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Embedding Large-Scale Information Technology into the Organization's Work Systems

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Abstract

It has long been recognized that to reap intended benefits from their Information Systems (IS), organizations have to embed them, i.e. fully incorporate them into their projects and work systems. This has resulted in a considerable body of research on the topic. Despite this long-standing interest in studying the embeddedness of information systems, our understanding of how it develops and materializes in an organizational context is still limited. IS embeddedness unfolds over some time and involves not only the organization's work systems but also the individual users and behavioural team processes. However, IS/IT scholars have examined the phenomenon almost exclusively at the organizational level. This has resulted in an incomplete theoretical understanding of the phenomenon and a limited capacity of managers to devise interventions to secure IS embeddedness. Accordingly, the purpose of this paper is to offer a multilevel framework of IS embeddedness that contributes to advancing IS/IT embeddedness research while providing managers with useful insights about the kind of managerial interventions most suitable to secure IS embeddedness depending on whether the work environment or the organizational system is considered to be the primary embedding context. To do so, the study draws from extant research on micro-foundations, work-team literature in organizational psychology, and multilevel theory development to shed light on the mechanisms of embeddedness and its underlying processes; and how such mechanisms can be fostered and strengthened through examining the way individual, group and organizational characteristics interact and combine to give rise to the embeddedness of IS. In doing so, the study provides a better understanding of both the micro and macro-aspects of IS embeddedness including its emergence process on the one hand and managers' expanded capacity to secure the embeddedness of IS implemented under their auspices on the other hand.

Keywords: *Technology embeddedness, Enterprise information systems, Multilevel theory, Sensemaking, Legitimacy judgment, Managerial interventions*

1. Introduction

Various strategic imperatives such as effectiveness, efficiency, and the strengthening of organizational capabilities prompt organizations to deploy large-scale or Enterprise Information Systems (EIS) [1][2][3]. However, empirical evidence shows that organizations do not always yield the intended benefits - even when adoption, implementation, and acceptance were successful – unless such systems are fully embedded into the organization's

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work process [4][5]. Accordingly, Business and IT managers feel pressure to devise interventions likely to influence the extent to which IS implemented are embedded into the organization's work systems. To do this properly, managers need to understand the mechanisms of embeddedness and its underlying processes, including those relating to its emergence across organizational levels. However, such knowledge is currently limited.

The issue of IS embeddedness is generally examined with organizations' efforts to harness the potential of information systems in their business activities and strategies. Therefore, IS embeddedness studies are primarily concerned with whether an information system implemented has been integrated and used in a way that provides operational and strategic benefits to the organization. Indeed, embedding an information system amounts to incorporating it into the organization's work systems in a way that effectively supports and enables its business goals, activities, and strategies [6]. As such, IS embeddedness refers to the extent to which the use of technology permeates the organization's work systems that comprise procedures, standards, work habits as well as artifacts, and various existing technologie [7]. While contemporary IS-researchers recognized IS embeddedness as a critical variable, very few have offered theoretical explanations of its origins and process of formation, the critical elements that this formation is likely to involve, and much less how individual, group, and organizational characteristics combine to shape the emergence of the phenomenon at the organizational level. Indeed, since the issue of IS embeddedness involves harnessing the potential of information systems in the organization's business activities and strategies; it is inherently regarded as a strategic concern. Accordingly, IS-researchers have adopted the perspective of organizational theorists and strategy scholars who are generally concerned with firm-level phenomena. Incidentally, IS embeddedness studies find themselves disengaged and not concerned with IT management practices; and have paid little attention to the processes whereby individual behaviour, perceptions, judgments, and interactions give rise to IS embeddedness. As such, existing studies have peculiar difficulties in grasping the inner structure and process of EIS embeddedness. This is surprising since the success of organizational projects depends to a large extent on the knowledge, skills, and experience of individuals and groups within the organization. Thus, examining EIS embeddedness at solely the organizational level of analysis leaves unanswered some legitimate questions: what are the bottom-up process whereby IS embeddedness emerges from individual and group behaviours up to the organization? To what extent do practices specific to individuals and groups constrain or enable embeddedness? Which of these practices should IT management rely on to ensure an acceptable degree of IS embeddedness? I feel that a fruitful approach would be to increase our understanding of both the micro and macro-aspects of IS embeddedness including its emergence process. However, the real contribution will be advancing the theory of IS embeddedness in a way that informs IT management decisions intended to secure the extent to which IS implemented are embedded into the work systems. Accordingly, the purpose of this paper is to come up with multilevel theorizing about EIS embeddedness that contributes to advancing the theory of IS embeddedness while recasting the conversation to inform IT management practices so that managers can influence the extent to which IS implemented under their auspices are embedded. Fundamentally the paper is based upon the premise that individual, group, and organizational characteristics interact and combine to give rise to the embeddedness of IS.

The sections that follow first make the case for a multilevel examination of IS embeddedness; then develop the multilevel model of embeddedness highlighting the specific processes unfolding at the micro, meso, and organizational levels. Essential to this development is the two-step process of emergence, namely how the phenomenon originates in

the cognition, affect, behaviours, or other characteristics of individuals, is amplified by their interactions and manifests as a higher-level, collective phenomenon [8]. This includes discussion about macro-to-macro level Influences: higher-level contextual influences that do not have any effect at the lower level; and macro-to-micro influences, namely how contextual factors contribute to individual-level mechanisms. The paper concludes with a discussion of the conceptual and managerial implications of the model including limitations of the study and issues requiring further research.

2. The case for a multilevel model of IS embeddedness

A multilevel theory is neither always needed nor always better than a single-level theory [8], then what is, from an organizational perspective, the interest to develop a multilevel model of EIS embeddedness? Several reasons argue in favor of such an endeavor.

First, the key questions addressed in studies of organizational IS embeddedness — questions about the propensity of firms to initiate and sustain the IS embeddedness of complex technologies including the social, institutional, and political factors influencing this IS embeddedness [7][9] — imply cross-level interactions within the organizational system. The examination of level interactions is crucial for understanding how organizational-level processes of IS embeddedness are enacted by individuals, and how micro-level processes, through which managers and targeted users exert their agency, contribute to the formation and the emergence of organizational-level processes of IS embeddedness. Consideration of relationships between micro and macro-level processes entails a multilevel conceptualization of the phenomenon.

Second, EIS is typically implemented to improve organizational efficiency and performance. Therefore, their embeddedness is a matter of Information Technology (IT) management which means that it involves judgments, decisions, skills, knowledge and behavioural attributes from IT managers and targeted users in addition to the firm's competency in managing IS. This extends the theoretical focus on IS embeddedness as a uniquely organizational-level outcome to also include the processes through which it emerges from such individual-level resource components. Then, issues such as who are the actors, what they do, how they do it, and how all this combines to shape the IS embeddedness process become the main concerns for examination. This portrays IS embeddedness as a bottom-up multilevel process phenomenon resulting not only from organizational level factors but also actions performed by individuals and groups. This is consistent with a long tradition of IS research that stresses the role of users in shaping structures through the emergent nature of IS-organization interaction [10], the influence of decentralized actions, and in particular, how the value of IT is in practice created through micro and macro-level actions [11].

To sum up, the preceding arguments suggest the need for an integrative model linking organizational IS embeddedness with individual and group level behaviours to comprehensively examine the formation of IS embeddedness including the character of the emergence process.

3. A multilevel model of EIS embeddedness

Considering the foregoing development, IS embeddedness is defined as an organizational-level phenomenon originating at the individual and group levels. Thus, the development of the model is concerned, one the one hand, with accounting for how IS-embeddedness constructs and processes are related across levels, including the level of theory at which they

operate; and, on the other hand, with explaining the processes of emergence through which the phenomena at the individual and intermediate levels combine to form an organizational-level construct distinct from those at its origin, while also accounting for the theoretical process underlying the emergence of the phenomenon [8].

The simple but effective Coleman's [12] framework is adapted [Figure 1] to organize the theorizing effort and clearly distinguish between macro- (upper part) and micro (lower part) levels including how phenomena at these different levels are linked.

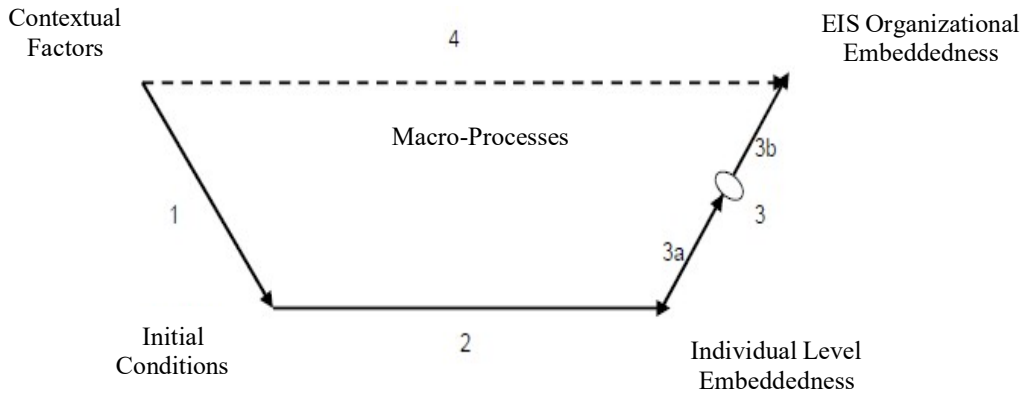

Figure 1. A general model of social science explanation

Accordingly, I first identify the initial conditions and then elucidate the mechanism by which the initial conditions give rise to the individual-level embeddedness process formation – how the encounter of targeted users and the EIS triggers diverse complementary processes of sensemaking, judgments and leverages the individual-level resource elements, namely the skills, knowledge and behavioural attributes needed to integrating EIS into their practices (Arrow 2). Second, integrating insights from the group/teams literature and the social cognition theory I explain the process of emergence of the phenomenon (Arrow 3a). At the same time, I describe how through dynamic interactions among individual-level elements properties of individual attributes – such as frames specific to each group of users – compile to form EIS embeddedness at the organizational level (Arrow 3b). Fourth, I examine the nature of the organizational-level embeddedness as a function of the compilation process. Finally, I specify the theoretical underpinning of the top-down process linking contextual factors at the macro-level with initial conditions of individual action at the micro-level (Arrow1).

3.1. Roots of EIS embeddedness: individual attributes

EIS embeddedness entails the breadth and depth of the use of the system. While the former (breadth of the system use) refers to the extent that the new EIS is incorporated into the organization's work practices such that it is no longer perceived as a novelty, but rather taken for granted; the latter conveys the idea that the EIS becomes so deeply embedded in organizational routines that it configures the workplace architecture by linking different organizational elements such as roles, formal procedures, and emergent routines. Accordingly, EIS embeddedness is better conceptualized as an organizational-level phenomenon originating in the individual attributes and human capital of targeted users and

managers. Within the human capital literature, it is widely accepted that the skills, knowledge, and experience of individuals can be leveraged for the organizational benefit [13]. More specifically, the role theory asserts that organizations achieve their goals and objective through their role structure, i.e. the coherent pattern of activities linking the work of individual members; and the ability of such members to perform a particular role rests in their knowledge, skills, behaviours, and attitudes [14]. This fundamental insight makes it clear that EIS embeddedness is rooted in the full range of knowledge, experience, skills, behaviour, and attitude (KESBAs) of target users and managers. The corresponding multi-level model of EIS embeddedness is illustrated in [Figure 2].

Considering that EIS embeddedness is both a process and a firm-level strategic outcome that has to do with IT-based value creation and competitive advantage, my argument harmonizes with the micro-foundations literature in strategic management which recommends paying considerable attention to explanatory mechanisms located at the level of individual action and interaction and particularly how the micro-foundations are linked to firm-level outcomes [15]. Theoretical and empirical work underscores the role of individuals in explaining firm-level heterogeneity and the variance in performance among firms [16][17]. Similarly, years of explanations for information technology's organizational consequences have shed light on the role of human agency in shaping the enactments of enterprise information systems after their implementation recognizing that targeted users are "relatively free to enact technologies in different ways. They can use it minimally, invoke it individually or collaboratively, and improvise in ways that produce novel and unanticipated consequences" [15] [pp.3]

Overall, extant theoretical and empirical work shows that micro-level elements, such as human agency, characteristics, knowledge, experience, skills, and cognitive capacities, play a crucial role in explaining organizational outcomes and may thus serve as microfoundations for understanding emergent organizational-level phenomena such as the embeddedness of EIS. Then, with regard to EIS embeddedness, what initial conditions and evolutionary processes trigger individual actions? such conditions are to be found in the encounter of the EIS with the targeted users as the use of specific technologies structures social interaction among users and shape organizational outcomes [19].

Individual-level EIS embeddedness refers to the extent to which the system is used beyond routine tasks and is positively supported by individual users. At this level, initial conditions are concerned with the user's encounter with the ambiguous nature of EIS. This triggers two complementary and concomitant micro-processes – sensemaking and social judgment – that structure individual actions (Arrow 2 in [Figure 1]). This complementarity and concomitance between the processes of sensemaking and legitimacy judgment takes place through the process of attribution regarding the psychological impact of opportunities and difficulties related to the use of technological innovation in organizational settings

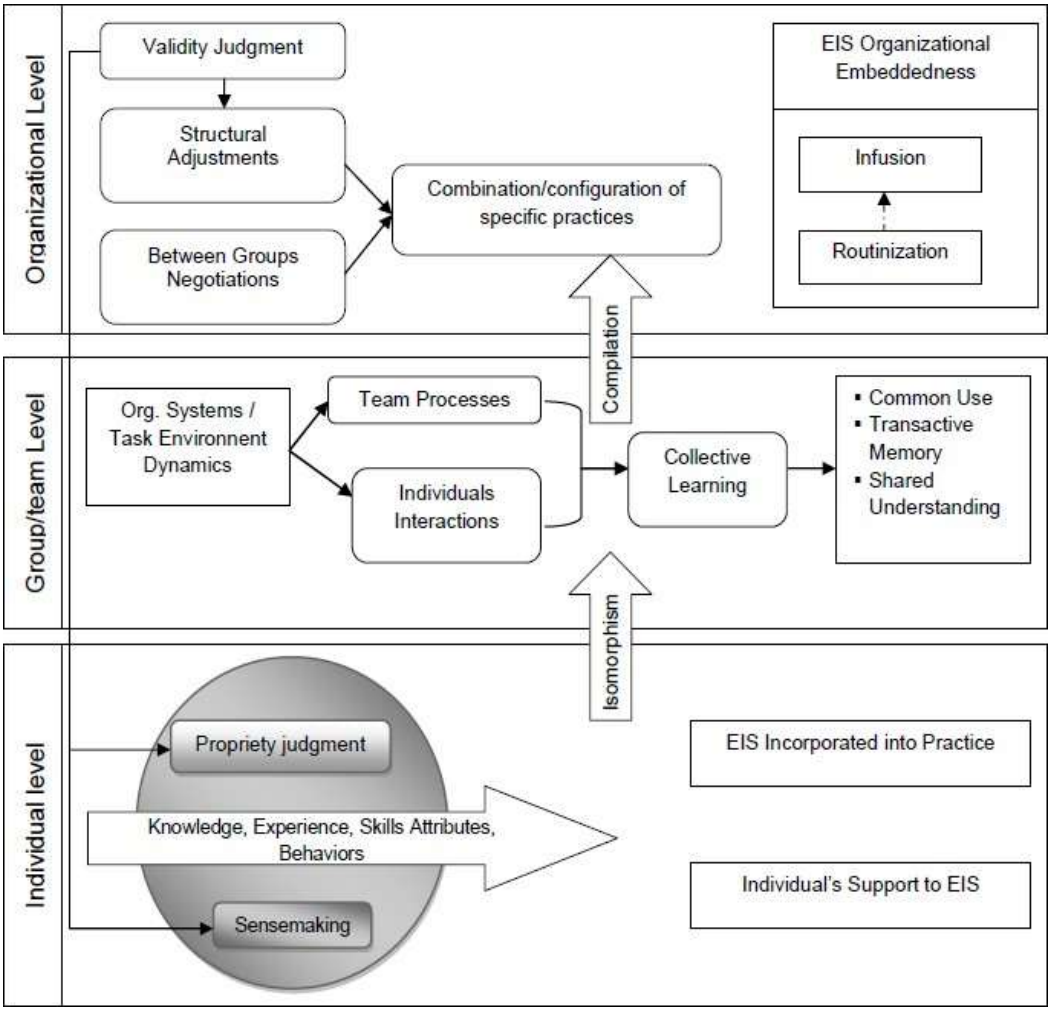

Figure 2. The multilevel model of EIS embeddedness

3.1.1. Sensemaking process

Enterprise Information Systems (EIS) are complex not only because of the institutional arrangements required for their deployment but also because of their constitutive technologies. EIS combines diverse technologies which are often exogenous to the organizational context and their deployment is usually unrolled in several phases and involves many planning activities. Nowadays, EIS also includes digital technologies such as the internet, artificial intelligence, big data, and cloud computing. Therefore, their introduction can be expected to create a certain mismatch into the existing systems of meaning, including the new requirements for day-to-day activities in the organizational context [19]. Such diverse technologies, therefore, affect targeted users' ability to reason about the structures making up EIS because technologies in general and new information technologies, in particular, lend themselves to interpretive flexibility. They allow for different possible and plausible interpretations by various social groups and may therefore be misunderstood, uncertain and complex [20][21][22]. Therefore, their deployment in the organizational environment is likely to create problems never before experienced by managers and the targeted users.

Information systems in general comprise artifacts – tangible and intangible resources [23][24] - and schemas - structural elements incorporated in the technologies [25]. In the case of EIS, artifacts and schemas are most of the time greater in scope and number and are moreover embedded in multiple structures. Therefore, the meaning ascribed to such a system may depend on a given actor's ability to access the system's schemas and artifacts; that is, his or her ability to reinterpret the schemas and the set of artifacts other than through those already incorporated into these artifacts. In addition, the diversity of actors involved exacerbates ambiguity in interpretations.

All of the above considerations highlight the ambiguous nature of EIS and the need for targeted users to make sense of the technologies underlying these systems so that they can use and integrate them into their practices. This requires individuals to combine their knowledge, experience, skills, behaviour, and abilities (i.e. the horizontal arrow at the bottom of [Figure 2]).

Embeddedness may thus be seen as having its roots in an individual's engagement in a process of 'sensemaking' when faced with the potential use of technological innovation. In the course of that interpretive effort, individuals become engaged emotionally, behaviourally, and cognitively[26][27] – since they need to explain by words or actions their understanding of the system in question, no matter how embryonic, to themselves and other people. Based on their interpretations, actors develop a certain number of hypotheses and expectations that form their understanding of what the EIS is and what it can be used for [20]. Thus, the sensemaking process ultimately serves to grasp the reasoning and philosophy underlying the use of the system [25]. In the course of that process, individuals build up a schema, a frame or kind of cognitive map in which language plays a central role by enabling them to start naming and explaining what had formerly been sensations or feelings [28]. This new comprehension of technology encompasses both the nature and applications of the information system including the consequences associated with its use in a given context. Sensemaking conditions individuals' actions, to the extent that ―they develop particular assumptions, expectations, and knowledge of the technology, which serve to shape subsequent actions toward it‖ [20]. Thus, at the individual level, the sensemaking process amounts to understanding the IS innovation, its use, and its incorporation into individuals' practices.

3.1.2. Social judgment process

The encounter between individuals and the new EIS involves also a process of social judgment that targeted users and other stakeholders render to the legitimacy of the enterprise information system. Legitimacy exists at both individual and collective levels. At the collective level, it refers to validity, namely the extent to which there appears to be a consensus within a collective that the entity is appropriate for its social context [29]. Here, I am concerned with the individual-level form of legitimacy, *propriety*, which essentially refers to an individual's judgment regarding an entity's social acceptability, namely the extent to which an entity is appropriate for its social context [29][30].

Empirical evidence from social psychological research suggests that instrumental and relational considerations influence to some extent individuals' legitimacy judgments [29]. Therefore, it is reasonable to think that judgments rendered by individuals on the legitimacy of a new EIS may rely on both instrumental and relational concerns. From an instrumental standpoint, some users may regard the new system as legitimate because of the instrumental needs protected or promoted by the system. In this regard, they may perceive that the deployment of the new system will benefit them personally or contribute to the achievement

of their unit/ organizational goals. Users may also view the EIS as legitimate because it benefits relational needs at the individual and group level. Some organizational members may perceive that because of the EIS, their social identities both as individuals and as a group were being granted new status and consideration within the organizational system. Barley's [19] study on the impact of Computerized Tomography (CT) scanner technology on the social order of two Boston radiology departments has evidenced such evolution of work relationships between radiologists and technicians because of the interpretive challenges induced by the new technology. Unlike x-rays, the CT scanner required some image interpretative ability to operate. These interpretive skills disrupted the traditional hierarchy of technicians (as image producers) and radiologists (as image interpreters), granting a new status to technicians within the organization. Insights from institutional theory suggest that the legitimacy of the EIS is likely to be also evaluated from a moral standpoint – whether or not it contributes to the overall well-being of the organization as defined by the system of values or organizational objectives [31]. For instance, in a study of the deployment of telehealth systems in four University hospitals in Quebec, it has been found that health professionals only agreed to make the effort to integrate telehealth systems into their practices when they finally felt that telehealth could help solve the persistent shortage of health professionals in remote areas and thus improve the quality of care for these populations [32].

Contrary to what the previous discussion seems to suggest, not all newly implemented Information systems lend themselves to an evaluative judgment mode. When a new category of information systems is designed, developed, and marketed upon concepts, principles, patterns, and technologies borrowed from other recognized and proven systems, it acquires the immunity to questioning that is cognitive legitimacy. As the future behaviour of the system can be anticipated, decision-making by different stakeholders (users, managers, and leaders) about the system is facilitated. A major observation of institutional theory is that isomorphism, a general tendency toward homogenization across entities confers legitimacy [33][34][35]. In other words, to the extent that a new entity complies with the expectations formulated by existing institutions, it is not being actively evaluated but, instead, is passively accepted and uncontested [29]. Therefore at the individual level, judgment on the propriety of the EIS can take place either through an evaluative mode, or passive judgment mode.

In summary, the deployment of EIS, because of its complex nature, triggers two complementary micro-level processes – sensemaking and propriety judgment – that structure individual actions. Both processes are somewhat intertwined but differ with respect to their mechanisms and outcomes. The sensemaking process encompasses activities whereby knowledge is processed, analyzed, understood, interpreted, and internalized. It amounts to understanding the IS innovation such that it can be used and incorporated into individuals' practice. The propriety judgment process produces a generalized legitimacy judgment that serves to guide users' behaviours with respect to the new EIS either to support it or to attempt to change it depending on whether it is perceived to be legitimate or not. Once a general legitimacy judgment has been granted, the system ceases to be subjected to evaluation. So the cognitive energy of users is now focused on assimilating bits and pieces of information to confirm the use of the system to the initial legitimacy judgment they have made. Accordingly, any new information about the instrumental, relational, or even moral status of the system is interpreted in a way that is consistent with the generalized legitimacy judgment. The legitimacy of the EIS helps stakeholders manage the uncertainty surrounding the system by relieving them from the obligation to re-evaluate their existing legitimacy judgments each time. In doing so, it serves to minimize the cognitive energy that stakeholders would otherwise have to invest to this end.

All that being said, a major concern remains unaddressed: since individuals assess propriety by benchmarking an entity's perceived properties and behaviours against a set of social norms, what could be the appropriate set of norms to be applied in the case of an EIS?

The choice of norms against which the entity's propriety is assessed is dictated by the nature of the entity on the one hand, and the evaluator's identity on the other. For this study, the entity under scrutiny is large-scale information systems deployed for strategic motives; then, the prevailing norms will be those governing the area of information systems management. Information Systems Management (ISM) – the managerial and technical strategies and competencies that significantly improve or add value to the use of information systems within an organization [36] – is a domain-relative practice, that is a complex form of socially established cooperative human activity that possesses its internal standards of excellence identifiable to practitioners and that always interlocks to a set of practices that is part of organizational life [37][38]. Essential to this claim is the notion of internal standards of excellence that constitutes the norms as they preclude evaluators from adopting a disconnected point of view to form their judgments based on individual preferences. Indeed, to enter practice, one must first silence one's judgments in order to learn the standards appropriate to the practice [37].

Regarding the evaluator's identity, it has been established that different categories of stakeholders use different sets of standards and arrive at different judgments about the legitimacy of an entity [39]. Thus, profession being a predominant social category usually plays a crucial role in the choice of the norms to be applied. Research in social psychology has shown that the relative prioritization of judgment dimensions is partly determined by the evaluator's social identification with the group associated with the entity under evaluation [29][40][41]. In Knowledge-based organizations such as healthcare establishments, law, engineering firms, etc., when professionals perceive that their professional norms are inscribed in technological innovation, they tend to use it frequently, consistently, and assiduously as much as needed for the potential benefits of the innovation to be realized. Technical normalization constitutes how the patterns of organizing (routines, rules protocols, etc.) are inscribed in technology and how organizations inscribe the technical world they produce [42]. In the study of the deployment of telehealth systems mentioned earlier [32], one strategy facilitating the embeddedness of telehealth systems is concerned with operational compatibility. During the design phase, manufacturers incorporated into the systems clinical contents and procedures that mirror the way targeted health professionals usually operate.

Taken together, the sensemaking and the legitimacy judgment processes enact a system of meaning that helps interpret what the system is and may be used for including the extent to which it is deemed appropriate for the social context. As such, both processes underpin the formation of the Individual level EIS embeddedness which is the extent to which the EIS is used beyond routine tasks and is positively supported by individual users.

3.2. The emergence process of EIS embeddedness

This section focuses on the mechanism whereby individual KESABs are amplified such that EIS embeddedness emerges to manifest as a higher-level, collective phenomenon. I argue that EIS embeddedness is manifested at the organizational level through a two-phase emergence process: from individual-level to meso-level (group/team level), then from group-level to organizational-level (i.e. arrow 3a and 3b in [Figure 1]). This distinction is required because the processes of emergence differ with respect to their mechanisms, and result in two different forms of emergence: composition – higher-level phenomena that are essentially

the same as they emerge across levels) – and compilation – higher-level phenomena sharing acommon domain or some common features but are not identical [8].

3.2.1. From individual to group level

Specifying the end states of composition or compilation is required but not sufficient, multilevel research must also provide the theoretical explanation of mechanisms driving the emergence.

At the group/team level, users mostly embed EIS through interacting with each other in practical work primarily within their work unit boundary. At this level, EIS embeddedness takes place through an interactive and collective learning process. This theoretical position points to interaction, team processes, and the organizational system and/ or task environment dynamics as the key enablers of the emergence process. Accordingly, the exposition of the theoretical process of EIS embeddedness emergence combines insights from social cognition theory and the groups/ teams literature.

Organizational-level outcomes are, among other factors, a function of the processes organizational members use to interact with each other to accomplish the work. The process is both the carrier and output of interaction since the process also emerges over time as team members interact and the team develops [43][44]. Thus interactions among individuals/team members and processes may provide insights into how EIS embeddedness emerges. Through interactions, team members combine their knowledge, experience, skills and behaviours, and effort to yield meaningful outcomes through a given technology and eventually contribute to the attainment of specific organizational goals. Processes capture how team members carry out this combination of resources [45].

Most of the time, team tasks – the primary focus of team-member activities – vary their demands on team processes because of the dynamic task environment in which they are embedded. As such, processes are dynamic and difficult to capture in real-time. However, recurrent patterns of interaction that constitute processes acquire certain emergent states such as collective cognitive structures and routinized behaviours patterns [45]. Indeed, emergent states are not team interaction or actions leading to outcomes, but the product of team processes that may serve as new inputs to subsequent processes and outcomes [43]. They are said emergent to stress their fluidity and sensitivity to contextual influences.

Based on the foregoing theoretical foundation, and considering that EIS embeddedness captures the various stages of diffusion such as adaptation, learning, and rationalization within the organization before yielding broad and in-depth use, the account of how EIS embeddedness emerges across levels has to be grounded in the theoretical processes of macrocognition and collective learning – namely, how groups, teams, and other collective entities learn, develop meaningful knowledge, and apply it to resolve significant and challenging problems [46]. Although iterative and cyclical the collective learning process tends to yield particular emergent states such as shared mental models, transactive memory, and others resulting from the amplification of KESABs through interactions among individuals and by which individual actions and the outcomes of the individual-level processes emerge across levels. Therefore, the fundamental question is: what triggers the interactions by which the individual's KESABs are amplified?

Theoretical insights gained within team effectiveness scholarship, make realize that interactions among targeted users of the EIS are triggered by either the organizational system (roles and structure) or the task environment that is in most cases the dominant embedding context for their task activity. More importantly, the task environment dynamics or

complexity – the extent to which task demands require interdependence and coordination among individuals [13] for accomplishing common goals – directly influences which specific KESABs may emerge into the organizational-level construct of EIS embeddedness. Indeed, enterprise information systems (EIS) are extended systems that cut across different functional and knowledge areas including several categories of actors. In today's organizations, the complexity of the tasks is increasingly inducing multidisciplinary and interdisciplinary modes of work organization that in turn require some degree of interdependence and coordination mechanisms. The extent of interdependences is a function of the task demands complexity. Provided the integration capability of EIS, organizational members are increasingly using them for exchanging knowledge, information, skills, and even behaviours; to consult each other and engage in collaborative works such as problem-solving, decision-making, etc. For this to work effectively, collaborators must share some common frames of reference regarding the nature of the task demands and the technology to be used.

Individuals' cognitive frames, namely the set of expectations and suppositions which inform their response to IS innovations, are generated in the context of social interactions with colleagues who are simultaneously engaged to interpret the new EIS. Thus, interactions are the means whereby individual scripts, schemas, and semantic labels are pooled to develop shared understandings and action plans. This process may be regarded as a specific instance of the general principle that individuals faced with ambiguous situations will attempt to derive meaning not only through independent testing and research but also through interactions with others undergoing the same experience [47][48]. When someone within a work unit finds how to carry out a particular task, teammates are quickly informed [18]. In other words, users take advantage of their social networks to acquire contextual knowledge from peers and find new ways to embed the EIS into their work practices [49]. As result, in addition to shared understanding, they build over time a transactive memory which is a sort of informal repertoire that keeps fellow team members aware of who knows what including smaller groups knowledgeable about specific system problems. Using such interactions, personal schemas and individual representations are diffused throughout the reference group. Interaction is undoubtedly the vehicle for this pooling, but common frames result primarily from the frequency of such interactions, which make up a cycle of events [50].

A high level of interdependence between the activities of a reference group, team tasks, increases the frequency of these cycles and, accordingly, the emergence and formation of shared mental models and transactive memory at the group level. Since embeddedness at the individual and group levels involves cognitive processes that result in the generation of frames of reference and categorization schemes, the emergence of embeddedness from the individual to the group level mainly conforms to a process composition model (the first upward arrow in [Figure 2]). Indeed, the group outcome comprises aggregated individual embeddedness inputs, namely the development of images, categories, vocabulary, expectations, and suppositions. In short, at both the group and individual levels the processes of embeddedness are functionally isomorphic, in that they share the same meaning, the same content, and the same nomological network [8]. In fact, at the individual level, the embedded sub-processes of embeddedness, in addition to the legitimacy judgment regarding the propriety of the EIS, involve making sense of the system, experimenting with possible applications, and integrating it into individuals' practices. At the group level, these include shared understanding of the EIS and coordinated use of it.

3.2.2. From group to organizational level

How do emergent states such as shared understanding and coordinated use relate to the dimensions of EIS embeddedness: breadth of usage or routinization and depth of usage or infusion? The routinization and infusion manifestations of embeddedness are essentially organizational phenomena, which have no individual counterparts. Therefore, at the organizational level, while group interactions are needed, they alone do not guarantee IS embeddedness. It is true that routinization results from the repetition of behaviour patterns as a result of within-group and between-group interactions. However, moving from the group to the organizational level, the embeddedness process becomes less fluid and incremental, more staccato and disconnected [28]. It usually entails modifications being made to existing systems and processes [51] that extend beyond social cognition. The inertia that constrains established institutions results in a more disjointed kind of organizational embeddedness mechanism compared with the more incremental development of the phenomenon at the individual and group levels. Further, through routinization, the modified structures, systems, and procedures provide a new context for interaction such that the representations of groups, and even more so of individuals, carry less weight because they are embedded in the organization [28].

There are also practical reasons for believing that embeddedness at the level of the organization may involve many fewer individuals than at the group level. In most organizations, individuals interact regularly only with a subset of other employees, whereas they will eventually interact with most if not all of the other members of a group [52]. In this regard, organizational embeddedness probably enacts a slower and riskier process, which is more sensitive to contextual factors. Each social group within a large organization (engineers, finance professionals, marketers, and human resources specialists) may well develop its technological frames relating to an EIS, for reasons as diverse as their specialty, occupation, or ideology [20]. In particular instances, EIS may be thought of as a trading zone where alternative beliefs, ideologies, frames, and logic are negotiated. Through such negotiations, EIS can serve "as an orchestration tool that connects contributions from heterogeneous actors by matching those with solutions to those with problems" [85, p.3]. We have all too often witnessed tense negotiations about the frames specific to each group involved, with their divergent belief systems and interests in an EIS project. This highlights that the negotiation process plays a key role in the EIS embeddedness at the organizational level. Such negotiations result in two possible outcomes. First, the technological frames of the different groups may be irreconcilable. If so, the embeddedness of the EIS will become a source of conflict that the collective legitimacy judgment, that is validity, may help resolve. In contrast, when the groups' frames are congruent, an implicit and reasonable agreement may result. In that event, it is conceivable that groups' specific practices might combine to configure the modalities of insertion of the EIS into the organizational routines of which it will become an integral part. It is also reasonable to surmise, given that this use is institutionalized, that it will become more widespread and more integrated and that modifications may be made to the EIS architecture to take account of how various organizational elements will henceforth be connected [54].

The above discussion suggests that organizational embeddedness would emerge from the compilation of the various frames specific to each user group. In this way, embeddedness at the organizational level does not result from the convergence of the technological frameworks of the various groups involved, but rather from their combination in a particular configuration. Consequently, the two constructs are qualitatively different at the two levels,

even though they are functionally equivalent. While group-level embeddedness results from the composition of the embeddedness process at the individual level and concerns the role and use of technological innovation, organizational embeddedness refers to the incorporation of the innovation into organizational routines, with subsequent changes to the administrative and technological infrastructure which translate into an extant use of it. Thus, both constructs are concerned with a single domain but are manifested in different ways. Accordingly, I contend that organizational embeddedness results from a compilation of each group's specific embeddedness into a particular configuration.

4. The organizational manifestation of EIS embeddedness

The result of emergence is a higher-level collective phenomenon [8], namely the organizational-level of EIS embeddedness. It is regarded as a second-order latent construct characterizing the breadth and depth of usage of a particular IS innovation within an organization (i.e the upper right in [Figure 2]. Accordingly, this section describes EIS embeddedness in terms of these two interrelated dimensions with regard to the emergence process.

The breadth of usage - EIS embeddedness originates in the users' KESABs and coalesces through the shared understandings of the groups and teams that make up the organization. Groups of users, by coordinating their actions with those of others, construct new schemes for coordinated actions, approve collective actions, memorize and repeat those initiatives, and transpose them to new situations until their use is *routinized* meaning perceived as normal, taken-for-granted. They also use these schemes more frequently which amounts to inserting them into the organization's routines. Over time, the repetition and persistence of these collective actions define patterns of interaction and communication, which routinization tends to formalize. Such coordination further requires actors to consider both frameworks for interaction at the organizational level, such as norms and rules, and guidelines at the individual level, such as scenarios and previous representations. These organizing principles may conflict with the socio-cognitive orientations of the group. When this happens, conflicts contribute to the generation of new cognitive configurations and may therefore lead to a renewed social representation of the system, given the social context in which it is embedded [55].

Depth of usage- Thus, as the organization progresses in its understanding of the EIS and its potential applications, it is likely that it will modify its work system along a cumulative learning curve. This in-depth understanding and the change it induces in the work system bring users to *infuse* the system into the organization: use more and more of the EIS's features to execute a larger set of tasks; use the EIS in a more integrated way to build links between sets of activities; finally use the EIS to perform activities that were not identifiable or feasible before the system was implemented [56]. All this relies on the existence of a networked memory system, a kind of transactive memory system that allows a shared awareness of the knowledge and expertise of members of the different groups [57]. A given team, functional area, or group can therefore access the distinct expertise and knowledge of others, thereby enabling collective access to knowledge and know-how as needed [58]. In other words, occupational groups develop a network structure that bundles distinctive know-how into a reservoir of knowledge, skills, experiences, and competencies. While theoretically distinct, breadth and depth of usage are interrelated.

4.1. Macro-to-macro level influences

In compilation models, the resulting construct is often subjected to higher-level contextual influences that do not have any effect at the lower level (i.e. arrow 4 in [Figure 1]). Experience and research show that for broad and in-depth usage to fully take place, some organizational interventions are needed to induce and sustain the changes necessary to accommodate the use of the EIS. Enterprise Information Systems (EIS) are not deployed in a vacuum, but in organizational contexts with well-established social structures such as operational practices, professional culture, and existing technologies. EIS, therefore, has the potential to significantly alter such an institutional base. This stresses that their deployment raises concerns about both their operational compatibility – compatibility with preferred work style, existing work practices, prior experience, and values – and technological compatibility which is the extent of EIS integration with other IS applications. Indeed, it is widely acknowledged that effective EIS organizational embeddedness relies upon specific adaptations in the post-deployment phase that address both the technology and organizational practices. Therefore, to foster and sustain broad and in-depth usage, a range of organizational, administrative, and technical measures must be carried out to ensure operational and technological compatibility. These include the implementation of new rules, procedures, governance schemes, and even the development of a management manual. In some cases, these measures also include adjustments to the administrative infrastructure (upper level of [Figure 2]) such as the provision of specialized human resources, the appointment of a coordinator, as well as a steering committee to try to create some sort of governance, and finally, dedicated budget lines [32].

In addition, since EIS is constantly evolving, IT managers and users must plan for continuous updates to harness technological advances to the improvement of the quality of services including the ability to cope with emerging organizational needs. Thus, in contrast to improvised learning which involves unplanned activities disseminating knowledge among users and which takes place at the group level, organizations have to deliberately implement strategies to reinforce learning and integration of targeted users' competencies in a way that induces normative responses and continuous upgrading of skill levels. This also stresses the need for a technology department that is vigilant enough to identify, evaluate and act on adaptation opportunities in an ongoing fashion.

4.2. Top-down: Macro-to-micro level influences

Contextual factors can significantly contribute to individual-level mechanisms (i.e. arrow 1 in [Figure 1]) that lead to collective responses which ultimately constitute macro phenomena [59]. With regard to EIS, institutional logics – the socially constructed patterns of symbols and material practices, assumptions, values, beliefs, and rules by which individuals and organizations produce and reproduce their material subsistence [60] – serve as ―material-symbolic languages‖ [61], sort of ―vocabularies of practice‖ [62] to provide stakeholders with meaning to the social reality embedded in the EIS. Institutional logics also provide stakeholders with reference and substance to form their validity beliefs (collective legitimacy judgment) about the EIS since they entail the transformation of practices by which objects are treated as they are reformed and/or taken up by one logic or another [61][62]. With that said, in the case of EIS embeddedness what institutional logic comes into play?

Theories of technological innovation suggest that institutional factors among others influence the extent to which complex technologies are embedded into organizational practice [7]. In the case of such innovations as EIS, institutional logic plays a role from the outset and

helps to reduce the ambiguity of interpretation surrounding them by proposing and organizing vision – that is, the public concept of an innovation held by a community. Thus, when the actors involved in EIS projects need to make sense of the situation, they do not act in a vacuum since they have at their disposal the representations of other actors that they can draw on to develop their own. In practice, EIS projects can be very different from one another, and will therefore employ quite distinct technologies which may often not yet be stabilized and may sometimes still be at the prototype stage. In this context, an organizing vision works as a sensemaking structure that helps actors to understand the nature of EIS and their roles in the social, technical, and economic context. In this way, the organizing vision may remove or minimize the ambiguity characterizing EIS and its possible applications. By formulating expectations, hypotheses, and knowledge regarding the key aspects of EIS, the organizing vision potentially ensures the congruence of the different technological frames of reference of the actors involved, and may also align the schemas incorporated in the configuration of these systems with the organization's institutional regime: its values, practices, norms, culture, and technologies. When this happens, individuals experience less conflict in integrating the new system into their practice.

The organizing vision also provides a legitimation structure that complements the sensemaking structure by conveying ideas or arguments that legitimize the IS innovation. That discourse deploys arguments that are technical and functional, as well as political, organizational, and business. The legitimation structure of the organizing vision seeks to communicate not only the expected benefits of the innovation but also the underlying philosophies and the reasons underpinning its development. For example, in addition to being presented as an IS innovation that allows organizations to improve customer service, increase sales and ensure greater efficiency, a Customer Relationship Management system (CRM) is promoted as a solution to challenges that companies face in differentiating their products due to commoditization resulting from a lack of knowledge of their customers. Similarly, by framing telehealth as a solution to the problems of access to healthcare for populations in remote areas and to the problem of recruiting and retaining physicians in these areas, the organizing vision not only clarifies the benefits of telehealth but also chimes with society's concern for equity [63]. In doing so, it emphasizes the importance of telehealth systems and strengthens the social norms and values that encourage and prize their use, motivating users to take ownership of them. Indeed, validity, the institutionalized legitimacy judgment exerts conformity pressure on stakeholders, in particular on targeted users. Thus, though individuals still rely on their propriety judgments, they are cognitively bound to infer propriety from judgments aggregated and communicated by macrolevel judgment validation institutions (media, regulators, judicial system) and from observable behaviours and discourse of other actors in their immediate social surrounding [30]. Therefore, an organizing vision enshrining the rationale for EIS in terms of existing values and social norms in the IS community provides stakeholders with substance to collectively render a positive legitimacy judgment about the EIS.

In all, concerning EIS, the organizing vision conveys the institutional logic that provides stakeholders with meaning to the social reality embedded in the EIS on the one hand and substance to form their valid judgment on the other.

5. Concluding discussion

One important contribution of this paper to the advancement of research on information systems concerns the development of a multilevel theory of EIS embeddedness since IS/IT

researchers have often examined it at only the organizational level. The model presented in [Figures 1] and [Figure 2] illustrates the individual-level and cross-level mechanisms whereby and through which the EIS embeddedness emerges at the organizational level. The model also draws attention to the top-down influence of macro contextual factors on mechanisms at the individual level. As such, the paper has implications for both researchers interested in understanding how individuals' attributes and interactions are amplified to emerge at the organizational level and managers interested in designing managerial interventions intended to foster IS embeddedness.

5.1. Conceptual implications

Defining EIS embeddedness as the organizational-level emergence of individual attributes may, at first sight, appear similar to existing conceptualizations since it shares their view of organizational learning dynamics involving the individuals and the organization.

I define the level of theory for EIS embeddedness at the organizational- level but I locate its origins in the individual-level characteristics in terms of personal skills, knowledge, experience, attitudes, and behaviours – accordingly, EIS embeddedness is conceptualized as fundamentally a multilevel bottom-up phenomenon. Second, my argumentation recognizes that, in its essence, embeddedness amounts to a process of institutionalization of the technology across the organization. Then, attention needs to be paid to the cognition of individuals at the micro-level as well as to the examination of interactions between individuals and institutions at the macro level [30]. In this regard, I specified at the micro-level the sensemaking and the legitimacy judgments mechanisms whereby individuals' experiences with technology are distilled into understandings that become apparent through the expression of personal skills, knowledge, and behaviours for the technology. At the same time, I also elucidated the macro-level influence of institutional factors on the processes of sensemaking and legitimacy judgment. Third, defining the level of theory of embeddedness at the organizational-level offers the opportunity to examine how the dominant embedding context triggers interactions between individuals and between groups, which in turn allow to suggest a two-phase emergence process of EIS embeddedness yielding different emergent states: a composition model from individual-level to the group-level resulting in shared understandings of the technology and a compilation process from the group-level to the organizational-level relying on transactive memory.

5.2. Managerial implications

An imperative for developing a multilevel model of EIS embeddedness lies in the fundamental mandate to enable managers to derive managerial interventions capable of securing the extent of EIS embeddedness. Designing managerial interventions concerning EIS embeddedness, instead of an isolated endeavor with well-defined boundaries, directs attention to a wider option, that of the basic organization of work. Interaction constitutes a central theme in our argumentation about how individual KESABs are amplified to higher levels. This opens up two potential avenues to develop managerial interventions aiming to foster and sustain rich interactions. The avenue taken depends on whether the work environment or the organizational system is considered to be the primary embedding context.

When the work environment constitutes the primary embedding context, the design of effective managerial interventions for supporting EIS embeddedness will naturally target the workflow structure since it defines interaction requirements and constraints that must be attended to. The main concern of such interventions will be to strengthen IS/IT capacity, as

weaknesses in this area are likely to seriously affect the organization's ability to embed strategic changes related to IS/IT [65]. Thus, particular attention must be paid to the role structure through which the coherent pattern of activities and relationships is embedded in the workflow structure. More importantly, such interventions will essentially involve fine-tuning the processes that derive the value from the EIS.

The organizational system, as the primary embedding context, connects managerial interventions to higher-level considerations: the success achieved by firms in their efforts to leverage the potential of information systems in their business activities and strategies [66] and the firm's superior ability to embed IS innovations relative to rivals. Accordingly, such managerial interventions are bound to address concerns about interactions throughout the organization's value creation processes. Developing such managerial interventions requires senior managers to have not only business expertise but also strategic IT-related knowledge, including a comprehensive knowledge of the organization. In other words, to sustain the sort of interactions that enable the capabilities of IS to enhance business performance, managerial interventions need to make business and IT imperatives a mutual priority as to embed them into the full intraorganizational relationships. In this regard, managerial interventions for facilitating EIS embeddedness are bound to leverage the firm's business strategies, work processes, products, and services including the firm's competitive assets. Taking stock of the accumulated wisdom about the organization of IT activities, such managerial interventions must be founded on an organizing logic of IT activities capable of fabricating organizational arrangements that enable the firm to couple tightly and adaptively business and IT knowledge on the one hand and to exploit its prevailing downstream and upstream business markets on the other [72].

Another potential area for managerial implication deals with influencing the legitimacy judgments of the EIS by potential users and particular stakeholders. This highlights that management must also design interventions to influence the social processes through which a newly deployed information system is legitimized. One particular kind of managerial intervention for fostering EIS embeddedness relates to rhetorical strategies that managers could develop and deploy to influence the propriety judgments and validity beliefs of potential users and other relevant stakeholders. To do so, managers can draw from the many rhetorical strategies found in discourse literature. With regard to IS innovations, propriety-promoting strategies could involve using success and failure narratives [73], problematizing the ineffectiveness of existing systems [74], and emphasizing the moral value of the extended use of the system. Regarding validity beliefs, rhetorical strategies may involve stressing either the endorsement of the EIS by an increasing number of peers [73] or presenting its implementation and future use as natural and inevitable because of the absence or the inadequacy of alternatives [75][76].

6. Limitations and future research directions

This article expands existing work on IS embeddedness by introducing a multilevel perspective. Despite its contributions, the paper has some limitations. For example, while offering a broad framework for developing a more complete examination of the embeddedness of EIS, the paper could not provide a definitive portrait of how the phenomenon takes place and unfolds. First, it is not practically possible to produce such a portrait in just one paper because the phenomenon is too complex, with too many variables affecting the dynamics at the different levels of analysis. These include variations in the technological artefacts, organizational culture, business sector, and psychological and

interpersonal dynamics, among many others. Second, the embeddedness process often develops over a period of time and its final structure may be coloured by interactions and events having taken place far away from the IT management realm. As such, the study should be only intended as a substantial beginning and as an invitation to scholars to further advance this agenda. To develop something approaching an accurate portrait of EIS embeddedness, scholars will need a much more extensive body of empirical research focusing on the actual embeddedness of many kinds of EIS in different contexts.

An important area for future research will be developing a strand of a substantive theory of EIS embeddedness. One of the most promising avenues to do so will be within the process of identifying differences and similarities of contextualized instances, and patterns, across and within case studies focused on a similar EIS [77]. In this study, EIS refers to an all-catching term encompassing information systems built around a global architecture and revolving around a single database (e.g. Enterprise Resources Planning (ERP), CRM, etc.), those that conform to a Best-of-Breed system (e.g. Knowledge Management Systems (KMS), Telehealth systems, etc), namely a combination of different software packages with a more limited focus that is integrated by the means of some type of middleware, sort of Enterprise Application Integration (EAI) solution. Such variations being intended for different business requirements are likely to induce significant variations in the processes of emergence. Another issue that merits further scrutiny concerns the organizational context. Organizational systems and task environments vary with the organization-type which dictates the workflow structure, thus interaction requirements and constraints. This will involve examining specific social processes (sensemaking, legitimacy judgments, and others) in a contextualized way, as parts of a wider configuration of social relations comprising groups, tasks, technology, and experience. Thus, case study research has to be privileged to favour both internal and external contextualization.

Finally, insights provided in this study may be used to foster the embeddedness of any kind of technological innovation characterized by complexity and fuzzy boundaries, involving both the elements of the innovation and the organizational structure required for a full implementation [78].

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