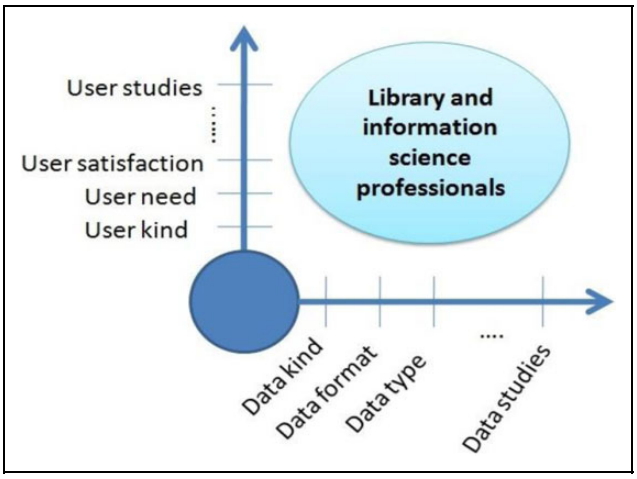

Figure 3. First dimension for added value to information systems.

is facilitating information discovery and use. According to user needs, the environment in which they will use information, their information-seeking behaviour and the information/data they need (right information type, right format, right secondary information and so on) will be included in the information system. The following examples show some defining features for adding value using this dimension:

- Selecting the most useful information items/sources based on users' needs.
- Determining appropriate data models and structures.
- Incorporating effective metadata schema and metadata elements for every entity included in the information system.
- Setting efficient search features to find users' desired data as quickly as possible. This includes browsability, simple and advanced search.
- Designing the information system in such a way that guarantees it can meet changing user needs including the possibility of new data specifications.

It is clear that librarians are the king of the first dimension's realm because librarians deal with user studies, need assessments, information acquisition, organization, dissemination and management in their routine work. Both the knowledge of the user community and issues about data and information are completely relevant to their skills, thus they are the best agents for adding value to information systems in this dimension. Since Taylor's model and TEDS framework manipulate data based on user criteria, these two models can be featured in this first dimension as pictured in Figure 3.

Dimension 2: Goal–user–service

The goals of every information system will determine the range of services that should be offered to its users. In this dimension, in addition to the user, the service element is considered. The goal of this dimension is information dissemination. One of the main purposes of every information system is adding to the knowledge of its users and providing an interactive user-centred environment. To do so, the questions such as what services are necessary to meet the information needs of the user community should be addressed.

For this dimension, it is necessary to determine the services that facilitate user interactions with information and other users. These services can be directly provided by human resources (such as virtual reference desks) or using computer software or applications (such as online translation or automatic metadata addition). This dimension provides the user community with its interactive environment.

Some of the value-added options in this dimension are:

- allowing customizability of information system based on user community needs;
- offering services like current awareness service and selective dissemination of information or other guidance and referral services through live chat, email and FAQs;
- ensuring users' privacy and confidentiality;
- providing an information translation service;
- making customer relationship management efficient and effective;
- presenting Web 2.0 technologies such as RSS feeds, wikis and blogs; and
- managing knowledge and converting tacit knowledge into explicit knowledge.

As shown in Figure 4, library and information science professionals (because of their experience in offering different information services to user communities), computer and IT professionals (because of their experience and knowledge about designing computer software and applications to deploy automated information services) and social

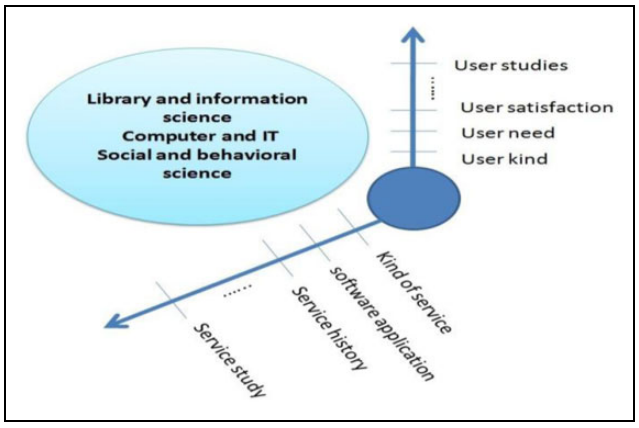

Figure 4. Second dimension for adding value to information systems.

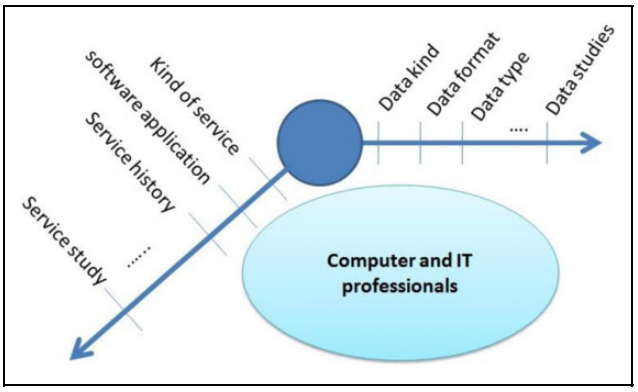

Figure 5. Third dimension for adding value to information systems

and behavioural science researchers (because of their expertise in doing research about user communities and users' cognitive and behavioural aspects that are necessary for offering efficient and effective services) are among the main groups that can play a major role in adding value to the information in this dimension.

Dimension 3: Goal–service–data

The third dimension in the model is goal–service–data. In this dimension, services and software applications for adding value to data are considered. In this dimension, it is presumed that goals of the information systems are the primary representation of users. The main function of this dimension is information generation or secondary information, the result of combining existing data and discovering patterns and relations governing them.

The designers of information systems in this dimension need to consider the data specifications and user needs represented in information system goals and then search for innovative ways to make existing data usable and extract new information for users. Some options for adding value in this dimension are:

- improving search and ranking algorithms;
- data mining;
- analysing data and automated report generation;
- data visualizing; and
- ensuring interoperability of information systems.

The main actors in this dimension, as shown in Figure 5, are computer and IT professionals because they deal with data structures, software design and programming, and they can develop effective software applications (as services) to process existing data effectively and add to the values of information systems. Data analysts can also play a major role in this dimension. They can analyse existing data using a range of tools and software and then develop good reports from this current information.

Conclusion

Studying added value in information system development has a long history and has been dealt with by many researchers. Actually, every kind of effort and service that can make data accessible and usable for potential users of an information system can be regarded as a form of adding value. Every information system consists of various elements. Among these elements, goals, users, data and services have great importance. The goals of an information system determine its objective, target users, content (data), and services. All these elements can be identified through precise goal analysis.

Existing models for adding value in information systems are very general and do not distinguish between the various aspects of value addition. The theoretical model proposed here specifies three dimensions for adding value through combining basic elements of every information system (i.e. goals, users, data and services) in the form of 3D model. Every kind of research and project dealing with information system enhancement can be nested in one of these three dimensions. Further studies are needed for testing the model's comprehensiveness and reliability.

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