A Meta-Theory for Understanding IS in Socio-Technical Systems

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Abstract

Information systems (IS) research often attempts to examine and explain how technology leads to outcomes through usage of information technology (IT). Although extensive research in this area has resulted in a significant number of theories, limited work has been done on integrating these theories. This paper presents adaptive structuration theory (AST) as a meta-theory for examining IS within a socio-technical systems (STS) context. Two main contributions are: 1) an understanding of meta-theory and how it fits with other meta-studies and 2) applying AST as a meta-theory to: A) achieve deeper domain understanding, B) provide an overarching perspective for reviewing literature and linking existing theories, and C) build and test better domain specific theories of IS within STS. The paper also provides illustrations on reviewing literature using AST in the virtual team domain as well as an illustration of theory development using meta-theory in the domain of technology-mediated learning.

1. Introduction

The role of information systems (IS) and information technologies (IT) in organizational change has been a subject of large investment and a topic for a lot of research. Often these efforts have failed to produce the promised benefits, and much research points to the lack of focus on socio-technical systems (STS) models (people, process, tasks, technology and their relationships) of change as the cause for failure [1-3]. STS models for organizational intervention and improvement have a long history in European management practice and research and have had a lesser influence in the US, where more technical focus has followed due to a scientific management way of seeing organizational improvement [4]. The accumulated STS literature shows marked improvement for effective change, easier worker transitions, and improved productivity over either a technical or a social view alone, but it also presents researchers and practitioners with daunting complexity [5].

Regarding IS as the technical side of STS efforts to implement change using group support systems, decision support systems or other forms of IT leaves an unbalanced view. Instead, viewing IS as influencing all elements of STS helps to explain conflicting findings and somewhat unclear theoretical contributions in IS research on these topics while providing a call for more integration of social and technical dynamics in future research [6-10].

IS researchers, similar to researchers in other disciplines, have recognized this challenge of integrating IS findings into larger theories that address both social and technical dynamics of change at any level – individual, group, or organizational [11]. Such arguments emerge in prominent journals and conferences where researchers call for a "*good grand theory*" [11, 12] or research on the Big '*T*' theories [13, 14]. There is a need to improve our understanding of such overall conceptual frameworks in the IS field, particularly within the framework of STS. In STS, issues of interaction between the various components of a system i.e. people, process, tasks and technology represent dynamic and complex relationships making linkage of findings across studies particularly valuable.

However, most individual IS studies often produce 'little t' theory. 'Little t' theories focus on a smaller number of constructs and are used to explain/predict empirical results in a particular context [14]. 'Little t' theory development allows for narrow studies examining few or no social factors. There are numerous such theories in IS research. They are valuable for understanding factors under certain very narrow conditions. How to aggregate and understand the 'little t' results in IS research in order to produce robust theory that applies more generally across domains remains unclear. One effort to clarify this process gives guidance on classifying 'little t' IS theories into five categories [12]. This classification system helps typify 'little t' contributions, but it lacks an overarching perspective for inter-relating the five categories of theories or guiding the understanding of relations between the theories within each classification, perhaps because it attempts to address a wide variety of contexts within IS research.

The synthetic view across 'little t' theories in order to describe and understand larger patterns is meta-theorizing [15]. Meta-theoretical discussions exist in IS reference disciplines such as library science [16], marketing [17] and management science [18, 19], and we see some sign of them in IS for understanding success [20]. Despite the recognition in various disciplines of the need for overarching or meta-theories,

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there is surprisingly little discussion in the IS discipline on what constitutes and how to build such a theory. While a number of papers discussing the constituents of a theory exists in IS literature [21, 22], the concept of meta theorizing has not adequately addressed.

Specifically, we find a paucity of meta-theoretical discussion of how IS operates within STS, where meta-theory would be particularly useful in guiding linkage of existing findings. This paper contributes to the discussion in the IS literature in two ways. First, we define meta-theory and present means for examining and placing meta-theoretical studies. Second, we develop and present an adaptive structuration theoretic (AST) meta-theory framework for improving studies of IS in STS.

In the next section we provide an introduction to the concept of meta-theory. Also presented is an overview of the major social theories that have influenced IS research, including their major assumptions. Following this we examine AST as a meta-theory for understanding IS in STS. We conclude with an example of how using AST as a meta-theory for IS in STS research enables theory building and linkage of theories.

2. The Constitution of a Meta-Theory

While meta-studies of IS research appear in top IS journals, little attention has been paid to the nature of meta-studies in IS research. In order to situate the present paper, we first define meta-theorization and its place within IS research.

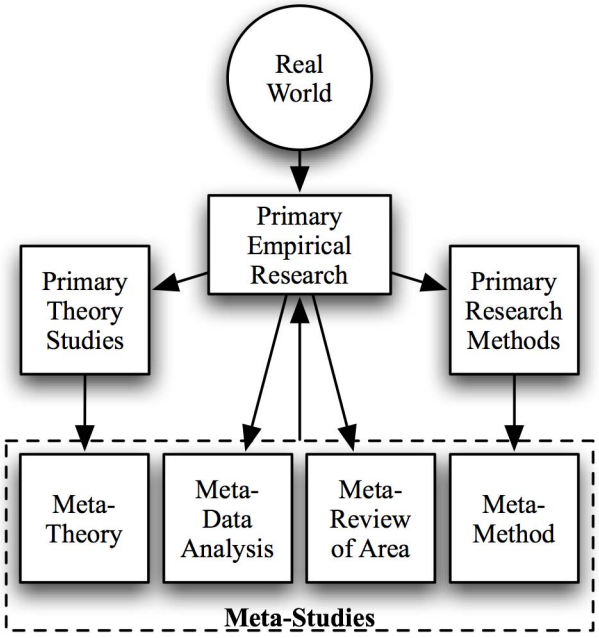

Figure 1: Primary/ Meta Study Relationship (Adapted from Zhao [23])

A meta *study* focuses on synthesizing knowledge in a particular area, summarizing the findings, and provides guidelines for future research in the area. In IS, we find various types of meta-studies, which may be characterized by four broad categories: meta-data analyses, meta-methods analyses, meta-reviews, and meta-theorizations (Figure 1). All meta-studies draw on primary empirical research.

Meta-data-analyses aggregate raw data collected from various studies to synthesize the findings related to the same phenomenon [24]. For example, Dennis et al. [25] performed a meta-data-analysis of the data collected in group decision support systems (GDSS) studies. These studies focus on the antecedents and outcomes of a specific phenomenon under investigation, focusing on the importance of the various constructs as well as the effect size of the relationships.

Meta-method analyses examine research methods, often focusing on how a given method has been applied in multiple studies. These studies elucidate methodological presuppositions necessary for application of a given method, evaluate efficacy of methods, or codify rules of usage [26]. For example, Chin [27] presented a review of the issues involved in structural equation modeling and suggested guidelines for IS researchers.

A meta-review, distinct from meta-data-analysis, provides an overview of a specific topic or domain. For example, Alavi and Leidner's [28] work summarizes the domain of knowledge management. In certain domains, such as group usage of technologies, we find that there may be numerous meta-reviews even within sub-domains such as virtual teams' literature [23, 29] and group support systems literature [30].

A meta-theorization reviews existing knowledge in a given domain, extracts constructs, and defines relationships between them, producing or evaluating a model that can parsimoniously display these constructs and relationships. Such studies define ways of seeing a field of study on the whole or evaluate ways of seeing a field of study in a domain as a whole.

A key difference between a meta-review and a meta-theorization is that a meta-review focuses on summing up what is known and what is not known within various established topics with the goal of guiding future research in the field being meta-reviewed, whereas a meta-theorization often involves meta-study of an existing theory in order to evaluate it. Thus, a meta-theorization constitutes second-order analysis as it pieces together findings from studies employing the theory (therefore "meta"). It examines the underlying structure of a theory questioning it and gathering the empirical evidence from existing studies

regarding its propositions and their adequacy and veracity [31]. Perhaps the best-known meta-theorization in the IS field is a study describing and producing a model of IS success [20, 32], which had only been implied theory prior to the meta-theorization's clarification.

Meta-theorizing greatly draws on empirical studies in the field (see Figure 1). Thus, as with all other forms of meta-analysis, such work is done after the theory has been developed and applied in a number of primary studies [33]. A good meta-theory (or a meta-theoretical perspective) has the following characteristics [30]:

1) Ability to provide a deeper understanding of the underlying theory: Meta-theorizing focuses on the theory itself to produce a better, a more profound understanding of the theory. It involves the effort to uncover the underlying structures of extant theory It makes a theory a subject matter of study in that it discusses the principles that are encompassed in the meta-theory [34]. Meta-theorizing is the study of theories to understand social realities while theory development is the study of a specific phenomenon in the social world more directly in order to create the theories. More specifically, meta-theorizing is interested in uncovering the 'sub-theoretical level', or the 'infrastructure' of the theory, so that the understanding can be applied to theoretical and empirical studies in social contexts such as e-learning, technology use, etc (see Figure 1).

2) Ability to provide Overarching perspectives: Meta-theories serve as a framework for developing overarching perspectives for a domain. Such an approach towards building an overarching approach allows us to assess the process by with the transcendent perspective is created. A meta-theory also has the ability to synthesize more than two theories into a coherent frame for simultaneously understanding them [15]. This is especially important in the case of Information Systems. IS currently struggles with its identity and understanding its core, a successful meta-theory would help clarify and solidify this core. For example – see work on meta-sociology [35].

3) Ability to facilitate theory development: A good meta-theory provides a net through which we understand a specific context. While the discussion of meta-theories is devoid of context, an understanding of the assumptions, constructs and their ontological arrangement should guide us through the theory development process for specific contexts.

3. AST as a Meta-Theory

In empirical studies, each of the goals outlined above would be independently studied; however, in a meta-theoretical study such as this one, they coincide [30]. In the following sections we examine these three goals in relation to adaptive structuration theory (AST) to identify how AST serves as a meta-theory for understanding IS in STS. .

3.1. Meta-theoretical Perspectives

A review of IS literature outlines two dominant philosophical camps used to explore IS STS: the structuralist and the voluntarist. The structuralist approach, also referred to as the deterministic, contingency or variance approach, holds that given a set of initial structures (social and technical phenomena) and context conditions, a result is predictable [36, 37]. This has been the dominant approach in the IS area. It emphasizes the fundamental importance of physical artifacts in explaining a phenomenon of interest. This approach assumes factors not controlled by the actor heavily determine the outcomes from a system. The actor's choices are assumed to be illusionary, marginal and/or trivial [33]. This is unfortunate for any IS research involving human interactions with IT, because, as discussed earlier, these IS phenomena exist within social contexts in which actors have agency to manipulate constructs during change processes [2].

Table 1: Meta-theoretical Perspectives in IS

	Structuralist approach [33]	Voluntarist approach	Structuration theory [38]	Adaptive Structuration theory [39]
Artifact	Norms and cultures that limit, shape or heavily constrain	Amendable products of free agents: constrain but also enable	Cognitive constraint/ resource: 'exist only as memory traces, '	Cognitive and objective constraint/ resource with intention (spirit)
Actors/ Agents	Choices: illusory, marginal and/or trivial. Norms/ culture dictate outcomes	Choices: real	Choices: real, perceptual	Choices: real, perceptual Limited to real options in objective structure

Research in IS using the voluntarist or process approach is limited. This approach assumes that humans make real choices and influence conditions and outcomes. It argues for a focus on the role of the any individuals interacting with IS, also termed actors, agents, or learners. Recent exemplary IS research calling for this approach has focused on developing a user-

centric agenda [34] and arguments for conceptualizing IS users as social actors[2]. A limitation of a voluntarist approach for understanding IS phenomena is its de-emphasis of structure or the role of the IT artifact [40].

An important theoretical perspective to come out of the voluntarist approach that helps re-emphasize structure is structuration theory [38]. Although structuration theory finds its home in the sociology literature, it has had a profound impact on IS research as well [41]. The core argument of this theory is that structures exist only in the minds of human actors or as traces of human actions. The focus is on the inter-subjectivity of actors enacting structures, that is, how they understand and come to use these structures, constraints and resources they understand to be present in a given situation. To understand social actions within IS phenomena, structuration theory has been very useful (see [42] and [41]for reviews of structuration theory in IS).

However, the use of structuration theory for understanding IS has a critical limitation. Structuration 'conflates' structure and agency i.e. reduces the understanding of structure to enacted cognitions [43]. IS, unlike other fields such as organizational behavior, is concerned with the use of artifacts in human-machine systems. The artifacts have properties of physical objects (machines) and enforce or limit human behavior. Conflating weakens the ability to understand technology's role in socio-technical change. The theory undermines any sense that structures are pre-constituted (e.g. embedded in technology by designers during development) and are relatively autonomous or influence action [44, 45].

Adaptive structuration theory draws on some of the assumptions of structuation theory and its voluntarist tradition; however, it adapts it to include advanced IT as a part of the social context and understanding of structure [39]. In this way, AST integrates the voluntarist and the structural approaches within an augmented structuration theory. AST allows structures to be separate from the actions or mind of actors making structures an *objective* part of the actor's context, allowing them to play an active role in the processes intervening between inputs and outputs, along with the actors [46].

AST argues that the influence of these objective structures in IT is mediated by the actions of the actors and their moves [39, 47-49]. In essence, AST enables the role of IS to be isolated and examined in conjunction with actors' actions during change processes. Thus, AST makes both technology and human agents part of the system, accounting for the interplay between people and technology, as well as the full predictability of IS use in individuals, group and organizations [50]. This allows AST to preserve the predictive potential of a deterministic perspective, while accounting for interpretive flexibility [51]. This provides a deep understanding of IS in STS.

3.2. Deeper Understanding

As a meta-theory, AST provides an ontological framework of constructs, assumptions and arguments. Poole and DeSanctis [41] identify seven requirements for applying AST effectively that will evoke the necessary understanding for each STS component given in Figure 2: 1) identification of structures, 2) relationships among structures, 3) description of the social system, 4) appropriation of the structures, 5) influence on structures, 6) influence of actors, and 7) power dynamics. We begin by mapping these constructs to a socio-technical view of a bounded work system (see Figure 2).

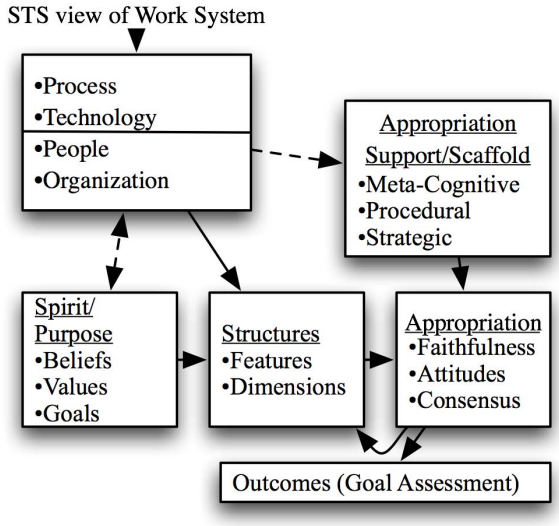

Figure 2: Adaptive structuration theory – a map of IS in a STS

AST outlines two basic premises. The first premise, incorporating the first three requirements, relates to the influence of structures embedded in a context. Structures are rules, resources and capabilities available in a work system [47]. Social and technical components compose STS. For these fundamental components, AST provides two subcategories each. The task or process and technology or specific IT comprise the technical component. People (users, programmers, end-users, etc.) and organizations (groups, teams, firms, society, etc.) comprise the social component. The work system establishes initial and potential structures [49].

To identify the structural potential and effect in a particular STS, one needs more structure specificity. AST structure encompasses spirit, features and dimensions [47] – see Figure 2. AST states that in a directed or purposeful social system, external structures

(such as ISs or ITs) reflect the beliefs, values and goals as understood by the designer within the work system, i.e., they are designed to reflect a spirit. The spirit is the "official line" which the IS presents to the participants regarding how to act, interpret the features and fill in the gaps in the procedures that are not explicitly specified [47].

Table 2: Structural Descriptors in AST

Structural Descriptor	Definition
Spirit	The general intent of the technology as it is presented to the user. It is reflected in the design and implementation
Features	Specific type of capabilities, rules and resources offered by or associated with the technology, technique or team
Dimensions	An aspect or characteristic of a structure, the bundled set of features implemented in a particular context

Structural features are the specific types of rules and resources offered by or associated with a structure [47]. For example, case studies have been broadly classified as McAleer Interactive Case Analysis (MICA) and Harvard Case Method (HCM) depending on the following features: role of the instructor, participant and the case guidelines [52]. Although useful in understanding the two different case study methods, Desiraju and Gopinath's [52] study comparing MICA and HCM failed to attribute learning differences to these features. Much technology-mediated learning research in the IS and education fields has also focused on the features in learning methods [53, 54], clarifying that the same features can be implemented in a variety of ways in different situations, often leading to very different learning outcomes. These implementation differences along with the variety of learning method features have led to inconsistent empirical comparisons, resulting in a lack of generalizable research results. Spirit and features are not enough to explain results.

AST also describes structures in terms of structural dimensions. A dimension describes an aspect of structure as a resource or constraint in work [47]. Dimensions are scalable, reflecting the amount of a given characteristic manifested in the structure. Sets of features are used to create a particular level of a dimension. For example, Silver used the dimension of restrictiveness to differentiate between decision support systems [55]. Restrictiveness measures the degree to which the features of a system limit the decision-making process. Features such as ability to show a spreadsheet, implement functions and executive programming code were used to measure restrictiveness of a decision support system. IT can positively or negatively influence dimensions in other elements of the work system, or it can provide dimensions that would not otherwise exist.

This focus on dimensions is unique to AST and helps IS researchers not only in enhancing our understanding of work system, but also in developing hypotheses and explaining research results in STS. In the above example, Desiraju and Gopinath [52] were able to explain their study results by focusing on the dimensions of feedback and restrictiveness of the case-based learning methods. Scaling of these dimensions can be accomplished by consulting manuals, reviewing the statements of designers, educators, or noting the comments of participants [47].

Table 3: Information Technology Structures: A Sample of Features and Dimensions

	Communication support	Process structuring	Information processing
Dimensions	Synchronicity Anonymity Simultaneity Interactivity Telepresence Richness	Restrictiveness Self-directivity Flexibility Synchronicity	Comprehensiveness Sophistication Feedback Personalization Authenticity
Features	Chat Email Audio/video/text Brainstorming	Scheduling Syllabus and course organizer Learning sequence	Voting Decision tools Simulated environment

Based on a review of IS literature, we have identified features and dimensions of IS structures, broadly classified by type of technology: communication support, process structuring and information processing [56] (Table 3). For example, some studies show that the GroupSystems™ brainstorming tool features the ability for participants to provide simultaneous input [9]. This input can be anonymous or not, varying the degree of the anonymity dimension [57]. The list in Table 3 represents major features and dimensions we found reviewing more than 100 articles; however, research exploring and identifying a complete set of features and dimensions would be useful. We present this selected set in order to demonstrate the broad applicability of AST as a meta-theory and the notion that a successful AST study may draw on only a portion of AST's features and dimensions as long as both are represented.

The applicability and usefulness of AST as a meta-theory extends to creation of propositions and hypotheses for predicting relationships between structures usage and outcomes. To accomplish this result, AST provides a framework into which other theories may be embedded. Such embedded theories help identify the criticality, scope and direction of impact as well as answer questions like: why certain

structures have more impact than others. The embedded theories provide a more detailed account of constructs and relationships for specialized domains of IS. We elaborate this point in section 3.3.

The second premise of AST, capturing the rest of the requirements outlined earlier, relates to the process of socio-technical work and the term 'reciprocal causation.' Together, the spirit, features, and dimensions of a structure form an STS' structural potential, which participants can draw upon to generate particular patterns of interaction and change [49].

These patterns guide coordination among people and provide procedures for accomplishing intentional change, such as achieving outcomes like learning goals [25] – see Figure 2. Actors can be purposeful in their actions and interact with the structures through the process of appropriation, i.e. a process where actors learn and adapt the structures based on their interpretation of the spirit[41]. The structures are produced and refined or discarded through interactions with actors. Since structures lead to appropriation and appropriation may cause changes in structures, thus is a reciprocal causation process (represented by the feedback arrow between appropriation and structures in Figure 2).

When analyzing technology appropriation, Poole and DeSanctis [58] suggest three constructs that indicate level of appropriation: faithfulness, attitudes and level of consensus. That is, IS will have its maximal effect on the whole if the design principles are kept intact (faithfulness), if members do not react negatively to it (attitudes), and if members agree substantially over how IS is used (consensus) (see Figure 2). Some generalized measures for faithfulness and consensus exist[59].

At any point in time, the use of technology can either be faithful or ironic. This construct is unique to AST's view on IS in STS and provides an important insight into IS potential and management over and above attitudes and consensus, which, arguably have been the target of much IS adoption research. A faithful appropriation of IS occurs when participants' interaction is consistent with the spirit [60]. We will elaborate this point in the domain of a technology-mediated learning goal example later. Faithfulness is not necessarily concerned with the precise duplication of the procedures provided; rather, it is concerned with whether the structures are used in a manner consistent with the overall goals and epistemological perspective. A unique or innovative use of the structures by the participant may well be faithful appropriation as long as the use is consistent with the spirit the IS is intended to promote[61].

Ironic appropriation occurs when the participants' interactions violate the spirit of the structure with or without abandoning the underlying learning method [58]. This introduces internal contradictions within the structures governing interaction. Over time, these contradictions will cause tensions in interactions that might lead to lower effectiveness of the structures. These contradictions must be addressed, detracting the participant(s) from the learning focus, leading to lower learning outcomes.

Actors in a STS can influence IS structures through 'reciprocal causation'. Depending on appropriation, structures may have to change to accommodate improved usage of IS, explaining the feedback loop between appropriation and structures. Poole et al. [60] identify nine categories of structuring moves they can employ to exert this influence: direct appropriation, substitution, combination, enlargement, constraint, contrast, affirmation, negation and ambiguity or neutrality. AST provides a framework with these moves, but why certain moves are more likely versus others or what influences efficacy of these moves remains unelaborated. When analyzing these, researchers need to drawn on narrower theories that focus on actors, their intentions, and individual expected outcomes on adoption or usage of IS. Theories from sociology such as the theory of reasoned action or theory of planned behavior as well as IS theories of technology adoption and acceptance would fit this need. As they are gathered into this AST STS meta-theory framework they become comparable and make sense as a coherent whole.

3.2.1 Appropriation Support/ Scaffolds

While the IS meta-theory framework may be used to gather IS theories to explain actors and moves during appropriation, it may also be used to understand the management of actors and their structuring moves. Within the framework, such influence is termed appropriation support or scaffolding. A scaffold, a term borrowed from the education literature, provides initial assistance to enhance faithful acceptance of structures. Scaffolding gradually fades as actors become more independent, confident and competent. Literature on scaffolds has focused predominantly on the effect of scaffolds on goal assessment outcomes[62]. Within the AST framework scaffolds influence appropriation of the work system structures, including IS structures. The AST literature has not paid much attention to scaffolding though some empirical research indicates that appropriation support or a scaffold can be critical for successful appropriation [63].

Three types of process scaffolds have been identified in the literature: meta-cognitive, procedural and strategic [62, 64]. Meta-cognitive scaffolds support individual reflection on learning, such as soliciting estimates of current understanding or cuing participants to identify prior related experiences they can reference.

Procedural scaffolding helps participants make navigation decisions, such as how to utilize available resources and tools. Empirical studies in GSS support the use of procedural scaffolds, especially those provided through facilitation [65]. Strategic scaffolds support participants in anticipating their interactions, such as analyzing, planning, and making tactical decisions. Hilmer and Dennis [66] used different decision making techniques in GSS and found positive support for strategic scaffolding. This process perspective for supporting appropriation within AST through scaffolds provides researchers with the ability to conceptualize manipulation of group usage and value gained from IS within an STS in order to explain its stability and adaptations as well as the impact it has on goal achievement (outcomes).

3.3. Overarching Perspective

Prior work has struggled to gain this overarching perspective on IS within STSs Borrowing from the virtual teams domain, we can map existing literature to the seven requirements for applying AST ("AST Focus") to examine which sorts of study have already been conducted [41] (Table 4). With this overarching perspective, we see that the majority of studies take a structuralist approach by attempting to explain and examine (1) structures and (5) contextual impacts of IS while neglecting the process effects of (2) relationships, (4) moves, (6-7) actors and power.

Table 4: AST Overarching Perspective Summary for Virtual Teams Domain

AST Focus	Applicable Topics/ Studies - (selected)	Total # Studies
1. Structures		
	common ICTs [67-69]; ICT comm. capability [10, 70-72]	>25
2. Relationships		
	IS – People [70, 73-76]; IS – Process [56, 69, 77-79]	~10
3. Social System		
	[80] – trust; [81, 82] – group structure & socialization	~20
4. Moves		
	[83, 84] - proactive or reactive; [85-87] - triggering events	~10
5. Contextual Impact		
	[88]- ICT impact; many GSS and CMC studies fit [7, 9, 89, 90]	>25
6. Actors		
	[91] - leader effectiveness	<5
7. Power		
	[92-94] – e-leadership	<5

As a tool for reviewing the literature, meta-theories such as AST provide an excellent tool for organizing the literature in a domain. By way of applying AST as a meta-theory for understanding IS in STS, researchers gain the ability to examine what is known in a domain as well as unknown from this overarching perspective, while also learning where their contributions would be most valuable. They may then use AST to guide their theory development.

3.4 Facilitate Theory Development

An extensive meta-review of the AST literature suggests that an adequate body of literature now exists to examine AST as a meta-theory [41]. This meta-theoretical examination aims to provide evidence of where and how AST serves as a meta-theory facilitating theory development within specific domains of IS within STS.

We find AST has been applied in at least five theory development domains within IS to facilitate development of theoretical models of appropriation and actor processes (see Table 5). DeSanctis & Poole [39] discuss the implementation of AST principles in a GDSS domain. Their model draws on theories of conflict handing, social judgments among other theories. A similar model for group discussion in a Geographic Information Systems (GIS) domain was proposed as AST2 [95]. This model clubbed structures into social/institutional, group and GIS. This model focused on understanding participatory decision situations. In an examination of communication practices, researches found that the need to study individual preferences as well as established organizational practices and media constraints [51, 96]. A fourth study in the TML domain examines effectiveness of learning methods used in e-learning. This model illustrates how e-learning technology, teams (if used) and learning techniques can all be combined together, while continuing to focus on the learner and his/her action [54]. The final domain is virtual teams, Leader intervention moves and effects have been examined, applying shared mental model theory as well as group development and transitional object theory [63, 97].

Table 5: Five AST-enabled IS models

Domain	(a) Embedded Theories; (b) Important structures; (c) Actor; (d) Phenomena explained
GSS/GDSS[39, 98-100]	
	(a) Conflict handling; Social Judgment; Decision Quality
	(b) Technology; Group; Task
	(c) Task oriented groups
	(d) Process of task Outcomes
GIS[95]	
	(a) Collaboration; negotiation; comm. action

	(b) Social-institutional; group participant; GIS
	(c) Groups
	(d) Participatory decision situations
Communications [51, 96]	
	(a) Rhetorical; Valance
	(b) Genres, institutionalized practices
	(c) Individuals Groups
	(d) Communication practices
e-learning [101, 102]	
	(a) Social Cognitive; Social Development; Task-Technology Fit
	(b) E-learning IT; Team; Learning Techniques
	(c) Learner
	(d) Learning method effectiveness
Virtual teams [63, 97]	
	(a) Shared Mental Model; Group Development
	(b) Team; Process; Technology
	(c) Team Leader
	(d) ICT facilitation effectiveness

3.3.2. Illustration of AST Meta-Theory Building

To illustrate how AST enables theory building involving IS in a STS, we briefly present an example from a study of technology-mediated learning (TML). With the increasing usage of technology in learning and training, TML has increasingly become a focus of interest for researchers. A central question in this domain is how does IS enable the process of learning? A theoretical model to address this question would need to take a process perspective to ascertain learning while also exhibiting falsifiability and utility [22]. Falsifiability determines if a theory is constructed such that empirical refutation is possible and relates to the ability to generate specific directional hypothesis / propositions within a specific phenomenon of interest. Utility, on the other hand, refers to the usefulness of a theoretical system used to study the phenomenon.

In TML, learning goals and epistemological perspective guide learning program design (the design of the STS). Learning goals focus on the desired knowledge to be attained [62, 103, 104], while epistemology establishes overarching beliefs and values about the nature of this knowledge and about what it means to "*know*" something [105]. The learning goals and epistemological perspective designed into the learning method and understood by individuals entering the learning process form the 'spirit' of its structures (Figure 3).Three sets of structures characterize the TML domain and socio-technical process at its core: team or the social setup of the team [39]; information technology or the array of possible uses of technology [106]; and learning technique or the specific procedures to attain learning goals [101]. These structures are shown in Figure 3. Domain-specific theories may be applied to create propositions for the process of interest (in this case learning) within the framework now that structures are identified.

For example, the most prevalent learning methods examined in end-user computer training are based on social cognitive theory (SCT). SCT focuses on two types of general learning methods: 1) observation of others' actions or behavior modeling and 2) observation of self-actions or enactive learning.

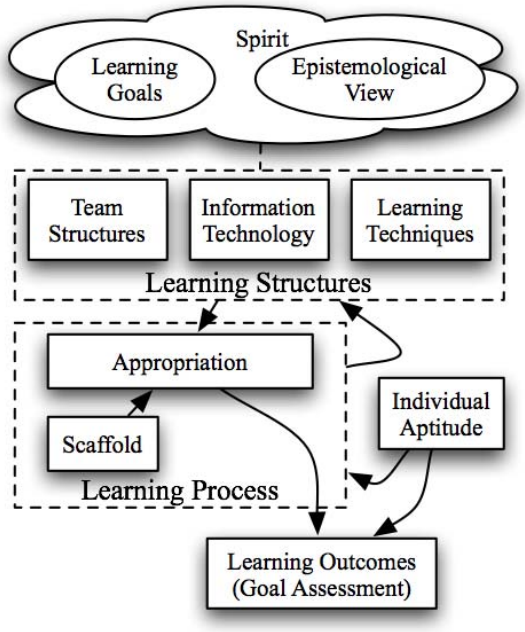

Figure 3: TML model enabled by AST

Gupta used an existing IT to implement SCT learning methods using a micro-simulated TML environment. The TML IT used, enabled examination of the dimensions of authenticity (showing the realism of action & consequence), restrictiveness (keeping learner focus on a restrictive set of functionality), and richness (audio/video presentation) for investigating computer-based behavioral modeling and its impact on learning outcomes. SCT indicates these dimensions would have a positive impact on learning outcomes. Similarly, social cognitive theory (which argues in favor of team work) can be dimensionalized and implemented through various features in a learning method. The AST framework enabled these theories to be combined and tested in a coherent model with scaffolds to support appropriation While the overall model illustrated the utility of the model, the use of specific theories makes the model falsifiable because expected outcomes and process results were specified and alternatives could be identified.

4. Conclusion

This paper offers two major contributions to IS research. First, it presents the components of meta-theory and distinguishes different types of meta-study so that future work may more readily undertake meta-theoretic efforts. Second, we identify how adaptive structuration theory (AST) serves as a meta-theory when applied to understand IS phenomena in socio-technical systems. This application enables linkage of other existing theories within an AST framework through its overarching perspective in order to gain a deeper understanding of a domain with IS STS and build better theories of processes of IS usage and influence on outcomes. Future IS research on IS in STS, contexts in which IS users play an active role during usage and may affect how usage develops, will benefit from applying this framework.

5. References

Due to the large number of citations in this work, we have abridged the reference format to include them all. Extended citations are available on request.

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