Enterprise-Level IS Research: Challenges and Potentials of Looking Beyond Enterprise Solutions

Robert Winter[a]
Institute of Information Management, University of St. Gallen, Mueller-Friedberg-Str. 8, 9000 St. Gallen, Switzerland

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Abstract: For more than 40 years, enterprise solutions, specifically enterprise systems, allowed companies to integrate enterprises' operations throughout. Starting with integrating core operational functions, the integration scope of enterprise solutions has increasingly widened, now often covering customer activities, activities along supply chains, and business analytics. IS research has contributed a wide range of explanatory and design knowledge dealing with this class of IS. During the last two decades, however, not only technological innovations, but also managerial / organizational innovations not only extend the affordances of enterprise solutions, but also challenge traditional approaches to their design and coordination. Particularly in large enterprises or complex business ecosystems, many IT/business alignment issues have not yet been fundamentally addressed, and novel, more decentralized (aka agile) forms of coordination have not yet been integrated with mainstream IS design and management practice. At the same time, IS complexity is not harnessed at all, and is increasingly threatening to impose limits to IS efficiency and flexibility gains. This position paper presents a cross-solution (= enterprise-level) perspective on IS, discusses the challenges of complexity and coordination for IS design and management, presents selected enterprise-level insights for IS coordination and governance, and explores avenues towards a more comprehensive body of knowledge on this important level of analysis.

1 INTRODUCTION

The history of enterprise systems can be traced back to the 1970ies. In the beginning, the integration scope was limited to a functional domain such as production planning, invoicing, payroll processing, or inventory management. Since functional integration cannot provide efficient support for cross-functional, end to end business processes (e.g., order-to-cash), the 1990ies brought a wide adoption of integrated enterprise systems as core component of corporate IT (Scheer & Schneider, 2005). Process-oriented enterprise systems facilitate cooperation and coordination of work across functional and organizational silos, thereby enabling significant efficacy and efficiency gains. Extending integration scope and leveraging such gains, later not only internal operative functions were integrated, but also customer activities and activities of partners along supply chains (Österle et al., 2001). Modern Enterprise Systems (e.g., SAP S/4 Hana) go even further by integrating operational functions of the 'extended enterprise' with advanced business analytics. Figure 1 illustrates the principle of integration, the common denominator of all evolution stages of traditional enterprise systems.

IS research has contributed a wide range of explanatory and design knowledge dealing with enterprise systems. During the last two decades, however, this (predominantly integration and adoption related) knowledge has been challenged not only by technological, but also by organizational innovations. On the *technology side*, cloud computing can enable easier and more flexible integration of functionalities across solutions, platforms, and / or vendors (Maliza Salleh et al., 2012). Digital innovation platforms (e.g., the Salesforce platform) enable to use customized complex services (of the platform core and complementors) without having to deal with their integration (Staub et al., 2021). On the

[a] https://orcid.org/0000-0001-9383-2276

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managerial side, decentralized control approaches (e.g., agile operations and agile development) not only influence the way organisations are structured, but also allow faster changes and concurrent variations of processes and supporting systems. The new 'ecosystem' level of management creates new integration affordances, but also induces a higher heterogeneity of data and supporting systems.

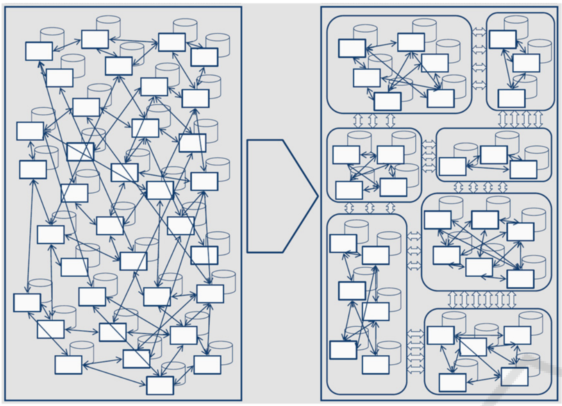

Figure 1: Integration Principle of enterprise systems (Murer et al., 2010, p. 127).

Over almost 50 years, the enterprise systems journey enabled ever increasing opportunities for efficacy and efficiency gains. The integration scope extended from function to process to 'extended enterprise' to ecosystem, while successively adding conceptual integration layers such as a shared operational data layer, a workflow management layer, an infrastructure integration layer, or a business networking layer. Not only computational power and digital proficiency in companies exploded over this long period, but also did enterprise system complexity - and thus IS complexity in general. Since many fundamental issues of IT/Business alignment seem to have not been fundamentally addressed yet (Luftman et al., 2013), complexity and governance challenges may increasingly impose limitations to the current and future efficacy and efficiency gains of enterprise integration. A more holistic, truly perspective "beyond enterprise systems" would allow for IS insights and designs that help to continue the success story.

2 THE ENTERPRISE LEVEL

Before discussing challenges for IS design and management and avenues towards a more comprehensive body of knowledge on the enterprise-level of IS research, we need to specify how the enterprise-level differs from other levels of analysis and how enterprise-level IS themes relate to existing IS discourses.

If IT/Business alignment and integration are considered to be essential perspectives for understanding and designing enterprise systems (and their interplay), the enterprise-level of analysis should include primarily concepts that (1) link business aspects to IT aspects and (2) are significant enough to be relevant on this 'global' level of analysis (i.e., are relevant beyond 'local' IS views by individuals, workgroups, functions, projects, etc.). While a business process, a software system, an organizational role or a business function are certainly relevant on other levels of analysis, they serve only as references on the enterprise level. The most relevant concepts on this level are (A) how software functionalities are used or could support business activities and (B) which functional capabilities are relevant to run the business – and thus need to be supported by organizational as well as business technology (usually IT) solutions. Since in complex organizations, thousands of business activities, software functionalities and functional capabilities exist (with a magnitude more interrelationships and references to business and technology concepts), multi-level aggregate views need to be established to keep enterprise-level models accessible to humans and to support 'architectural' coordination – in line with TOGAF's definition of enterprise architecture that focuses on "fundamental" components, their inter-relationships, and the principles and guidelines governing their design and evolution over time." (The Open Group, 2022).

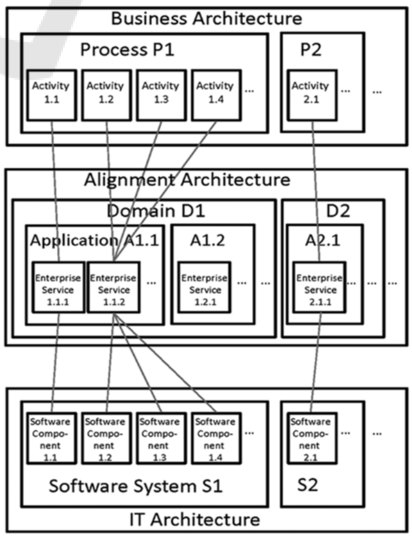

Figure 2: Principle of alignment models (Aier & Winter, 2009, p. 4).

Based on general systems theory and in analogy to design theories from Computer Science, Aier and Winter (2009) proposed "alignment" architecture concepts that (1) represent interdependencies between business and technology concepts and (2) can be aggregated to global models that are accessible for humans (Figure 2). They differentiate for aspect (A) "applications" as clusters of links that represent software support of business activities and (B) "capabilities" as aggregates of elementary capabilities. Capabilities constitute a common language for business concepts (e.g., activities) on the one side, and IT concepts (e.g., supporting IT functionalities) on the other. While the aggregation of applications is determined by the integration scope of respective enterprise systems, the aggregation of capabilities is based on their semantic closeness.

In practice, enterprise-level models of applications and enterprise-models of capabilities are frequently used in the context of Enterprise Architecture Management. Figure 3 illustrates how the references of an application architecture model to business concepts (in "business architecture" model) and IT concepts (in "infrastructure architecture" model) can be used to analyse and improve IT/Business alignment.

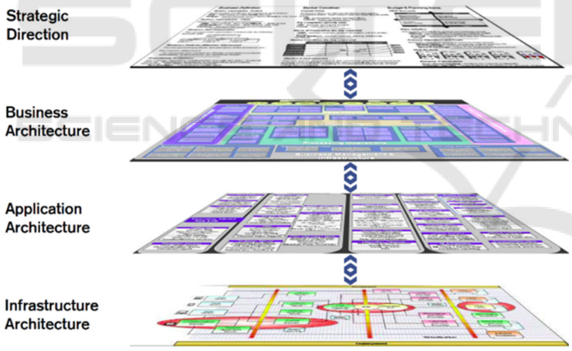

Figure 3: Enterprise-level analysis – Illustrated for application architecture (Source: Ernst, A.: Guest Lecture "Business Engineering Navigator", University of St.Gallen, 2013).

Based on requirements (1) and (2), the difference between enterprise-wide analysis and enterprise-level analysis can be defined: Enterprise-wide models represent entities across different units of an enterprise, but not necessarily linking business and IT aspects. In contrast, enterprise-level models are enterprise-wide models focusing on that linkage. Consequently, process architecture or software architecture models are enterprise-wide models, but (aggregate) application architecture and capability architecture models are enterprise-level models.

3 ENTERPRISE-LEVEL CHALLENGES AND EXEMPLARY APPROACHES

From the perspective (1) of IT/Business alignment and (2) significance to the entire enterprise, particularly the need for "architectural" coordination and the need to harness complexity stand out. Both challenges cannot be sufficiently approached in a decentral way, and both challenges have significant impact on enterprise performance. In the following, we present exemplary approaches to deal with these challenges from two contexts: large enterprise IS and digital platform-based business ecosystems.

3.1 Coordination and Governance

IS components generally do not act in isolation, but are interdependent with other IS components (Bernus & Schmidt, 2006). Not only needs component design to consider operational dependencies adequately, but also any changes to a single IS component may have unintended effects on multiple related IS components (Mocker, 2009) – both on the same architectural layer and on other layers.

Local business entities, such as project teams, tend to advocate for IS solutions that fit their specific needs and individual preferences. In contrast, global business entities, such as strategic initiatives, aim to improve the overall efficiency and effectiveness of the entire IS from an overarching, organization-wide perspective (Beese, Haki, et al., 2023). Consequently, concurrent 'local' change projects and increasing design / management autonomy lead to potentially inconsistent or redundant solutions (Hanseth & Lyytinen, 2010). In response to this challenge, researchers have investigated how to better restrain and control local change activities (Cram et al., 2016; Wiener et al., 2016). In practice, many organizations employ enterprise architecture management (EAM) for that purpose (Ross et al., 2006). While EAM activities aim at aligning local short-term, project-related activities with long-term, organization-wide objectives (Sidorova & Kappelman, 2011), e.g., by design sign-offs or architectural principles, decentral business structures and the prioritization of local project goals constantly create incoherencies. *Large enterprises* and *digital platforms* serve as two themes for illustrating how IS research can contribute to address this challenge.

3.1.1 Large Enterprise IS

Since traditional, coercive control mechanisms for architectural coordination appear to have reached their peak effectivity (Winter, 2014) and more formal control appears to be dysfunctional, clan control and self-control have been "discovered" by EAM and, combined with insights from digital nudging, implemented in the form of informal coordination interventions in large enterprises (Beese, Haki, et al., 2023). An example is the design and evaluation of an "architectural compliance label" that, instantiated for a change project, indicates the level of harm that project could create for the rest of the organization (Schilling et al., 2019). Published enterprise-wide, it has been shown that such labels have a coordinative aspect as they prevent local decision makers to deviate too much or too often from architectural principles and guidelines.

3.1.2 Digital Platforms

In digital platform-based business ecosystems, platform orchestrators often struggle to facilitate co-innovation whilst simultaneously retaining control over third-party complementors. To address this challenge, platform owners can deploy a variety of governance mechanisms such as platform boundary resources (with interfaces and programming resources as mechanisms), platform rules (with gatekeeping, decision rights, intellectual property sharing, pricing, revenue sharing as mechanisms) and ecosystem identity (with relational control as mechanism) (Staub et al., 2022). Staub et al. show that all except two mechanisms impact both, generativity and control, so that platform governance requires a complex design that cannot be solely based on a simple combination of mechanisms, but instead needs to be based on deeper insights on how platform/ecosystem types, platform strategies and governance configurations relate.

3.2 Harnessing Complexity

Xia and Lee (2005) propose distinguishing structural and dynamic, as well as technological and organizational aspects of complexity for change projects. Beese et al. (2023) show that this conceptualization of complexity is also useful on the enterprise level as it goes beyond a purely technical view on IS architecture and also includes organizational aspects. Complexity causes the overall IS architecture to become difficult to maintain and organizations struggle to flexibly respond to required or desired changes (Schmidt & Buxmann, 2011). Structural complexity is positively associated with dynamic complexity, organizational complexity is positively associated with technological complexity, and EAM moderates the relations between organizational complexity and technological complexity – and thus can improve IT/Business alignment (Beese, Haki, et al., 2023).

3.2.1 Large Enterprise IS

For *large companies*, Ross et al. investigate the relation between IS governance practices and business value, and propose a maturity development path (Ross, 2006; Ross et al., 2006): Starting with understanding business impacts of IT projects and establishing IT project standards in organizations with significant IT/Business disalignment, enterprise-level steering bodies and the development of enterprise-level systems constitute stage 2, along with establishing architecture standards and project sign-offs. On that basis, stage 3 is characterized by enhancing integration on the business side, business leadership of change initiatives, and establishing architectural guidelines. In any stage, governance practices need to be constantly adapted to changing context, technological and organizational change, and changing ambitions (Beese, Haki, et al., 2023). As this enterprise-level governance process is not only open-ended, but also implemented by a large number of (mostly local) interventions, this process has been appropriately designated as "managed evolution" (Murer et al., 2010).

3.2.2 Digital Platforms

According to the theory of platform leverages (Thomas et al., 2014), digital (innovation) platform-based business ecosystems promise to reduce complexity on the user side by providing mechanisms to flexibly integrate core platform service components with complementor's service components. Complexity on the user side is however reduced at the expense of significant complexity on of the supply side, both for platform design / orchestration and for complementor integration. Complexity has a pivotal role for determining the conditions under which innovation platforms outperform direct transactions between users and complementors (Schmid et al., 2021). Since these systems are relatively new objects of analysis, it has however yet to be clarified which complexity management mechanisms shall be applied to which aspects of complexity in digital platforms.

4 ENTERPRISE-LEVEL RESEARCH DOES NOT NEED TO BE MACROSCOPIC

The presented examples evidence that the enterprise level of analysis not only implies specific practical and research challenges, but also allows to develop specific insights and designs. Looking at large, complex systems does not necessarily enforce taking a macroscopic perspective – like much of traditional, descriptive IS research does. Approaches like agent-based simulation allow to study complexity and emergence of even large systems and derive novel insights. An example is how agent-based simulation of the interplay of large-scale social, business, and IT systems yield not only novel theoretical insights how different combinations of control intervention influence enterprise-level IS flexibility and efficiency (Haki et al., 2020). Such insights can also be translated into guidelines how to deal with complexity and emergence not only in development teams or business processes, but also on the enterprise level.

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