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Toward an Information Service View of an Enterprise

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TOWARD AN INFORMATION SERVICE VIEW OF AN ENTERPRISE

Vers une vision de l'entreprise comme un service d'information

Research-in-Progress

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Abstract

An information service view engenders a conceptual shift from the provision of defined and preset services or applications, to an environment that enables users to select and integrate pre-built technology services in the ongoing creation and re-creation of unique information systems. This paper presents the findings of an empirical study into one organization's experience in implementing information services. Using grounded theory research, the study characterizes information services not as information technology artifacts, but as relationships between heterogeneous actors interacting with technology services for business purposes. The findings are used to propose an information services view of an enterprise. The view presents three clusters of concepts that are distinct yet interdependent: enabled (choreographed) by enterprise-wide directives and structures, driven (orchestrated) by information services management, and founded (instrumentalized) on information service IT architecture. The paper ends identifying implications not only for the completion of this study but also for research and practice.

Keywords: Information Service View, Service Oriented Enterprise, Design, Development

Résumé

Cet article présente les résultats d'une étude empirique de l'expérience d'une organisation dans la mise en œuvre des services d'information. En mobilisant la théorie enracinée, l'étude ne caractérise pas les services d'information comme des artefacts mais plutôt comme des relations entre agents hétérogènes qui interagissent avec les services de technologie pour des fins commerciales. Les résultats sont utilisés pour proposer une vision de l'entreprise comme un service d'information.

TOWARD AND INFORMATION SERVICE VIEW OF AN ENTERPRISE

Introduction

An emerging vision among researchers, consultants, and business analysts is that in the near future, corporate environments will connect people, places and things through information services enabled by a heterogeneous set of networked technologies. In this vision, scalable, cost-effective information technology (IT) capabilities will need to be provisioned as information services, delivered as information services, metered and managed as information services, and purchased as information services. This vision, which has been referred to as "service-centric computing," "information technology services," "information on demand," and "computing grid," is about shifting the focus from infrastructure (e.g., hardware, software, and the complexity of day-to-day operations) to information services. From a pragmatic perspective, an information service is "the offering of a capability for generating, acquiring, storing, transforming, processing, retrieving, utilizing, or making available information via technology" (Federal Communications Commission, 2008). An information service makes multiple, heterogeneous information sources discoverable and accessible by breaking through traditional barriers of location, structure and context. This vision has built momentum during the last decade propelled by the powerful combination of the potential of services to lower capital and operational costs of IT infrastructure, increasing technical maturity for service provision, and the increasing demand for organizational agility to respond to a rapidly-changing business environment.

To date, however, this vision raises more questions than it provides answers. If we understand more accurately the patterns of servicing and the dynamics of information service relationships, we can begin to tap the full potential and value of information services for decision-making and for coordination of collective action. In this research, information services are not viewed solely as IT artifacts, but instead, as systems of interaction that include the relationships between heterogeneous actors and information services to achieve a functional business goal. The heterogeneity of actors includes managers who make decisions and choices on behalf of an organization; users who envision desired goals and create meaning and value through the action of selecting and integrating technology services in the ongoing creation and re-creation of unique information systems; and the developers who participate in the design, development and deployment of the technology at the programmatic level. As such, the core research question in our investigation is: What are the critical processes and elements associated with the development and use of information services in organizations? This calls for the examination of information services in the context of their use and modification based on actors' decisions and choices, and the structural configuration of the technology within the organization.

We began by reviewing the existing IS literature on information services, and found that it is centered on technical development and implementation issues. There is currently no literature articulating a clear theory critique or theory development regarding a coherent view of information services. Theory frameworks have been used with respect to early considerations of information services at an economic level (Gurbaxani et al. 2000; Konana et.al 2000) or more recently through a theory-informed business process engineering framework (Xiao and Greer 2007). Only recently has the IS community even recognized the need to critique and develop new theory to inform this emerging area of interest (Rai and Sambamurthy 2006). Unfortunately, the lack of a theoretically based view of information services is evident from both the fragmentation of the empirical research and the lack of in-depth sophisticated explanations of the information service phenomena. Despite the numerous studies that deal with the design and aspects of the underlying emergent information services technologies (such as Service Oriented Architecture, Resource Oriented Architecture, and Web2.0 technologies), there has been little effort to explicate the high level goals of an information service view.

This research makes three main contributions. First, drawing on the rich data of an organization's experiences, the paper proposes a grounded information services view (ISV) of an enterprise. This grounded view is valid empirically "because the theory-building process is so intimately tied with evidence that it is very likely that the resultant theory will be consistent with the empirical observation" (Eisenhardt 1989, p. 547). As argued by Eisenhardt (1989), the iterative comparison across sites, methods, evidence, and literature that characterize such research leads to a "constant juxtaposition of conflicting realities [that] tends to 'unfreeze' thinking, and so the process has the potential to generate theory with less researcher bias than theory built from incremental studies or armchair, axiomatic deductions" (p. 546).

Second, the ISV proposed in this paper adds a new conceptualization of the IT artifact that can complement the five meta-categories identified by Orlikowski and Iacono (2001) and is summarized in Table 1. As an IT meta-category, the ISV bears similarities to the ensemble view. The ensemble view is focused on "ways in the which the technology is to be developed.. [or] on how technologies come to be used" (Orlikowski and Iacono 2001, p126), and recognizes that social structures are built into a technology and then those structures are realized by users. The ensemble view is built on a strong socio-technical structure, one that is upheld by the ISV. The primary distinction between these two views is that the ISV encompasses a vision of recombinant computing, decoupling, reuse and interactions between technology and actors, and focuses on ongoing possibilities for action that are supported by the business environment where the technology and actors are embedded. This may include tailoring, creation of individual ontologies, and the discovery of meaning. In the ISV, the user directly acts with services and data sources to create an individual ontology for the actor's context and tasks. In the context of computing, ontology deals with "how we can describe the furniture of the world" (Dourish 2001, p 129). A primary focus of the ISV, participatory action by the user, reflects the new demands for tailorable technologies (Germonprez et al.2007) and a shift toward embodied computing and meaning (Dourish 2001). Inherent to the ISV is the recognition that "the users and the designers do not, in fact, share the same model of the task domain" (Dourish 2001, p 131) and that information services "will often be used in ways that were nor anticipated in their design" (Winograd and Flores 1986 p 53). In the ISV, the user, rather than the developer, makes decisions about the relationships among information services, types of pertinent data and what things functionally go together as representations of the real world (Hovorka 2005). In addition, the ability to create recombinant information services provides agility and dynamic capabilities for users to respond to environmental volatility (Overby et al. 2006).

Third, this research will integrate the specific, grounded ISV advanced here with the more formal insights available from the existing information services literature, developing a more general view that will allow researchers and practitioners to explain, anticipate, and evaluate the implementation of information services in organizations.

Meta-category clusters	Categories
I. Tools View: Focuses on IT as an engineered artifact, expected to do what its designers intend it to do.	**As labor substitution tool.** IT to substitute for labor. **As productivity tool.** IT to enable individuals and social institutions to extend their reach and achieve performance benefits. **As information processing tools.** IT to alter and enhance the way of processing information. **As social relations tool.** IT to shift social networks, communication patterns, and work activities.
II. Proxy View: Focuses on one or a few elements that are understood to represent or stand for the essential aspect, property, or value of IT.	**As perception.** IT as perceptual, cognitive, and attitudinal responses as the critical variables. **As diffusion.** IT as diffused across social systems. **As capital.** IT as costs (e.g., dollars spent on hardware and/or software) in a company infrastructure.
III. Ensemble View: Focuses on dynamic interactions between people and technology—whether during construction, implementation, or use in organizations, or during the deployment of IT in a society.	**As development project.** IT as a social process of designing, developing, and implementing systems. **As production network.** IT as the focus on building of "systems of alliances." **As embedded systems.** IT as an evolving system embedded in a complex and dynamic social context. **As structure.** IT as embodied social structures that is built into the technology by designers during its development and then is appropriated by users as they interact with the technology.
IV. Computational view: Focuses on IT capabilities to support, process, model, or simulate world aspects.	**As algorithm.** IT as represented through algorithmic endeavors to build new or enhance existing computational systems. **As model.** IT as a representation of social, economic, and informational phenomena through the methodology of data modeling and simulation.
V. Nominal View: IT invoked "in name, but not in fact."	**As Reference:** IT as incidental or background information.

Table 1. Conceptualization of the IT artifact based on Orlikowski and Iacono (2001)

Research Methodology

The research methodology followed is that of grounded theory (Glaser and Strauss, 1967; Martin and Turner 1986, Turner 1983), with an aim of generating a descriptive and explanatory theory of the factors associated with the implementation of information services in organizations. This approach was adopted for three main reasons. First, grounded theory "is an inductive, theory discovery methodology that allows the research to develop a theoretical account of the general features of a topic while simultaneously grounding the account in empirical observations or data" (Martin and Turner 1986, p. 141). This approach is particularly useful in our study given that no theory of information services development and use has been established to date. While models of IT implementation do exist (Ginzberg 1981, Markus 1983) these deal largely with the development stages of IS implementation and focus extensively on user involvement and user relation. Second, a major premise of grounded theory is that to produce accurate and useful results, the complexities of the organizational context have to be incorporated into an understanding of the phenomenon, rather than be simplified or ignored (Martin and Turner 1986; Pettigrew 1990). Third, grounded theory facilitates "the generation of theories of process, sequence, and change pertaining to organizations, positions, and social interaction" (Glaser and Strauss 1967, p. 114). These three characteristics of grounded theory—inductive, contextual, and process-oriented—fit with the interpretive rather than positivist orientation of this research. The focus here is on developing a context-based, process-oriented description and explanation of the phenomenon.

Research site

The **National Oceanic and Atmospheric Administration** (**NOAA**) is a scientific agency of the United States Department of Commerce focused on the conditions of the oceans and the atmosphere. NOAA's *strategic vision* is "an informed society that uses a comprehensive understanding of the role of the oceans, coasts, and atmosphere in the global ecosystem to make the best social and economic decisions."[1] To support this vision, NOAA is moving to provide geospatial information services to its various partners and interested parties pertaining to the state of the oceans and the atmosphere. In particular, in this investigation an information service initiative called "the rich inventory" service that is taking place within the National Geophysical Data Center in Boulder, Colorado was analyzed.

Data collection

This investigation began "as close as possible to the ideal of no theory under consideration and no hypotheses to test" (Eisenhardt 1989, p. 536). In accordance with the approach advocated by Eisenhardt (1989, p. 536), the research problem was formulated and the existing information services literature was reviewed in order to "specify some potentially important variables," but "thinking about specific relationships between variables and theories as much as possible, especially at the outset of the process" was avoided.

Research access was negotiated with NOAA in August 2007; over the next six months the field research was conducted (on-site observation, interviews, and documentation review). The focus was on the activities and decisions that were taking place as information services were being developed and implemented. Collection of multiple types of data from different sources provided triangulation and increased the reliability of the study.

Interviews were arranged with all middle and top managers (4 people), the leaders of technology implementation (3 people), and information service users (4 people). All interviews were tailored to each person, focusing on the interviewee's perceptions of what happened and why, how decisions and actions were influenced and made, and how conflicts were resolved. Interviews also addressed the interviewee's role, attitude, and motivations. The interviews were recorded and transcribed. Additional observations were noted at the time of the interview. At the end of each interview, the subject was asked to suggest other individuals who would be important sources for understanding the implementation of the company's strategy. Written data included both primary sources (annual reports, organizational charts, strategic information service documents, and internal correspondence and memos) and secondary sources (relevant Internet publications).

[1] NOAA Strategic Plan – http://www.ppi.noaa.gov/spo.htm

Data analysis

The analysis of the data was conducted in several steps following the recommendations by Glaser and Strauss (1967) and Elsbach and Sutton (1992) to move back and forth between the empirical data and possible theoretical conceptualization. First, background documents, publicly available information, and transcripts of interviews and meetings were used to create a detailed narrative history of NOAA's information services strategy. Though this narrative is descriptive in nature, it provided a mechanism for condensing the large volume of data and moving toward a more in-depth, within-case analysis (Eisenhardt 1989). In both the study database and the narrative, we endeavored to create what Yin (1994, p. 84) calls a "chain of evidence" that allows others to "follow the derivation of any evidence from initial research questions to ultimate case study conclusions." Together, both of these tools allowed other researchers to examine the data and determine whether they draw the same or different conclusions. Such an approach increased the reliability of the entire study (Yin 1994).

A key step in the analysis was to first create an event listing, a technique that can provide insight into "what led to what, and when" (Miles and Huberman 1994, p. 110), and then a critical incident chart (Miles and Huberman 1994) depicting the sequence in which capabilities were developed. The resources and capabilities themselves represent the researcher's interpretation based on evidence gathered from interviewees.

The final step in the analysis involved a variation on qualitative pattern matching between theory and data (see Campbell 1975; and Yin 1994). First, the concepts derived from collective or coordinated actions and from the interaction between technology and business actors that appeared to have influenced the information service view at NOAA were compared and contrasted with the array of concepts that have been discussed in the existing information services literature. Interview transcripts were cross-checked to verify that each of these concepts was supported by at least two sources of evidence. Then these concepts were clustered into meta-concepts and mapped (as shown in Table 2), and the map was reviewed by several contacts at the research site. The entire analysis was highly iterative and involved moving back and forth among the data, the existing literature, and the concepts that emerged as salient at the research site.

Research Results to Date

The information service view developed from NOAA's experiences is depicted in Figure 1. The figure shows the concepts that emerged as salient from the data analysis, as well as how they interact with each other. This ISV is influenced by the premise that technology, human action, and institutional contexts interact and evolve over time (Orlikowski and Robey, 1991). The view presents three clusters of concepts (meta-concepts) that are distinctive yet interdependent: enabled (choreographed) by enterprise-wide directives and structures, driven (orchestrated) by information services management, and founded (instrumentalized) on information service IT architecture.

Starting on the left side of Figure 1, we can walk through this view. We have labeled the first cluster "Information Service Choreography." Choreography is the art of making structures in which movement occurs and the "patterns of interaction among services and templates for sequences (or more structures) of interactions" (Treadwell 2004). Choreography has been defined as a technical layer in the web service description language (Kavantzaz et al. 2004) as providing a technical description of complementary behavior, ordering rules and information exchange. In the same way, Information Service Choreography focuses on corporate directives and structures that enable an information service engagement, collaboration and coordination fabric to emerge among the heterogeneous actors interacting with information services for business purposes. As shown in Table 2, the four concepts that were found to be important in this cluster at NOAA are: *vision, information service strategy, funding*, and *governance*. A unified *vision* of the company's services is a critical foundation upon which to define a coordinated direction for the integration of information services. *Service strategy* encompasses the overall direction, policies, plans, targets, and performance assessment supporting the information services oriented vision. The *funding* model poses obstacles or facilitates allocating resources to sponsor the evolution of enterprise-wide information services. Due to the cross-organizational nature of end-to-end business processes composed from various information services, *governance* structures ensure that decision making processes extend to guarantee better ongoing alignment that those of "siloed" organizations.

Meta-concept clusters	Concepts	Data (From NOAA)
Service Choreography	Vision	• An informed society that uses a comprehensive understanding of the role of the oceans, coasts, and atmosphere in the global ecosystem to make the best social and economic decisions. Interdisciplinary data/model sharing.
	Strategy	• Provide stewardship, products, and services for geophysical data describing earth, marine, and solar-terrestrial environments in a geospatial format.
	Funding	• Information services are being funded as research projects. A manager expressed, "We can work together with a data providers to develop a proposal so that resources are found to get a data service started. Then, the funding goes away, and it is unclear how in a sustainable way we can keep working."
	Governance	• A working unit within the National Geophysical Data Center has emerged as the developer of information services at NOAA. However, given that there was not a choreographed effort to clearly establish the service governance there were concerns that "There is a lot of talk about information services… but not enough top-down push pressure to play together." However, senior staff are developing emergent roles that were missing in order to support the whole workflow in developing new information services.
Service Orchestration	Ongoing alignment Fostering participation	• "We make sure that none of the [information] service that we provided operates independently, but each connects to a bigger picture." • "We created a Climate Data database that included historical films. Now the data manager can easily search and offer it to other people, including scientists and the academic community to search. He developed a "Google maps" type of tool to look at the stations where this data comes from. He can get people who are all over the globe to look at this, and they can help us to prioritize what film should be digitized first. This is an example of how we don't necessarily have all the expertise in-house to figure out what we should rescue. Instead, now we have experts and interested parties out there helping."
	Incentive	• "Climate scientists today understand that to better understand climate change, they need to combine data coming from different sources and showing different signals."
Service Instrumentation	Accelerated methods	• Recognition that "laying-out the requirements in the traditional waterfall design" is not possible." Thus, "we go through multiple iterations of the design. It is more in terms of rapid prototyping."
	Interfaces & standards	• "For users to begin using our information services it is important to make barriers very low. We came with a very simple interface based on existing standards, an XML dialect as the language that users need to learn to interact with our archive databases."
	IT architecture	• "An important discussion we had was about server consolidation. Moving applications and workflow processes over to centralized systems to assist our IT staff in the overall care and feeding of hardware and facilitating troubleshooting as operating systems possess similar characteristics. Furthermore, performing a periodic (annual) review session of data set status or new acquisitions is helping our IT staff plan accordingly or at least providing them a means to evaluate and decide if the center has limitations to support anticipated growth."

Table 2. Information Services View of an Enterprise: Categories, Concepts and Findings

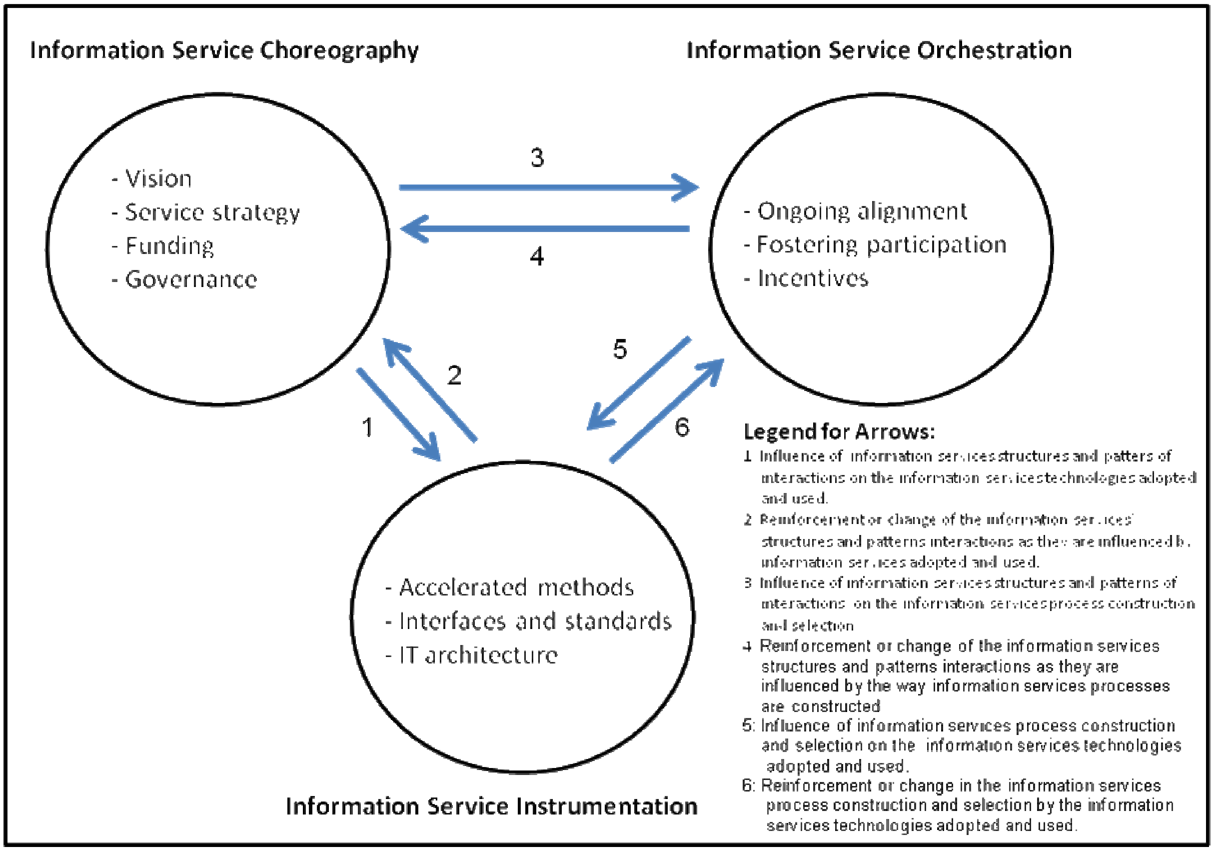

Figure 1. The information services view of an enterprise

We labeled the second cluster "Information Service Orchestration." Orchestration is the act of arranging a piece of music for an orchestra and assigning parts to the different musical instruments.[2] The great conductor and composer, Leonard Berstein said "The right music played by the right instruments at the right time in the right combination: that's good orchestration." As in music, information service orchestration is a critical element in the composition and deployment of sophisticated and complex information services. Like a music composer, an information service user has to select the necessary information service, to decide how they select and integrate information services in the ongoing creation and recreation of unique information systems. Information service orchestration has received significant attention over the past five years, especially from the Service Oriented Architecture community (Peltz 2003). Within that domain, it has been defined as "the ways in which business processes are constructed from Web services and other business processes, and how these processes interact" (Treadwell 2004). Table 2 shows the three concepts that were found to be important in this cluster at NOAA: *ongoing alignment, fostering participation*, and *incentives*. Given that information services are easily configured by managers and users, this drives *ongoing alignment* by helping to eliminate less strategic information services, abandon inefficient processes, institute best practices embedded in information services, and create new information services geared to support the enterprise's strategic and tactical business operations. Crucial for the emergence of new potential solutions as well a continuous information service improvements is *fostering participation* by helping managers and users discover information services, understanding their capabilities, and levering them optimally. The *incentives* of the organization and the various participants have to be aligned with the core competencies as well as the cultural and behavioral needs of the information service-oriented enterprise.

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[2] As defined in wordnet.princeton.edu.

The last cluster was labeled "Information Service Instrumentation." Instrumentation is a term used to refer to the particular combination of musical instruments employed in a composition, and to the properties of those instruments individually and has been applied as a term describing service management tools in requirements analysis (Cox and Kreger 2005). We define Information Service Instrumentation as the information technologies and services employed and their individual properties. Information Service oriented technologies are often thought of as being the drivers in implementing information services. However, what goes under the banner of information services technologies is often primarily plumbing technology. They are tools, important tools for sure, but only tools. The three concepts that were found to be important in this cluster at NOAA, as shown in Table 2, are: *accelerated methods, interfaces and standards*, and *IT architecture*. Rather than attempting to map out all the requirements before a system is developed or assume that unanticipated needs are not going to arise once it is in operation, *accelerated methods* focusing on proving a path for the system to be develop over time and improved—rapidly and continuously—well after it has gone live is more important. Simple *interfaces and standards* are needed to allow for effective decoupling to enable business process integration and interoperability with external business partners in addition to maximizing information service development efficiency. A coordinated and coherent *IT architecture* connects heterogeneous components and systems while providing multiple-channel access to information services, thus allowing business-units to focus on defining information service functionality independently of the technological infrastructure.

This research focuses especially on the technology, human action, and institutional interactions within each meta-cluster. For completeness, Figure 1 also shows the arrows connecting these three meta-concepts, recognizing the type of dynamic and continuous interactions among these clusters. The business rules and policies, the managed processes, and the technology are agile and flexible, and can be adapted quickly to new opportunities and competitive threats. Information services can be customized to provide special attention to preferred partners and alliances and activities. Furthermore, business partners can provide their own information services to create value-added inter-enterprise process chains. Thus, attending only one of these clusters would not provide a complete picture. By examining information services from the dynamic perspective of combining the three clusters, researchers can begin to understand how different actors within and across organizations define the critical components of information services of an enterprise.

Preliminary analysis reveals some interesting patterns. As one would expect, service instrumentation (e.g. standards, interfaces and architectures) are strongly influenced by both funding and governance. For example, NOAA is a distributed and highly heterogeneous organization. One scientific agency within NOAA had developed a set of services for its own user community. This has created tension and integration issues as the rest of the organization has moved to a geospatial database platform based on different standards and interfaces. This has financial implications as the two service sets compete for funding. Service choreography also affects instrumentation. In this case the vision for services was not a top-down or bottom-up initiative. Rather, it originated as a vision in a technical development group who had to both foster participation (to gain funding) and work within the constraints of pre-existing IT architectures. Simultaneously, instrumentation affects incentives and participation. The services development group requires a critical mass of users to secure continued funding for specific services. But users have their own priorities are not inclined to devote effort to services that require learning technical standards that are not broadly accepted and therefore valuable skill sets to learn. These types of interactions appear to be a form of Adaptive Structuration (DeSanctis and Poole, 1994). But other less well described interactions also appear among the meta-clusters. For example, to foster participation and recombinant service use, sufficient documentation must be available for users to be able to reconfigure services. This is a powerful incentive for users who wish to be able to connect to and use services and data that are outside their personal domain of expertise. But, it is also critical that meta-data be sufficient so that users have confidence that the services, data sets, and models they are combining are valid and can be used for the desired purpose (e.g. a map of topography used in weather modeling could not be used for navigation in a GPS system due to low resolution). Many of these interactions appear to be reinforcing or balancing feedbacks that have great implications for implementation success. Future work on the ISV should examine these interactions in greater detail as the processes within the meta-clusters are highly intertwined and the interactions will have strong influences on the development, implementation, adoption, and use of information services.

Conclusions

The vision of an information service view is the realization of user-enabled, real-time production of ad hoc information systems. Although new configurations for information systems can result from versioning or specific design changes, the evolutionary trajectory and evolving nature of systems is commonly the result of user-initiated mutability (Gregor and Jones 2007) or tailoring (Germonprez et al. 2007). The information service view embraces processes by which developers/providers expose information and allow user-initiated selection and configuration of information services that fit "the idea of the arising of something from out of itself, or emergent properties, and behavior." (Gregor and Jones 2007, p 326).

Traditional views of IT artifacts, as found by Orlikowski and Iacono (2001), assume that IT are either (a) an engineered artifact expected to do what its designers intended it to do, (b) a proxy focused on one or a few elements in common that are understood to represent or stand for the essential aspect, property or value of IT, (c) dynamic interactions between people and technology, or (d) a set of capabilities supporting process, model or simulation aspects of the world. This research-in-progress paper suggests that an information service view does not fit any of these lenses, and advances a new view focusing not simply in formally examining the technology and organizational context interactions, but in examining the recombinant nature of information services. The ISV presents three clusters of concepts (meta-concepts) that are distinctive yet interdependent: enabled (choreographed) by enterprise-wide directives and structures, driven (orchestrated) by information services management, and founded (instrumentalized) on information service IT architecture. It emphasizes a phenomenological *potential for action* in which the user continually tailors information services to create meaning and develops uses in new contexts or for new tasks (Germonprez et al., 2007). The ISV moves away from a predominant approach in systems design to over-engineer the IT artifact through a restricted set of data structures, interfaces, and reporting systems, so that work practices are constrained. This view is proposed as an initial meta-category of the key concepts and interactions that portray the process of developing and using information services in organizations. No claim is made that the concepts and interactions presented here are exhaustive. This research will proceed by studying information services implementations in other organizations. Thus, adding or modifying to the ideas presented here is how we build on each others' work.

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