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Information systems strategy: Past, present, future?

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ABSTRACT

The purpose of this paper is to contribute to the current discourse in the Strategic Information Systems (SIS) domain about the future and identity of SIS. We draw on Nelson's theorisation of the co-evolution of *Physical* and *Social Technologies* to redefine the SIS domain as a Complex Adaptive System (CAS) for the co-evolution of ICT and organisational capabilities and business models to create social and economic value. We conduct a meta-analysis of the domain based on a longitudinal review of SIS research over 33 years, and contrary to contemporaneous SIS literature which suggests that a paradigm shift may be necessary to address the increased turbulence, uncertainty and dynamism in the emerging competitive landscape, we find that the SIS research domain has the requisite adaptive capacity to evolve gracefully to address the challenges of the emerging networked competitive landscape. Drawing on complexity science and network theory we identify four priorities for the development of the domain for the future: conceptualisation of the SIS Domain as a CAS for the co-evolution of *Physical* and *Social Technologies*; the adoption of the network paradigm; access to a science of networks; and adoption of Complexity Science as an articulation device within SIS and across disciplines.

1. Introduction

The CFP for this special issue emphasises the strategic nature of Information Systems (IS) and calls for the re-invigoration of the Strategic Information Systems (SIS) research agenda. In this paper we examine the way in which SIS research has engaged with changes in the IS field over the past decades before moving on to examine whether the present is a pivotal moment for the trajectory of SIS research. We then speculate on what challenges the future might bring and how the SIS research domain should prepare itself to address these.

Our direct contribution to the call is the identification of the following four priorities for change in the domain as it moves from the present to the future: conceptualisation of the SIS Domain as a Complex Adaptive System for the co-evolution of *Physical* and *Social Technologies*; the adoption of the network paradigm; access to a science of networks; and adoption of Complexity Science as an articulation device within SIS and across disciplines. In the process of doing this we also make two other contributions to the SIS literature:

First, our examination of the past is through the analysis of the SIS research trajectory as evidenced by SIS publications in *MIS Quarterly* (*MISQ*), *Information Systems Research* (*ISR*) and the *Journal of Strategic Information Systems* (*JSIS*). There already exists a cumulative literature base of reviews tracking the evolution of the content of SIS research, and the emergence of dominant themes over the years. The purpose of our analysis is complementary and distinct: it is to develop a meta-level systemic perspective of the dimensions of change in the SIS domain as it accommodates the changes in IS research and

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practice over time. We contribute to the extant literature by drawing on Nelson's (2003) theorisation of coevolution of *Physical and Social Technologies* to define the SIS domain as a Complex Adaptive System for the coevolution of these technologies at all scales of organisation. Our analysis suggests that the SIS domain has the adaptive capacity to move smoothly from the present to the future.

Second, we contribute to the emerging literature on the need for a fundamental shift for SIS research and practice in order to deal with the increased turbulence, uncertainty and dynamism in the competitive landscape (e.g. El Sawy et al., 2010; Nevo and Wade, 2010; Pavlou and El Sawy, 2006; Pavlou and El Sawy, 2010; Tanriverdi et al., 2010). Many of the papers in that vein have used concepts from complexity science to articulate the key features that need to be addressed in the current and future "quests" for SIS researchers. We contribute to this body of work by establishing the need to move from a descriptive use of Complexity Science concepts to a more analytic, modelling-based approach to understand the relationship between network dynamics and structure in the emerging global, networked competitive context. Our analysis indicates that the transition from the present to the future can be achieved more smoothly than suggested in some of the current publications.

The rest of this paper is organised as follows. In the next section we analyse the evolutionary trajectory for SIS research between 1980s and 2011, and identify five dimensions of change associated with the accommodation of changes in the IS field over a 33 year period. In Section 3 we introduce Nelson's (2003) theorisation of the co-evolution of *Physical* and *Social Technologies* and develop a perspective on the evolutionary capacity of the SIS domain and its relationship with the wider strategic management frame. In Section 4 we interrogate the present state of the SIS domain in the context of the emerging literature on the need for a fundamental shift for SIS research to accommodate the increased turbulence, uncertainty and dynamism in the competitive landscape. We show the relevance of Complexity Science concepts and the centrality network dynamics in this discourse, and in Section 5 we articulate the nature and implications of the SIS domain as a Complex Adaptive System and develop our four propositions about the changes to be incorporated into the SIS domain as it continues to evolve and adapt to confront future challenges, followed by the conclusion in Section 6.

2. The past: evolutionary trajectory for SIS research: 1980s to 2011

In this section we sketch out the SIS research trajectory through a review of the articles published in *MIS Quarterly* (*MISQ*), *Information Systems Research* (*ISR*) and the *Journal of Strategic Information Systems* (*JSIS*) from January 1978 through to 2011 (inclusive) in relation to the emerging IT capabilities and their deployment in the wider context. The *Journal of Strategic Information Systems* (*JSIS*) was chosen for its specialisation in SIS. *MISQ* and *ISR* were chosen because they are ranked first and second respectively in the AIS list, and recognised in the extant IS literature as the top "pure MIS" journals (Rainer and Miller, 2005).

To build a boundary for the timeline of the 33 year trajectory we based our analysis on the most prominent literature, based on the profiles of these journals. The 33 year period was split into three sections, namely from 1978 to 1990, 1991 to 2000, and 2001 to 2011. This allows enough time for research topics to go through a large part of their life cycle (Sidorova et al., 2008). The data was collected using the embedded search-tools of *MISQ, ISR*, and *JSIS* websites. Our search was conducted using appropriate keywords related to SIS, including "Strategic Information Systems", "Information Systems Strategy", "strategic information", "competitive advantage", "business strategy", "information strategy" and "IS strategy" within the title or abstract of the journal article. The search covered the years 1978–2011 for *MISQ,* and 1990–2011 for *ISR* and *JSIS* (both established in 1990) and yielded a total of 170 research articles: 26 published in the period 1978–1990, 104 in 1991–2000 and 40 in 2001–2011. Table A1 in Appendix A contains a themed summary of the journal articles covered in this scan.

Our analysis followed the argument by Sidorova et al. (2008) that the intellectual core and identity construction of the discipline can be revealed by "aggregating individual research papers at a higher semantic level" (p. 470). Additionally, our analysis reflected the view that the published research is the reflection provided by the key stakeholders in the field (those publishing in the top tier journals) of the SIS identity, following the stakeholder approach to the SIS field (Scott and Lane, 2000).

Following Chen et al. (2010), and given that our search yielded a relatively small sample of abstracts, we conducted a manual scan and analysis of all the abstracts (detailed in Table A1 of the Appendix A) and a selection of highly cited papers and review papers (detailed in Table A2 of Appendix A) to interpret and highlight significant themes and contextual features associated with the extant SIS literature in the 3 successive decades. Our articulation of the trends across the decades contextualises the SIS discourse within the wider IS literature and triangulates the account of technological evolution and adoption in the three eras with the Gartner reports on industry trends over the relevant timeframe. We thus arrived at a categorisation based on the analysis of the topics to obtain a longitudinal and evolutionary view of the SIS field.

In our discussion of results we review our findings in light of the results of extant surveys that deploy both, quantitative techniques (e.g. Sidorova et al., 2008; Taylor et al., 2010) and qualitative approaches (e.g. Chen et al., 2010; Ward and Peppard, 2002). Our treatment thus provides a coherent perspective on the evolutionary features of SIS research over the decades, complementing extant accounts that focus on persistent features.

The rest of this section presents a synthesis of our findings about the trends in the SIS literature over the three decades in the context of developments in the IS field over that period.

2.1. The 1980s: corporate positioning of SIS: strategic framing and planning for strategic advantage

The SIS literature in the 1980s was largely concerned with getting corporate recognition of the strategic import of IS and getting SIS onto the corporate management agenda (e.g. Brancheau and Wetherbe, 1987; Dickson et al., 1984; Hackathorn and Karimi, 1988; King, 1978; Pybyrn, 1983; Tavakolian, 1989) by aligning SIS with Business Strategy. This focus resonates with Taylor et al.'s (2010) observation that the IS field in general was focused on establishing a distinctive identity for itself the 1980s. Our analysis of SIS papers for this period reveals two inter-twining strands: the first makes a case for information and systems as a source of strategic advantage, the second makes a case for the strategic importance of information systems based on their role in enabling and enhancing business strategy formulation and implementation.

The first strand concurred with Porter and Millar's, 1985 Harvard Business Review article highlighting the role of information systems in internal (value chain) and external (industry value system) integration and the role of information in competitive positioning. Scholars theorised about the value of information as a strategic resource (King, 1978, 1983, 1985) and its deployment as a strategic weapon (e.g. Doll and Vonderembse, 1987; Jarvenpaa and Ives, 1990; Kim and Michelman, 1990; Rackoff et al., 1985) for competitive positioning. The IS literature began to single out applications as Strategic Information Systems (SIS): ones that constituted the source of competitive advantage by conferring distinctive capabilities or positioning advantages on first movers. These tended to be novel applications targeted at specific business processes and functions – for instance airline booking systems (Copeland and McKenney, 1988), Computer Integrated Manufacturing (Doll and Vonderembse, 1987), or provided specialised decision support and planning functionality – for instance Videotex (Kusekoski, 1989); Computer Assisted Planning (Doyle and Becker, 1983), Executive IS and Decision Support Systems (Sherif and El Sawy, 1988).

The second, closely related strand was concerned with developing Information Systems Strategies and ensuring their alignment with Business Strategy. Much of the discourse here focussed on the importance of, and methodologies for, Strategic Information Systems Planning (SISP) and evaluation (e.g. Highsmith, 1981; King, 1985; Lederer and Mendelow, 1988; Lederer and Sethi, 1988; Selig, 1982; Watson, 1990).

The literature highlighted the importance of linking strategising and planning with internal alignment of applications development and strategic planning (Lorin et al., 1987). In practical terms this alignment was sought through improved SISP – the research challenge was cast as the quest for methodologies for systematic planning and evaluation (King, 1978; Lederer and Sethi, 1988) in order to deliver the promise of strategic positioning and competitive advantage through IS information systems implementation. From the development end, the quest was for structured systems planning and development methodologies (Hackathorn and Karimi, 1988; Highsmith, 1981), and getting recognition for the strategic role of the IS function in maintaining organisational effectiveness and agility in the evolving competitive landscape (Swanson and Beath, 1989).

To summarise, the 1980s represent the decade in which SIS research and practice became established as significant features in the wider strategy frame. The research themes established in this decade persisted over the next three decades (Chen et al., 2010; Luftman and Kempaiah, 2008).

2.2. The 1990s: seeking integration across intra- and inter- organisational boundaries

Alignment of SIS with Business Strategy was still the dominant issue on the management agenda as evidenced by survey data (Galliers et al., 1994). However, compared to the 1980s, SIS scholars paid greater attention to organisational, social and relational aspects affecting alignment. The academic literature focused on IT leadership and the role and requisite competencies of CIOs (Applegate and Elam, 1992; Roepke et al., 2000; Stephens et al., 1992; Watson, 1990), and the importance of business champions (Beath, 1991) for establishing the strategic position of IS in business. The shift was towards a more integrated IS-Business relationship and shared objectives between IS and Business leadership. It also advocated the participation of senior executives in SISP (Emery, 1990), a close intellectual and social CIO-CEO alignment (Reich and Benbasat, 2000, 1996) and the development of a broader, more externally focused perspective for realising the strategic potential of IT (Bergeron et al., 1991; Earl, 1993; Watson, 1990).

The *Corporation of the 1990s* (Scott Morton, 1990) presaged the 1990s as the decade for transformational change, and this was reflected in the SIS literature as writers recognised that strategic exploitation of these advances in IT would entail making substantial organisational changes, citing Hammer's 1990 *Harvard Business Review* paper "Reengineering Work: Don't Automate, Obliterate" (Emery, 1991). Business Process Re-engineering (BPR) was perceived as "revolutionary change", and its strategic importance was predicated on IT-enabled cross-functional process integration to deliver business processes with improved efficiency and an enhanced customer value proposition by reducing production costs and transaction costs (Currie and Willcocks, 1996; Earl, 1994; Hammer, 1990; Lacity et al., 1997; Mumford, 1994; Rao and Jarvenpaa, 1991; Sutherland and Remenyi, 1995; Venkatraman, 1991; Willcocks and Smith, 1995).

The 1990s also witnessed the emergence of e-business models, with SIS researchers taking a wider strategic perspective to analyse the electronic market place and the transformational impact of IT on market efficiency and competitive behaviour (Bakos, 1991; Baets, 1992; Bakos and Brynjolfsson, 1993; Brynjolfsson and Urban, 2001; Chan et al., 1997a,b), based on the economics of information. The 1980s' notion of IT as a source of competitive advantage came under close scrutiny in the 1990s. In addition to advocating the use of more stringent economic models and external intelligence to make decisions about strategic IT investments (Bacon, 1992; Barua et al., 1991; Bergeron et al., 1991; Hasan and Lampitsi, 1995; Kim

et al., 2000), SIS researchers examined first-mover and follower dynamics for IT-based innovations in the competitive landscape and pointed to the importance of key strategic resources and prerequisites for sustainable IT-derived competitive advantage (Clemons and Row, 1991; Kettinger et al., 1994). The literature on the Information Economy in the 1990s and early 2000s (e.g. Bakos, 1991; Brynjolfsson and Urban, 2001; Evans and Wurster, 2000; McKenney et al., 1997; Shapiro and Varian, 1999; Watson et al., 1998) focused on the new business models that were enabled by the Internet. However, literature also discussed the contradiction between the remarkable advances in the use of IS for competitive advantage and the relatively slow achievement of this advantage and the subsequent slow growth of productivity, the so called "productivity paradox" (e.g. Avison et al., 1999; Brynjolfsson, 1993; Watson et al., 1998).

The theme of requisite capabilities and competencies for sustained competitive positioning (Andreu and Ciborra, 1996; Clark et al., 1997; Fitzgerald, 1993; Lederer and Hannu, 1996; Levy and Powell, 2000; Kearns and Lederer, 2000) was echoed by writers focussing on wider human resource management issues for CIOs to address: they advocated the adoption of reusability-based strategies (Apte et al., 1990; Banker and Kauffman, 1991) and organisational transformation to ensure change-readiness in order to deliver SIS in short cycle times (Clark et al., 1997). Knowledge management (KM) and Knowledge-Based Strategy (KBS) appeared in the SIS literature early in 1990s (e.g. Applegate and Elam, 1992; Andreu and Ciborra, 1996; Galliers, 1999; Huysman et al., 1994; Maletz, 1990), highlighting the importance of knowledge exchange between individuals and the utilisation of IT-based knowledge management environments to advance the development of communities of experts.

To summarise, systemic integration is a recurring theme in the SIS literature from the 1990s, and the emergent pattern at the end of the decade suggests that the scope of strategic alignment had extended to integration across intra- and inter-organisational boundaries with the emergence of new ICT-based process- and business-models. This also resonates with Taylor et al.'s observation that inter-organisational systems appeared as a dominant theme in IS research in the 1990s.

2.3. The 2000s: the era of webs and networks

SIS researchers in the 2000s continued to explore the themes of integration, capability- and relationship-based competition, and the role of information, knowledge and social context in shaping the IT-derived competitive advantage for firms. However the contextualisation of the 2000s was extended to include networks and network dynamics in the competitive context (e.g. Kane and Borgatti, 2011; Preston and Karahanna, 2009; von Krogh, 2009; Yoo et al., 2010). Analysis of internal network relationships (e.g. Tillquist et al., 2002) and industry-wide network dynamics (Subramani, 2004) was seen as an important component of strategic IS design. The relational capital incorporated in these networks was seen as a source of value creation and competitive advantage based on sharing business processes and domain knowledge.

The importance of organisational deep structure and social dynamics (including core values, distribution of power and mechanisms of control) in influencing the implementation of strategic IS was a parallel theme (e.g. El Sawy et al., 2010; Hahn et al., 2009; McLaren et al., 2011; Pavlou and El Sawy, 2006; Silva and Hirschheim, 2007). Increasingly the literature focussed on cross-boundary projects and relationships, highlighting the importance of inter-personal relationships, shared information and knowledge process for achieving positive outcomes (Enns et al., 2003; Rai et al., 2009).

A common theme was the concern with the dynamism of the competitive landscape (D'Aveni, 1994; Eisenhardt and Martin, 2000; Sambamurthy, 2000). IT was cited as a trigger for the dynamism due to its pervasiveness and rapid pace of change (El Sawy, 2003), and researchers and practitioners focused on the quest for harnessing IT capabilities for corporate agility and competitive positioning (Desouza, 2006; Pavlou and El Sawy, 2006, 2010; Sambamurthy et al., 2003; Weill et al., 2002).

Associated with the wider discourse on dynamism was the question of strategizing for adaptation or transformation to remain competitive in the changing context. We identified three theoretical perspectives that received the attention of SIS writers in this period- the resource-based view of the firm (Wernerfelt, 1984), the concept of punctuated equilibrium (Burgelman, 2002; Gersick, 1991) and the concept of ambidexterity (Tushman and O'Reilly, 1996; Benner and Tushman, 2002).

The resource-based theory or resource-based view (RBV) of the firm was central to many of the publications (e.g. Nevo and Wade, 2010; Oh and Pinsonneault, 2007; Rivard et al., 2006; Peppard and Ward, 2004; Wade and Hulland, 2004) as an explanatory framework for the between-firm differences in profitability resulting from strategic IT investments. Authors emphasised the synergistic relationship between IT assets and organisational resources, underlining the fact that investment in IT was not by itself a necessary and sufficient condition for sustained competitive advantage. Co-specialisation of IT resources and capabilities with tacit, socially complex firm-specific resources was shown to enhance the customer value proposition and explain variations in performance (Nevo and Wade, 2010; Piccoli and Ives, 2005; Ray et al., 2005). They emphasised the importance of *dynamic* capabilities (Teece et al., 1997) in enabling firms to renew and re-invent their resource base in order to adapt to the changing competitive context and, to re-position themselves to maintain or improve their competitive positioning.

Punctuated equilibrium and ambidexterity were both used as theoretical devices to explore the evolution of longitudinal changes in SIS alignment, and the tension between the imperatives for evolutionary and revolutionary change. Sabherwal et al. (2001) demonstrated the utility of the punctuated equilibrium lens (in which long periods of relative stability are inter-leavened with short periods of revolutionary change) for making sense of changing patterns of alignment between business and information strategies and business and information structures over time.

The engagement with ambidexterity (Galliers, 2006; He and Wong, 2004) was associated with a discourse on the importance of organisational learning, and March's (1991) articulation of exploration (experimenting with new alternatives) and exploitation (refinement and extension of existing competencies, technologies, and paradigms) as joint requirements for viable organisations. Ambidexterity entails the pursuit of both exploration and exploitation at the same time, and the SIS literature was concerned with the problem of dynamic alignment and challenge of maintaining a balanced approach to investments in exploration and exploitation for organisational learning and innovation.

During this decade the uncertainty of the competitive context (Markus et al., 2002; Oh and Pinsonneault, 2007) and the potentially destabilising effects of exogenous contingencies (Silva and Hirschheim, 2007), became an explicit concern for SIS researchers. Markus et al. (2002) highlighted the challenge of designing systems for emergent knowledge processes in complex contexts where the knowledge requirements are complex, distributed across people and evolving dynamically. The scope of this challenge has increased to engage more external players and harness the intelligence of markets and society for open innovation and crowd sourcing (e.g. Chesbrough, 2003; Dittrich and Duysters, 2007; Teubner, 2007; Yoo et al., 2010; Watson et al., 2011), whilst Web 2.0 capabilities and the possibilities of exploiting user-generated content transform the scope of IS from supporting well-designed business processes, to supporting process requirements and changing user behaviours and in dynamic contexts. (e.g. Jiang et al., 2005; Merali and Bennett, 2011). We will return to these themes in Section 3 where we engage with the views of researchers from the next decade who propose that the uncertainty and dynamism of the competitive environment calls for a paradigm shift in SIS research agenda.

2.4. The long view of the SIS research trajectory

In recent years there have been a number of reviews aimed at defining the scope and content of SIS research (see Table A2 in Appendix A). These works were diverse in their methodology, scope and motivation, and our selection included papers that were primarily intended to be review articles, papers that provided contemporary commentary on the key issues in the field based on practitioner surveys and ones that were primarily concerned with some particular topic or perspective of IS/SIS research but included significant reviews of the field as part of their contextualisation. These scholars have focussed on the trends related to the content and perspective for SIS (e.g. Chen et al., 2010; Peppard and Ward, 2004; Sidorova et al., 2008; Taylor et al., 2010; Wade and Hulland, 2004), its positioning with respect to business strategy (e.g. Chan and Huff, 1992), and its implementation and evaluation (e.g. Chan et al., 1997a,b).

Whilst many of our observations discussed above concur with the findings from earlier reviews, it is important to note that the purpose of our analysis is not to provide a definition of SIS research trends: our interest is in exploring how existing SIS constructs have dealt with advances in IT capabilities and the issues associated with adopting and leveraging these capabilities over the three decades. In other words, we are concerned with developing a *meta-level* perspective on persistent identity, evolutionary trajectory and characteristics of the SIS research field over time by identifying

- the meta-level patterns of content and focus of SIS research,
- the underlying use of key concepts over time and
- trends associated with changes in the nature of IS strategic processes and strategising over this period.

in the context of evolving technological capabilities (e.g. ERP, SOA, Cloud Computing) and their deployment in practice in order to gain insights about the persistence of identity and the evolutionary capacity of the SIS field.

2.4.1. Meta-level patterns and underlying use of concepts

With regard to the meta-level patterns of content and focus of SIS research, our findings broadly concur with those of earlier reviews concerned with defining the scope and content of SIS research (e.g. Chen et al., 2010; Peppard and Ward, 2004). For example, in their 2010 review Chen et al. define extant SIS research in terms of three persistent strands: alignment of SIS with Business Strategy (citing key contributions by Chan et al., 1997a,b; Chan and Reich, 2007; Henderson and Venkatraman, 1999), SISP (citing key contributions by Galliers, 1991, 2004; Premkumar and King, 1994; Ward and Peppard, 2002), and IS for competitive advantage (citing key contributions by Melville et al., 2004; Piccoli and Ives, 2005; Wade and Hulland, 2004) – strands that we found already established in our analysis of the SIS publications of the 1980s. Similarly, our observations about SIS parallel Taylor et al.'s (2010) observation that the 1980s were concerned with establishing IS as distinct discipline, and that inter-organisational systems became prominent in the IS publications in the 1990s and 2000s.

However, whilst in our search results the dominant topics related to SIS displayed stability with the same ones appearing as prominent over the decades,[1] our manual analysis of the topics and the underlying concepts associated with them showed a changed focus for their usage over the decades. For example, the quest for competitive advantage in the early 1980s morphed into a concern with *sustainable* advantage in the late 1980s, and became linked with the development of capabilities and the

[1] However there were some clear trends in the level of attention accorded to the terms in the abstracts over successive decades: alignment of IS with business and corporate strategy, and the concern with competitive advantage increased in significance consistently from one decade to the next, whilst the interest in planning peaked in the 1990s before dropping below its 1980s score in the 2000s. The focus on the achievement of value from IS investments, as well as the focus on utilising the resource-based view of the firm to discuss the IS value as a means to build and sustain capabilities was particularly significant in the late 1990s and the 2000s.

resource-based theory of the firm in the 1990s and 2000s. Similarly, "complexity" first appeared in the SIS literature 1980s in relation to information systems, but became prominent in the 2000s with a different conceptualisation, associated with "Emergence", a term that did not appear in abstracts until the 2000s. Strategic planning for SIS is a focus of the literature across the three decades, but the 2000s are marked by an emphasis on SIS in turbulent environments and the dynamical view of the IS strategy, and by the 2010 complexity appears as an alternative lens to study the utilisation of IS in such contexts.

2.4.2. Change in five dimensions

Our contextual analysis showed that over the three decades there were significant advances in IT capabilities and their exploitation in the field. By triangulating our longitudinal analysis of the SIS research with contemporaneous trends in IS research and technology uptake we found that the evolution of the SIS trajectory over the three decades could be explained as a shift along five dimensions associated with strategising in SIS. The dimensions are shown in Table 1 along with the trajectory of trends in SIS research derived from our review of journal articles, Gable's (2010) analysis of the research published in the *Journal of Strategic Information Systems* since its inception, and technology trends derived from Gartner (http://www.gartner.com/) analysis of hype curves over successive decades. The final column of this table is discussed in the next section.

3. Evolutionary capacity of the SIS domain

Our long view of the trajectory of SIS research demonstrates the ability of the field to adapt and absorb changes in a controlled manner. Whilst the "headline" themes have remained relatively stable over time the technologies, applications and contextual and conceptual frames addressed have been diverse and changed over time. However the shift has been a gradual one: writers have introduced new issues in juxtaposition to ones already established in the dominant discourse. Whilst the IS field has addressed potentially disruptive technologies and associated "fads" (e.g. Abrahamson, 1996; Baskerville and Myers, 2009; Kieser, 1997; Newell et al., 2001; Westrup, 2002) in each decade, taking a long view, the strategic frame has evolved relatively smoothly to accommodate their impact (for example, over time e-business has become an integral part of business, knowledge management is an integral part of management).

The trajectory demonstrates the adaptive capacity of the SIS field at a systemic level: over the successive decades it has extended its scope in several dimensions:

- Integration: from internal alignment of business and IS to integration with global networks.
- Participation: from engaging internal players to engaging society.
- Resource base: from a focus on internal IT resource management to leveraging human, social, relational and intellectual capital *dynamically* and *across* boundaries.

Meta-level stability has been maintained over a 30 year period during which the pace of technological change has increased (El Sawy et al., 2010) new concepts have been generated endogenously or imported from other disciplines, and a diversity of (sometimes competing) practices, models, and value propositions have thrived amongst IS academic and practitioner communities (Galliers, 2003, 2006; Taylor et al., 2010).

Table 1
Trends in the IS field 1980–2011.

Dimension of change	1980s	1990s	2000s	2010+
Dominant Alignment Challenge	Aligning SIS with Business Strategy	Developing SIS for Integration of IS with Business	Developing SIS for Networks and Resource-based competition (valuing relational, human and knowledge resources)	Developing SIS for complex, dynamic, distributed contexts
Integration Focus	Systems	Process	Resource	"Global" socio-economic system architectures
Emergent/adopted IT trends	Applications Portfolios	Integrated Systems	Enterprise Architectures; Service-Oriented Architectures and Web-based services;	Multi-scale Ecologies; Cloud Computing
		ERP (Enterprise Resource Planning) and CRM (Customer Relationship Management) Systems	Business Intelligence and Knowledge Management Environments	Web 2.0 and Social Media
Scope of Strategic Contextualisation	Internal	Industry-linked	Cross-Industry Value webs and Networks	Wider Global-Local Socio-Economic context
Scope for Business Model Innovations	Value Chain	Extended Enterprise	Value webs; Global reach	Distributed, Socially Relevant

Its capacity for dynamic alignment and the adoption of "plastic boundaries" enable sustainability for the SIS field as a *generative* research domain in the management arena: the trajectory demonstrates a capacity for integrating concepts from computer science and various social science and management research domains (such as economics, sociology, organisational behaviour and strategic management).

This characterisation of SIS field has some resonance with the findings of Sidorova et al. (2008) and Taylor et al. (2010) in their analysis of the IS literature. Our multi-level characterisation resonates with Sidorova et al.'s classification of IS research into macro- and micro-levels. The adaptive characteristics of the SIS trajectory and the coexistence of stability (and relatively smooth evolution) at the meta-level with diversity and churn at lower levels suggest the kind of ambidexterity that Taylor et al. advocate for the IS field: with the co-existence of both "Mode 1" research emphasising the creation of a rigorous body of knowledge and establishment of identity of the field and its researchers in academia, and "Mode 2" research having a trans-disciplinary character, working across boundaries with heterogeneous stakeholders and real world problems.

3.1. The SIS domain and co-evolution of physical and social technologies

We have argued so far that the SIS domain is dynamic, adaptive and ambidextrous. Going forward we propose the following abstraction to define the position of SIS research on the broader canvas of socio-economic research drawing on Nelson's (2003) theorisation of technological evolution.

Nelson observed that there are two types of technology that play a major role in economic growth, *Physical Technology* and *Social Technology*. *Physical Technology* refers to what we generally refer to as "technology" – in the case of SIS this would include everything we refer to as "Information and Communication Technologies" (ICTs). *Social Technology* refers to the ways of organising work and people, and includes things like organisational forms, work design, business practice, legal, institutional and social structures and conventions. He then argued that in order for society and the economy to benefit from technological invention, *Physical* and *Social Technologies* must co-evolve.

We propose that the SIS domain is profoundly the domain that is responsible for the co-evolution of *Physical Technologies* (ICTs) and *Social Technologies* to deliver social and economic benefit. This conceptualisation is consistent with the reviews of the field which cumulatively define the SIS domain as multi-level, multi-scale and multi-dimensional, and its focus as that of developing, harnessing and leveraging IT for competitive positioning and organisational performance.[2] As observed by writers on IT and competitive advantage over the decades (e.g. Mendelson and Pillai, 1998; Mithas et al., 2011; Nevo and Wade, 2010) IT cannot confer sustainable competitive advantage in the absence of information systems management and organisational capabilities. This reasoning holds at any scale: ranging from the local implementation of systems in individual businesses through to large-scale adoption of global systems in multi-divisional and multi-national enterprises, and the success or failure of innovations in global markets (Nelson, 2003).

This conceptualisation of the SIS domain is central to our discussion about the future of SIS research in Section 5.

3.2. Connecting with the wider strategic management frame

Before we move on to the next sections to look more closely at SIS research for the future, it is useful to position the importance of IT advances in the wider context of strategic management.

In the management literature ICTs have been implicated as both drivers and enablers of the 'Network Society' and the 'Network Economy' (Axelrod and Cohen, 1999; Castells, 1996; Evans and Wurster, 2000; Shapiro and Varian, 1999). The capabilities afforded by successive generations of IS/IT have increased in power and impact over the decades, creating new opportunities and challenges, and the past three decades have witnessed step changes in:

- Connectivity (between people, applications and devices).
- Capacity for distributed storage and processing of data.
- Reach and range of information transmission, and
- Rate (speed and volume) of information transmission.

The exploitation of these capabilities has given rise to the emergence of network forms of organising as processes, information and expertise are shared across organisational and national boundaries. The increase in the number of components to be integrated across diverse technological platforms and business systems demands complex architectures. Greater connectivity and access to an increased variety and volume of information constitute greater informational complexity (Chaitin, 1990), creating the need for more powerful semantic, algorithmic and computational capabilities.

Increased global connectivity and speed of communication have contracted the spatio-temporal separation of world events: informational changes in one locality can very quickly be transmitted globally, influencing social, political and economic decisions in geographically remote places (Merali, 2006; Merali and McKelvey, 2006). In SIS discourse (see for example Chen et al., 2010; Chi et al., 2010; El Sawy et al., 2010; Gnyawali et al., 2010; Tanriverdi et al., 2010) this trend has been reflected in:

[2] *Inter alia* the abstracts and articles we reviewed defined SIS domain as ranging over the acquisition/development of IT and systems, their implementation and evaluation, their use in diverse organisational and business processes and practices, and their contribution to performance in diverse social, organisational competitive and technological contexts.

- The critical role of information and knowledge in competition.
- Increased dynamism, uncertainty and discontinuity in the competitive context.
- Pressures for fast decision making in the absence of complete information, and
- The importance of learning and innovation to afford requisite flexibility and adaptability for survival.

This is echoed in the literature on competitive dynamics where the network economy is characterised by competition in high-velocity environments, speed of technological change, and uncertainty (Eisenhardt, 1990; Li and Atuahene-Gima, 2002). Organisations, needing to shape and redefine their own competitive arena (Hayton, 2005), are confronted with the need to continually innovate (Autio et al., 2000; Hayton, 2005; Tushman and O'Reilly, 1996). This brings with it the challenges of working towards radical and incremental innovation, (Nambisan, 2002) while dealing with resource constraints (Barney, 1991; McDougall et al., 1994; Stevenson, 1999) to achieve an efficacious balance of risk and return.

Whist the context was changing over the decades to deliver innovative business models exploiting advances in IT capabilities with increasing complexity, ubiquity, richness and reach, the core constructs of the SIS research domain remained stable, but not static. Over the three decades that we have reviewed above, the SIS domain *absorbed* the complexity presented in the wider IS and strategy field by extending its scope to accommodate changes and new concepts.

In the next sections we look more closely at the current calls for changes in the SIS research agenda, and, looking to future to define the challenges and opportunities for the field, we propose that it will be well served by drawing on Complexity Science to address the emerging trends.

4. The present: presaging interesting times

In this section we consider the present in light of the recent publications in the field. Many of these argue that emerging IT capabilities and their adoption in business and society have given rise to a step change in the complexity, dynamism, uncertainty and unpredictability of social, political and economic systems. They suggest that developing requisite SIS capabilities to deal with these changes will entail a paradigm shift, and they proffer methodological and conceptual alternatives to enable such a shift to take place (e.g. El Sawy et al., 2010; Nevo and Wade, 2010; Oh and Pinsonneault, 2007; Peppard and Ward, 2004; Tanriverdi et al., 2010; Wade and Hulland, 2004).

For the purposes of this discussion we focus on a selection of papers from the 2000s that offer alternatives, both for formulating the challenge that SIS scholars face, and the approaches for dealing with these challenges (El Sawy et al., 2010; Tanriverdi et al., 2010; Nevo and Wade, 2010; Oh and Pinsonneault, 2007). All of them challenge or reframe the concepts embedded in what Chen et al. (2010) identified as the three most persistent threads in SIS research over the past three decades: alignment of SIS with Business Strategy, SISP and IS for competitive advantage. Their assertions, theorisations and recommendations are based on the premise that the emerging competitive landscape (resulting from the advances in the capabilities and ubiquity of digital technologies and their deployment) is complex and characterised by increased turbulence and dynamism, and that the dominant approaches of past decades are inadequate for strategising in this emergent context. The common challenge for SIS, they assert, is to develop new perspectives, methodologies and strategies for dealing with this dynamic context.

Common across these scholars is the view that we need to adopt a holistic systems perspective: Nevo and Wade (2010) base their arguments on a combination of systems thinking and RBV, whilst Oh and Pinsonneault (2007), Tanriverdi et al. (2010) and El Sawy et al. (2010) use concepts from Complexity Science and complex systems thinking. This move is motivated by the belief that it is no longer possible for organisations to isolate endogenous dynamics and deployment of resources from the changes that are happening in the environment. These authors assert the importance of understanding the nature of the dynamic relationship between the organisation and its environment (which contains other, heterogeneous organisations and resources interacting with each other). At a more general level there is a concern with the need for systemic theory building to understand the dynamics of such relationships- for example El Sawy et al. (2010) advocate the use of configuration theories (as alternatives to the more commonly used variance theories and process theories) for defining the patterns of unfolding interactions at "the confluence among environmental turbulence, dynamic capabilities and IT systems" (which they label as the phenomenon of digital ecodynamics), whilst Oh and Pinsonneault (2007) in the course of exploring different conceptual and analytical approaches for assessing the strategic value of IT, highlight the efficacy of non-linear approaches for understanding relationships between alignment and performance in turbulent environments.

Whilst they differ in their focus and prescriptions, the ideas of these authors draw on the systems concepts summarised in Table 2 to characterise the systemic complexity and to ground their recommendations for future directions in SIS research.

Prominent in the current discourse are the challenges posed for SIS theory and practice by the non-linear dynamics, emergence and the open, non-equilibrium nature of systems: together these features give rise to uncertainty, unpredictability and turbulence in the competitive landscape, making alignment and SISP problematic.

Table 2
Complex systems concepts.

Complex System	Complex systems are open, non-linear systems, composed of many (often heterogeneous), partially connected components that interact with each other through a diversity of feedback loops
Complexity	The complexity of the system arises from its composition: it comprises a large number of heterogeneous entities (e.g. individuals, groups, organisations, nations) that have varying degrees of interconnectivity and interdependence. Relationships may be asymmetric and vary in nature, strength, stability and persistence. The variation in connectivity and the degree and nature of the interdependence may be across *time or space*
Non-equilibrium Dynamics	The system is characterised by non-equilibrium dynamics. It is also open – its components interact with each other *and* with those in the environment (which contains other, heterogeneous organisations and resources interacting with each other): these interactions may be asymmetric, they are contingent on prevailing conditions and local sensitivities, and vary over time. Fluxes in and out of the system vary, and system stability is predicated on mutual adjustments between components within and across system boundaries
Emergence	The observed system and its behaviour at the macro-level is an emergent phenomenon: the local interactions of components at lower levels give rise to a collective macro-level behaviour that is *different in scale and kind* to the properties of the individual components at the lower levels
Non-linear Dynamics	The complex, networked nature of the relationships between components gives rise to non-linear dynamics – small changes in one location can be transmitted and amplified through the network of connections to produce large changes at the system level
Complex Adaptive Systems (CAS)	CAS are complex systems that embody the characteristics defined above, and they have the capacity to adapt in the face of environmental perturbations whilst retaining their integrity and identity

4.1. Alignment

The SIS concept of alignment has received a great deal of attention throughout the decades, and perspectives on alignment have changed progressively- as Chan (2002) points out, alignment is a complex, dynamic process with a moving target. Oh and Pinsonneault's (2007) analysis, focusing on the non-linearity of complex systems provides a succinct perspective on the implications of non-linearity:

> "*. . . nonlinear perspectives suggest that organizations are dynamic systems that never settle down and are continuously on the move. As a result, organizations are likely to be in disequilibrium states in which no deterministic and simple linear solutions are present. . . even a small difference in the degree of fit between business strategy and IT can lead to large variations in organizational performance...In fact, a sustainable "perfect" alignment may be an illusionary concept, given the speed and magnitude of change in business and technological environments*" (p. 246).

In addition to the challenge of attaining "perfect" alignment, environmental turbulence poses the difficulty of selecting the most suitable dimensions for alignment. McLaren et al. (2011) and El Sawy et al. (2010) also consider the problem of selecting dimensions for alignment and advocate using configurational theories (Meyer et al., 1993) to bound the number of combinations of dimensions to consider. Tanriverdi et al. (2010) on the other hand, argue that the dynamism and uncertainty of the "dancing", rugged competitive landscape necessitates abandoning the quest for alignment and replacing it with a quest for co-evolution. However, this then raises the challenge of selecting the dimensions for co-evolutionary fit for which they do not propose a solution.

4.2. SISP and competitive advantage

Common amongst scholars focusing on the challenges for SISP, strategising and competitive positioning in the face of the inherent complexity, turbulence and dynamism of the competitive landscape, is the question of defining how SIS can contribute to competitive positioning here. The papers cited in this section highlight the reflexive relationship between a firm and its environment – strategic moves by the firm can impact on, and possibly shape changes in, the structure and dynamics of the environment (e.g. as other firms respond by imitation or innovation), and changes in the environment may impact on the firm's resource base, structure and behaviour. Whilst this dynamic existed in the past, its impact is exacerbated by the increased complexity (in terms of the number and diversity of firms and resources that can interact, and combinatorial possibilities afforded by richness and reach of digital technologies) and the rapid pace of IT-related change in the competitive landscape.

A common approach is to advocate the adoption of co-evolutionary strategies to retain viability in this context: to adapt and evolve, continually developing new capabilities and relationships that are well-aligned with the changing opportunities for competitive positioning in the dynamic context. Relating this to extant literature in SIS, Tanriverdi et al. (2010) advocate reframing the quests for alignment, integration and competitive advantage respectively as quests for co-evolution, re-configuration (of business processes, products and services, and the contracts, resources, and transactions associated with them), and renewal, entailing what may be interpreted as a degree of Shumpeterian destruction (destabilising old sources of competitive advantage, and dismantling out-moded capabilities and endowments) and a capacity for re-invention to remain competitive in the changing landscape. Their argument for renewal parallels the

earlier discourse on dynamic capabilities in the strategic management literature (Teece et al., 1997; Teece, 2006) and underlines the transient nature of competitive advantage in the face of environmental turbulence. Whilst they use the CAS concept to describe the nature of Complex Adaptive Business Systems (CABS) they overlook the potential of CABS to exploit IT in adaptive strategies that involve external players or the development of higher level collective structures for stabilisation in turbulent environments. El Sawy et al. (2010) on the other hand emphasise the potential of exploiting mutual dependencies of diverse components in ecological constructs.

Two common themes run through the SIS literature discussed in this section: the interconnected or networked nature of the whole system and the need for holistic systems concepts and constructs to articulate the dynamic aspects of the interactions and (co)evolution of organisations in, and with, their dynamic contexts. Below we look more closely at the network motif and at the suitability of complexity science for furnishing the requisite systems concepts that the SIS literature calls for.

4.3. The network motif

The network motif is apparent in the wider management literature with a discernible shift from focusing solely on the firm as a unit of organisation to focusing on networks of firms, from considerations of industry-specific value systems to considerations of networks of value systems, and from the concept of discrete industry structures to the concept of ecologies (see for example Burgelman, 1991; Buchanan, 2002; Lewin and Volberda, 1999; Merali, 2006; Merali and McKelvey, 2006; Seidl, 2007).

The SIS literature suggests that the dynamism in the competitive terrain requires firms to be agile and reconfigure their resource base and organisation in a co-evolutionary fashion to keep up with demands of the changing landscape (Sambamurthy et al., 2003; Weill et al., 2002). Tanriverdi et al. (2010) advocate a strategy of re-configuration and renewal in order to maintain such a fit. We argue that this is not a viable proposition for four reasons- firstly, discontinuous change in the environment may demand the acquisition of new capabilities that cannot be developed endogenously, secondly the pace of change in the environment may be too rapid to allow for the cycle of dismantling existing resource bundles and sources of competitive advantage to create the requisite new capabilities, thirdly it would irrevocably destroy relational capital built up over time, and fourthly it would be a wasteful process in contexts with high degrees of perturbation.

We suggest that a more viable approach would be to adopt a network form of organisation of resources, with a network that spanned organisational boundaries and connected with diverse others, through diverse relationships (varying in strength, longevity and nature), in a constellation that optimised adaptive potential. This entails developing strong and long-lived relationships with some collaborators, more transient relationships with others, and deciding which resources and capabilities need to be sequestered within organisational boundaries, which ones can be shared with others, and which can be acquired from others. The central idea for this strategy is to create a structure which embodies the requisite potential for ecologically stable relationships alongside more transient ones to deliver the requisite bundle of resources for effective positioning in the prevalent context.

To deal with the problem of provisioning for the future in a dynamic context we propose a parallel investment based on real options thinking – i.e. to make small investments in a number of different resources that may become valuable in the future. This approach should aim to ensure that the constellation contains the requisite variety and micro-diversity that will support the dynamic configuration of viable resource bundles in the face of environmental turbulence.

A further level of complexity arises because of the reflexive relationship between the firm and its environment – the firm is a component of the multi-dimensional, multi-level nature of the competitive landscape, and the macro-level properties of the whole system emerge from the dynamics of locally situated, inter-connected components. As identified in the literature (e.g. El Sawy et al., 2010; Kauffman, 1993; Tanriverdi et al., 2010; Pavlou and El Sawy, 2006, 2010) if the landscape is a rugged one, it is possible for firms with limited visibility of the landscape to get stuck in suboptimal niches.

A fundamental problem in this situation is firstly, one of deciding what the requisite level of investment in heterogeneity should be, and second, what an efficient strategy would be to explore the competitive landscape in order to identify regions of superior performance. This second problem is identical to that posed by March (1991) in his identification of myopic firms that under-invested in exploratory learning (Levinthal and March, 1993).

In this discussion we used the network approach to address the issue of competitive positioning in SIS, but the approach is equally relevant for exploring issues of SISP, particularly in the current IT landscape with its diverse population of technological capabilities and platforms, service providers and media choices to cater for a diverse and heterogeneous population of clients and user groups.

4.4. The Science of Complex Systems for articulating system characteristics in the SIS domain

Overall, the "paradigm shift" advocated in the papers discussed here is predicated on the premise that the present and the future for SIS entails navigating a competitive landscape characterised by complexity, dynamism, uncertainty and unpredictability of social, political and economic systems. All the authors advocate taking a holistic, systemic

perspective and offer constructs and concepts to explicitly address the reflexive relationship between the organisations and their environment.

The use in these papers of concepts from Complexity Science to articulate the rugged and dynamic nature of the competitive landscape, the adoption of the CAS paradigm to articulate the characteristics of dynamic, viable business systems, and the engagement with consequences of non-linear dynamics illustrates the relevance of these concepts for the future SIS research agenda.

Here we outline the concepts from Complexity Science and the network paradigm that can be used to articulate the system characteristics and dynamics that scholars in the 2010+ era have engaged with, and we propose that going forward, Complexity Science can provide a scaffolding and core concepts in the future trajectory of SIS, whilst adoption of the network paradigm constitutes a natural progression for the co-evolution of physical and social technologies.

Over the years SIS scholars dealing with dynamic contexts have emphasised the importance of change, transformation and adaptation. Concepts like punctuated equilibrium, ambidexterity, co-evolution and emergence have been used to characterise the process of change since the 1990s, and more recently writers have drawn on Complexity Science concepts to articulate organisational behaviours and interactions in dynamic an uncertain contexts.

In response to the call by scholars in the 2010+ era for a holistic systemic approach in SIS we propose that the complex systems paradigm offers a generic definition for systems of the kind that these writers describe. The use of complex systems concepts in SIS literature to date has been rather piecemeal, with different authors selectively using particular concepts to focus on specific aspects of SIS. It has also been largely descriptive, used to define or characterise behaviours or characteristics of dynamic systems and their states. However, in addition to providing a language and concepts for describing the phenomenology of complex systems and their behaviours, Complexity Science is also concerned with explaining the network mechanisms that underpin this phenomenology.

By definition complex systems are essentially network systems (Merali, 2004)- the network of a complex system embodies a set of heterogeneous nodes (embodying resources, capacities to act, etc.) which have the potential to be connected in a variety of ways through diverse relationships (or links).

More specifically complex systems are open, non-linear systems, composed of many (often heterogeneous), and partially connected components that interact with each other through a diversity of feedback loops. Their complexity derives from the partially connected nature of the network and the non-linear network dynamics which make the behaviour of these systems difficult to predict (Casti, 1997). The non-linearity of these systems means that small changes in inputs can have dramatic and unexpected effects on outputs.

This construct serves to explain the link between the structure and dynamics of systems at all scales, and underpins macro-level behaviours (such as punctuated equilibrium) displayed by complex systems.

The concept of CAS is highly relevant for articulating the dynamic characteristics of digitally connected organisational forms (see Merali, 2004, 2006) for comprehensive review of Complexity Science and IS). CAS adapt and evolve in the process of interacting with their environments. They have the potential (capacity) for both adaptation and transformation through the dynamic adjustment of local negative and positive feedback loops. Adaptation at the macro-level (the 'whole' system) is characterised by emergence and self-organisation based on the local adaptive behaviour of the system's constituents. The relationship between the system and the environment is a reflexive one: changes in the system both shape and are shaped by changes in the environment. The CAS paradigm imposes the need to consider the dynamics and mutually defining consequences of the relationship between the system and its environment, taking us from issues of simple adaptation to issues of co-adaptation and co-evolution in dynamic contexts.

From a complexity perspective, viability[3] in dynamic contexts is predicated on access to the requisite variety of responses to match the demands of the context. The network thus constitutes the locus of diversity generation, because it has the potential to be "rewired" according to contingencies, and its *potential* diversity is greater than that displayed at any particular moment in time (Merali, 2005). The adaptive potential is conferred by

- the micro-diversity of the components,
- the existence of the requisite degree of connectivity between nodes and
- the capacity for spontaneous re-configuration of the pattern of linkages.

Complexity Science provides a generic framework for the study of complex systems in dynamic contexts, and as such provides a scaffolding for the development of more specific concepts and models for describing and explaining particular behaviours and phenomena of interest to SIS scholars. For example, the construct of CAS and its associated network dynamics accommodates the constructs for defining both, ambidexterity and punctuated equilibrium.

[3] Not all nodes are equally connected, and individual nodes may be connected to a number of different nodes at any given time. The connectivity of individual nodes may change over time: depending on the task at hand, attendant constraints and proclivities, individual nodes activate particular connections in the network at particular times (Merali, 2006). The global network form at any given moment is a manifestation of the collective pattern of interconnections: over time we can expect to observe a dynamic network topology, with individual constellations in the network becoming activated selectively as and when needed for particular collaborative and transactional contingencies.

4.5. Modelling CAS

Whilst the concept of using the network approach is a relatively simple one, the behaviour of CAS is difficult to predict because of their sensitivity to initial conditions and the potential for non-linear responses to contextual perturbations. To understand the mechanisms underpinning the dynamics we need to access descriptions of the system at multiple scales from the micro to the macro at the same time.

Complexity Science offers the modelling approaches for exploring the dynamics of such non-deterministic systems, revealing the way that the micro- and macro-level relationships play out over time. Agent-based computational modelling has characteristics that are particularly useful for studying contextually embedded systems. An agent based model is comprised of individual 'agents' (e.g. firms) commonly implemented as software objects (Casti, 1997; Holland, 1995, 1998). Agent objects have states and rules of behaviour. They can be endowed with requisite resources, traits, behaviours and rules for interacting with, and adapting to, each other. Typically agent-based models deploy a diversity of agents to represent the constituents of the focal system, and the modeller defines the environmental parameters that are of interest as the starting conditions for the particular study. Repeated runs of the model reveal collective states or patterns of behaviour as they emerge from the interactions of entities over time. Agent-based modelling facilitates the inclusion of micro-diversity (e.g. the rationality of agents can be limited, agents can be made diverse so there is no need to appeal to representative agents, payoffs may be noisy and information can be local), allowing us to study the diversity of (local) behaviours at fine scales and to observe the emergence of the global characteristics at the large scale. Running the model furnishes us with an entire dynamical history of the process under study.

5. The future trajectory of SIS research

Our earlier definition of the SIS domain as being responsible for the co-evolution of Social and Physical Technologies based on Nelson's theorising, and the discussion of CAS and Networks in the last section leads us to make the following four propositions for the future of the SIS domain.

5.1. The SIS domain as a CAS for the co-evolution of Physical and Social Technologies

If we take a systems perspective then we can now argue that the SIS domain is itself a CAS: it has retained its integrity and stability by adapting and evolving over time. Pressures or incentives for innovation are both internal and external. External incentives include learning from innovations in other domains (as identified by Taylor et al., 2010) and responding to perturbations and opportunities in the competitive landscape (e.g. economic downturns, liberalisation of global markets, the appearance of disruptive technologies). Internal incentives arise from the evolutionary process within the domain: individual organisations realise their own SIS by exploring and exploiting existing and emerging ICT capabilities to create new process- and business models. Successful innovations may become prominent through a process of adaptation and diffusion in the wider population, or in some cases due to a sustained first mover advantage, but their pre-eminence in the field only lasts until they become displaced by newer *Physical* and *Social Technologies*. Whilst surveys of "best practice" or other popularity measures may suggest the homogenous adoption of dominant models, the situation is a messier one, because the domain is an open CAS and at the ground level contains the requisite variety of approaches, resources and capabilities for SIS implementation. The coevolutionary process for *Physical* and *Social Technologies* at the level of individual organisations is also a complex one as pointed out by Lyytinen and Newman (2008) and realised SIS is often very different from espoused SIS (Chan et al., 1997a,b).

5.2. The network paradigm is an essential component of the future development of the SIS domain

5.2.1. Co-evolution of Physical and Social Technologies

At a fundamental level the assertion above follows from our definition of the domain: the emerging *Physical Technologies* in the ICT domain are essentially technologies for integration of complex networks (Web 2.0, Cloud computing). Leveraging the capabilities of these *Physical Technologies* and their future associated inventions necessitates an investment in co-evolving *Social Technologies* and network forms of organising with suitable business models and governance and management instruments for exploiting the *Physical Technologies* for utilising distributed resources and capabilities.

5.2.2. Wider strategic imperatives

This challenge for SIS is acknowledged in the current IS literature, for example in recent publications on digital infrastructures and platform evolution (Tilson et al., 2010 Tiwana et al., 2010). The development of *Social Technologies* to exploit the network capabilities of ICTs is not confined to the IS field – the mainstream Strategy, Organisation Science and Economics literature has been engaged with the development of network business models, network forms of organisation and non-equilibrium dynamics of economic and social systems since the 1990s (e.g. Ahuja, 2000; Anderson, 1999; Anderson et al., 1988; Arthur et al., 1997; Axelrod and Cohen, 1999; Burt, 1992, 1997; Castells, 1996; Ghoshal and Bartlett, 1990; Granovetter, 1973, 1985; Powell et al., 1996; Saxanian, 1990; Wasserman and Faust, 1994). The advent of the internet and associated

technologies and more recently the emergence of Web 2.0 and social media capabilities have been paralleled with concerted efforts by physicists and mathematicians to understand the properties of complex networks at all scales in order to explain the dynamics of competition and the behaviour of markets, and the evolution and influence social networks (Castellano et al., 2009; Newman et al., 2006; Albert and Barabassi, 2000; Albert et al., 2000).

5.3. Access to a science of networks is essential for future SIS

The complexity of the multi-dimensional, multi-level SIS alignment is already a prominent topic in the extant SIS literature as discussed earlier. As the ubiquity and absorption IT-enabled products, services and experiences expand, the scope of SIS research will extend to have systemic relevance for the whole of the management field. We believe that the potential exists for SIS to be a dominant force in the strategic management field because of its expertise in systems and information. Whilst the current discourse on the need for a paradigm shift has focused largely on the impact of IT we believe that the future identity of SIS research will evolve around the field's expertise in understanding systemic phenomena and the information dynamics and representations in multi-media cyber-social contexts.

The SIS literature discussed in the last section has already raised the issues of unpredictability and turbulence associated with the non-linear dynamics of network systems. The properties of IT-enabled business networks have profound implications for the performance of business and economy at local and global dimensions as evidenced by the recent financial crisis. Managing issues of sustainability, robustness and resilience of IT-enabled global systems requires an understanding of network structures and the relationship between structure and dynamics. Complexity Science offers a set of concepts and modelling approaches to enable the analysis of the relationship between network structure and dynamics, and to experiment *in silico* with the implementation and consequences of interventions and strategies in dynamic networks of social and technological components (e.g. using Agent-based Modelling).

Whilst the use of Complexity Science concepts in current SIS research have been largely for descriptive purposes, complexity science offers resources that can be exploited by the SIS community to move to a more analytical stance. This transition is already happening in the wider IS and organisational science communities as evidenced by the papers in special issues of Organisation Science and IS journals on Complexity Science.[4]

5.4. Adoption of complexity science as an articulation device across disciplines

Connections with Organisation Science and Strategic Management are well established in the SIS domain, and scholars have used structures and concepts from the natural sciences (e.g. ecologies, adoption, selection, evolution, punctuated equilibrium) to explore and explain phenomena related to IT-related change. As highlighted above, scholars in these fields are also engaging explicitly with Complexity Science and network dynamics. We propose Complexity Science as a suitable lens for articulating multidisciplinary research and dealing with the future challenges in a coherent manner.

6. Conclusion

In relation to the SIS trajectory the present represents a potential keystone moment between the past and the future. The emerging digitally connected socio-economic context is intricately interwoven with the exploitation of IT capabilities. The emerging literature on the future of SIS research advocates a paradigm shift in research and practice to deal with the increased turbulence, uncertainty and dynamism in the competitive landscape.

Looking to future we believe the major challenge for the field will continue to be one of dealing with complexity of dynamic, networked, technical, social, political and economic contexts as summarised in the final column of Table 1. We anticipate that the mastery of network thinking will be a core intellectual capability in the next decade.

We agree with the SIS scholars reviewed that the SIS paradigm for the future needs to address the emerging dynamic competitive context. However we argue that because the SIS domain is itself a CAS, this need can be accommodated smoothly within the trajectory of SIS, building on the extant diversity of the field and its adaptive capacity.

A key contribution from our analysis lies in using Nelson's theorisation to propose *network science and network thinking as an essential paradigm for the future evolution of the SIS domain*, to enable the co-evolution of the requisite *Social Technologies* to shape and leverage the emerging network ICT capabilities.

We have argued for the utilisation of complexity science concepts to frame the future SIS research in terms of the development of the field. On the wider canvass, Complexity Science provides a powerful locus for engagement in trans-disciplinary research. This represents a strategic opportunity for the field: the intricate interweaving of IT and IS in business and society provides SIS researchers with the opportunity to occupy centre stage in the wider field of Strategic Management.

[4] See for example: *Organization Science*, Special Issue: Application of Complexity Theory to Organization Science, 10, 3, 1999; *Journal of Information Technology*, Special Issue on Complexity and Information Systems, 21, 2006.

Appendix A

Table A1
The evolutionary key challenges in SIS research from 1980–2011.

Decade	Key challenges	Literature
1978–1990	Formal Strategic Information Systems Planning (SISP)	Doyle and Becker (1983), Hackathorn et al. (1988), Highsmith (1981, 1978), Lederer and Sethi (1988), Lorin et al. (1988), Pyburn (1983), Sherif et al. (1988), Singleton et al. (1988), and Uday et al. (1990)
	SIS and the achievement of Strategic Advantage	Horner Reich and Benbasat (1990), Kim and Michelman (1990), Maletz (1990), Rackoff et al. (1985), and Tavakolian (1990)
	Top management's role in SIS and SISP	Brancheau and Wetherbe (1987), El Sawy (1985), Emery (1990), Javernpaa and Ives (1990), Lederer and Mendelow (1988), Selig (1982), Watson et al. (1988), and Watson (1990)
1991–2000	IS/IT alignment with Business Strategy	Baets (1992), Holland and Lockett (1992), Chan et al. (1997a,b), Kearns and Lederer (2000), Kim et al. (2000), Lacity and Hirschheim (1995), Moreton (1995), Powell (1993), Smits et al. (1997), and Ward and Peppard (1996)
	Formal Strategic Information Systems Planning (SISP)	Bai (1997), Baker (1995), Cavaye and Cragg (1993), Earl (1993), Huysman et al. (1994), Flynn and Goleniewska (1993), Fitzgerald (1993), Lederer and Gardiner (1992), Lederer and Hannu (1996), Lambert and Peppard (1993), Niederman et al. (1991), Premkumar and King (1994), Sabherwal and Robey (1995), Saarinen and Sääksjärvi (1992), Segars and Grover (1999), and Ruohonen (1991)
	SIS, strategic impact, and the achievement of sustainable Strategic Advantage, through development of capabilities for better performance	Andreu and Ciborra (1996), Atkins (1994, 1998), Barua et al. (1991), Bergeron et al. (1990), Brady et al. (1992), Chan and Huff (1992) Choudhry (1997), Clark et al. (1997), Clemons and Row (1991), Fowler and Wilkinson (1998), Dutta and Doz (1995), Horner-Reich and Benbasat (2000), Gatian et al. (1995), Kettinger et al. (1994), Levy and Powell (2000), Merali and McKiernan (1993), Morgan (1995), Noble (1995), Ramani and McKinney (1994), Raghunathan et al. (1999), Ramaswami et al. (1992), and Segars et al. (1994)
	Business Process Re-engineering and Electronic Data Interchange. Electronic markets	Bakos (1991), Cox and Ghoneim (1998), Currie and Willcocks (1996), Earl (1994), Emery (1991), Lacity et al. (1997), Lundeberg (1992), Loebbecke et al. (1996), Johnston and Yetton (1996), Mumford (1994), Sutherland and Remenyi (1995), Remenyi and Cinnamond (1996), Wastell and Kavalek (1994), Willcocks and Smith (1995), and Wrigley et al. (1994)
	Outsourcing as a strategy for IS development/ implementation	Lee and Kim (1997) and Willcocks and Fitzgerald (1993)
	Interorganisational IS	Cavaye and Cragg (1995), Suomi (1992), Webster (1995), and Williams (1997)
	Role of culture in SIS deployment	Garfield and Watson (1997), Grover et al. (1994, Madon (1992), Mata and Fuerst (1997), and Shore and Venkatachalam (1996)
	IT professionals in strategy making	Adam and Murphy (1995), Angel and Straub (1993), Applegate et al. (1992), Bacon (1992), Baeth (1991), Doukidis et al. (1992), Hasan and Lampitsi (1995), Grindley (1992), Niederman (1993), Stephens et al. (1992), Pearson et al. (1996), and Raghunathan and Raghunathan (1993)
	IT/IS benefits measurement, success, and the paradox	Avison et al. (1999), Chan et al. (1997a,b), Devan et al. (1998), Clarke and Jenkins (1993), Frolick et al. (1993), Heatley et al. (1995), Jurison (1996), Noble (1995), Watson et al. (1998), Whyte et al. (1997), and Williams (1996)
2001–2011	Strategic Information Systems Planning (SISP) and formal planning	Braa et al. (2007), Krell and Matook (2009), and Teubner (2007)
	From outsourcing to offshoring and opensourcing for SIS	Agerfalk and Fitzgerald (2008), Hahn et al. (2009), and Rai et al. (2009)
	IS and business alignment for Sustainable Competitive advantage, creation of value, and performance	Chen et al. (2010), Watson et al. (2011), Enns et al. (2003), Preston and Karahanna (2009), Slaughter et al. (2006), Chen et al. (2010), Cragg et al. (2002), Croteau and Bergeron (2001), Dehning and Stratopoulos (2003), Griffiths and Finlay (2004), Ragu-Nathan et al. (2001), Ravishankar et al. (2011), Sabherwal and Chan (2001), Tallon (2007), Tillquist et al. (2002), and Vannoy and Salam (2010)
	SIS and strategic advantage in turbulent environments: dynamical/CAS/co-evolutionary view, and competences	Guillemette and Pare (forthcoming), Levina (2005), Markus et al. (2002), Pavlou and El Sawy (2006, 2010), Piccoli and Ives (2005), El Sawy et al. (2010), Silva and Hirschheim (2007), and Tanriverdi et al. (2010)
	IS value, RBV, and building capabilities	Bharadwaj et al. (2007), McLaren et al. (2011), Nevo and Wade (2010), Oh and Pinsonneault (2007), Peppard and Ward (2004), Wade and Hulland (2007), and Ray et al. (2005)
	IT professionals in strategy making	Biros et al. (2002) and Kane and Borgatti (2011)

Table A2
Indicative SIS review publications and studies of the state in the SIS field from 1980-2011.

Journal abbreviation	Publication details	Purpose	Research method	Dominant themes/propositions
MISQ	Dickson, G.W., Leitheiser, R.L., Wetherbe, J.C., Nechis, M., 1984. Key Information Systems Issues for the 1980s MIS Quarterly 8, 3, 135–159	– Provides both IS academics and practitioners with a list of 10 critical issues to be tackled or to be considered for future research	Quantitative Delphi, survey of chief IS executives	Suggests 10 critical issues in IS research in order of importance:
		– Argues about the ten most critical issues facing IS executives – Ranks these issues in order of importance – Examines whether there is consensus within managers regarding these issues		– Strategic Planning – End user computing – Integration of Information Technology – Software Development – Measuring Effectiveness – Organisational Learning – Alignment in Organisation – Human Resources – Data as Corporate Resource – Applications Portfolio
MISQ	Brancheau, J., Wetherbe, J.C., 1987. Key Issues in Information Systems – 1986. MIS Quarterly, 11, 1, 23–45	– Provides both IS academics and practitioners with a list of 10 critical issues to be tackled or to be considered for future research	Quantitative five-part Delphi	Suggests 10 critical issues in IS research in order of importance:
		– Argues about the ten most critical issues facing IS executives over the next three to five years – Ranks these issues in order of importance – Examines whether there is consensus within managers regarding these issues	Survey of chief IS executives and corporate general managers	– Strategic Planning – Competitive Advantage (highlights the use of IS as a major strategic weapon in many organisations) – Organisational Learning through the use of IS – The role of IS (proposes that organisations need to understand the increasing role of IS in organisations, despite being viewed as an overhead expense, with little appreciation)
		– Discusses whether there is consensus between IS and non-IS managers regarding these critical issues – Discusses the change in these critical issues over time		– The alignment of IS with business – End-User Computing – The role of data as a Corporate Resource – The development of an appropriate Information Architecture – Measuring the effectiveness of IS – The role of IT integration within the business – End-user computing, measuring effectiveness of IS, integration of IT which were previously high in the agenda of the IS executives now are ranked lower – The role of: human resources, software development, managing the applications portfolio, Decision support systems, and Office automation have dropped out of the top ten since 1983

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Table A2 (*continued*)

Journal abbreviation	Publication details	Purpose	Research method	Dominant themes/propositions
MISQ	Niederman, F., Brancheau, J.C., Wetherbe, J.C., 1991. Information Systems Management Issues for the 1990s. MIS Quarterly 15, 4, 475–500	– Provides both IS academics and practitioners with a list of 10 critical issues to be tackled or to be considered for future research	Quantitative three-part Delphi	Suggests 10 critical issues in IS research in order of importance:
		– Argues about the ten most critical issues facing IS executives over the next three to 5 years – Ranks these issues in order of importance – Examines whether there is consensus within managers regarding these issues – Provides both IS academics and practitioners with the critical issues to be tackled or opens avenues for future research	Survey of chief IS executives and corporate general managers	– The role of information architecture – Making effective use of the data resource – Improving IS strategic planning – Specifying, recruiting, and developing IS human resources – The facilitation of organisational learning and use of IS – Building a responsive IT infrastructure – The alignment of IS with the business – The use of IS for the achievement of competitive advantage – Improving the quality of software development – Planning and implementing telecommunications systems – The role of: IS definition within organisations, IS effectiveness measurement, and end-user computing have dropped out of the top ten since 1986
JSIS	Chan, Y.E., Huff, S.L., 1992. Strategy: an Information Systems Research perspective. Journal of Strategic Information Systems 1, 4, 191–204	– Reviews the business strategy literature, findings and recommendations that are especially relevant to IS researchers in order to justify the need to study the relationship of SIS with the overall business strategy – Includes a carefully selected bibliography to enable IS researchers to explore concepts discussed	Qualitative study of the relevant literature on strategy and classification according to focus, data utilised, analysis provided, and strategy dimensions	– Both the content and the structure of strategy need to be considered when conducting strategy-related research – Focus must be given to both formulation and implementation stages of IS strategy – Different methodologies should be considered when conducting research on IS strategy, for instance case studies or historical approaches – Alignment or strategic fit is fundamental to strategy – Strategic fit between IS and business strategy are necessary for business performance
MISQ	Chen, D.Q., Mocker, M., Preston, D.S., Teubner, A., 2010. Information Systems Strategy: Reconceptualization, Measurement, and Implications. MIS Quarterly 34, 2, 233–259	– Reviews the IS literature to provide a new typology which operationalises IS strategy so that it could be applied holistically in organisations; and discusses the implications of this review for the three closely related streams of SIS literature, namely SISP, IS alignment, and IS for competitive advantage – Classifies IS Strategy literature in different strands: IS strategy as the use of IS to support business strategy; IS strategy as the master plan of the IS function; and IS strategy as the shared view of the IS role within the organisation	Qualitative systematic review of the extant literature and use of classification covering different strands of the SIS literature	– IS strategy is operationalised along IS innovation – Depending on the aim of the organisation to pursue IS innovation, strategies can be either IS innovators or IS conservatives, or undefined

Table A2 (*continued*)

Journal abbreviation	Publication details	Purpose	Research method	Dominant themes/propositions
		– Provides a definition of IS strategy to promote future research while it examines the development and implementation of IS strategy		– Organisations with different IS strategies differ significantly in their nature of IS planning practices – Organisations with different strategies differ in their nature of IS strategic alignment – For IS innovators, if a less formalised approach is used it will have a positive impact on IS strategic planning success. IS strategy is driving business strategy – For IS conservatives, the formalisation of the approach will end up in a IS strategic planning success. Business strategy drives IS strategy – IS innovators are associated to a greater level of competitive advantage and higher levels of firm performance than IS conservatives
JSIS	Gable, G., 2010. Strategic Information Systems Research: An archival analysis. Journal of Strategic Information Systems 19, 1, 3–16	– Reviews literature on SIS published in JSIS in order to stimulate further discussion on the direction of the SIS field	– Qualitative literature search in relation to topic classification systems previously developed by IS researchers	– Classification of SIS research into
		– Presents a structure which aims at interrelating and discussing research topics within SIS literature in JSIS	– Use of Endnote, Excel, and iterative bottom-up analysis of academic papers supported by top-down deductive considerations	1. IS for Strategic Decision Making
		– Presents results of an evaluation of JSIS research articles from 1991 to 2009. – Publishes a comprehensive bibliography of all 316 JSIS full research publications		1.1. Strategic Planning 1.2. Information Planning 1.3. Decision Support (DSS, EIS, GDSS) 2 Strategic Use of IS 2.1. Alignment of IT and Business 2.2. Lifecycle of an IS for Strategic Use 2.3. IS and Globalisation 2.4. E-Commerce 2.5. IS for Competitive Advantage 2.6. IS for Internal Strategic Efficiency 2.6.1. BPR 2.6.2. ES/Integrated IS 2.6.3. EDI 2.7. Knowledge Management Use 3. Strategies for IS Issues 3.1. IS Management 3.2. IS Planning 3.3. IS Organisation (incl Outsourcing) 3.4. IS Development Methods 3.5. Application Service Provision 3.6. IS Implementation 3.7. IS Evaluation 3.8. IS Adoption

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Table A2 (*continued*)

Journal abbreviation	Publication details	Purpose	Research method	Dominant themes/propositions
JSIS	Peppard, J., Ward, J., 2004. Beyond strategic information systems: towards an IS capability. Journal of Strategic Information Systems 13, 2, 167–194	Reviews IS literature drawing on RBV in order to suggest a necessary shift from SIS literature to an RBV perspective which highlights the issues of sustainability and continuous value through the development of IS capabilities	RBV stance towards the study of SIS in organisations	– Organisations need to develop IS capabilities to achieve excellence and to align these with the overall business strategy – The development of IS capabilities comes through a track record of successful implementation. – A strong IS capability means better incorporation of IT/IS in business strategy and better alignment of IT/IS with this strategy
MISQ	Piccoli, G., Ives, B., 2005. Review: IT-Dependent Strategic Initiatives and Sustained Competitive Advantage: A Review and Synthesis of the Literature. MIS Quarterly 29, 4, 747–776	Reviews extant literature on the role of IT in sustaining competitive advantage to suggest an integrative framework which includes the determinants of IT sustainability with the process through which the implemented IT-dependent strategies evolve to limit the decay of competitive advantage	Structured qualitative methodology to review articles drawn from the fields of information systems, strategic management, and marketing	– Suggests a model summarising the determinants of sustainable competitive advantage based on the use of IS – Proposes the shift of focus on IT-dependent strategic initiatives, since technology belongs, *inter alia*, to an activity system that enables the creation of economic value – There exist barriers to the development of IT-dependent strategic initiatives, that is, IT resources barrier, complementary resources barrier, IT project barrier, and pre-emption barrier
ISR	Tanriverdi, H., Rai, A., Venkatraman, N., 2010. Research Commentary—Reframing the Dominant Quests of Information Systems Strategy Research for Complex Adaptive Business Systems. Information Systems Research 21, 822–834	Reviews the SIS literature focusing on (a) strategic alignment, (b) integration and (c) sustained competitive Advantage and by building on concepts from complexity science and Complex Adaptive systems it re-evaluates, revises, and re-directs the SIS literature, suggesting research questions that are critical in understanding SIS in today's landscape	Uses concepts from Complexity Theory and Complex Adaptive Systems to theorise on SIS	Suggests a shift in the three quests of IS strategy, that is: – From alignment to co-evolution of IS strategy with the rugged competitive landscape of today's organisations – From Integration to Reconfiguration: IS strategy should enable the organisation to reconfigure its network of contracts, resources, and transactions to support the firm's dynamic co-evolution with a dancing, rugged, competitive landscape – From Sustained competitive advantage to renewal: IS strategy should enable a firm to get a series of competitive advantages in the rugged competitive landscape in which it is embedded, then destabilise and unlearn the reasons behind previous advantages to repeat this pattern.

Table A2 (*continued*)

Journal abbreviation	Publication details	Purpose	Research method	Dominant themes/propositions
MISQ	Taylor, H., Dillon, S., van Wingen, M., 2010. Focus and Diversity in Information Systems Research: Meeting the Dual Demands of a Healthy Applied Discipline. MIS Quarterly 34, 4, 647–667	– Reviews the IS field from the way it is structured and its direction in order to argue that the health of IS field lies in meeting the dual need of academic rigour and practical relevance, as reflected by the plethora of topics around a coherent research core. – Provides an empirically derived answer to how the work of the research community is reflected to the IS discipline's character	Longitudinal quantitative study using the bibliometric technique of author co-citations to map the intellectual structure of the field	– The IS field is still robust as indicated by the increase in the number of researchers working and co-citing work from each-other – The IS strategy appears to maintain a focus on the strategy issues and business (e.g. performance) outcomes – IS strategy research is augmented by the use of various – including qualitative and quantitative – methods – Attention in the SIS literature is paid to the interorganisational systems, where researchers are focusing on the issues arising from delineating and implementing new strategic directions for collaboration between businesses
MISQ	Wade, M., Hulland, J., 2004. Review: the resource-based view and Information Systems Research: review, extension, and suggestions for future research, MIS Quarterly, 28 1, 107–142	Reviews relevant SIS literature in light of the Resource-Based View (RBV) of the firm	Takes an RBV view on IS research	– Addresses the issue of resource complimentarity in IS research and the role of factors mediating the relationship between IS resources and firm performance – Using RBV IT is conceptualised as only asset-based, whereas IS as a mixture of assets and capabilities formed around the use of IT in a productive way. – Suggests it is IS resources and that are inimitable, non-substitutable and imperfectly mobile, influencing directly and indirectly competitive position and performance
MISQ	Sidorova, A., Evangelopoulos, N., Valacich, J.S., Ramakrishnan, T., 2008. Uncovering the Intellectual Core of the Information Systems Discipline. MIS Quarterly, 32, 3, 467–482	– Reviews the relevant IS literature to unveil the intellectual core of the IS discipline from the multitude of individual research papers	Quantitative methodology: – Uses Latent semantic analysis to uncover the core IS research areas – Analyses abstracts from MISQ, ISR, and Journal of Management Information Systems from 1985–2006 (1615 articles)	– Suggests the classification of IS research into a macro level which deals with organisational and societal issues, and a micro-level, which has to do with interactions at both individual and group/organisational level – The areas IS research focuses are:: IS development, IT and organisations, IT and individuals, IT and markets, IT and groups – The IS field focuses on the study of how IT systems "are developed and how individuals, groups, organizations, and markets interact with IT" (p. 467) – The IS field has become over the years less focused on technology and more focused on business processes

Appendix B. MISQ, JSIS, and ISR publications from 1978 to 2011

B.1. 1978–1990

Apte, U., Sankar, C.S., Thakur, M., Turner, J.E., 1990. Reusability-based strategy for development of information systems: implementation experience of a bank. MIS Quarterly 14 (4), 421–433.
Brancheau, J., Wetherbe, J.C., 1987. Key issues in information systems – 1986. MIS Quarterly, 11 (1), 23–45.
Doll, W.J., Vonderembse, M.A., 1987. Forging a partnership to achieve competitive advantage: the CIM challenge. MIS Quarterly 11 (2), 205–220.
Doyle, James R., Becker, Jack D., 1983. Computer assisted planning (CAP) at Dinero International Bancorporation. MIS Quarterly 7 (3), 33–46.
El Sawy, O.A., 1985. Personal information systems for strategic scanning in turbulent environments: can the CEO go online. MIS Quarterly 9 (1), 53–60.
Emery, J.C., 1990. The management difference: a tale of two is projects. MIS Quarterly 14 (3), 11–13.
Hackathorn, R.D., Karimi, J., 1988. A framework for comparing information engineering methods. MIS Quarterly 12 (2), 203–220.
Highsmith, J., 1981. Structured systems planning. MIS Quarterly 5 (3), 35–54.
Horner Reich, B., Benbasat, I., 1990. An empirical investigation of factors influencing the success of customer-oriented strategic systems. Information Systems Research 1, 325–347.
Javernpaa, S., Ives, B., 1990. Information technology and corporate strategy: a view from the top. Information Systems Research 1, 351–376.
Kim, K.K., Michelman, J.E., 1990. An examination of factors for the strategic use of information systems in the healthcare industry. MIS Quarterly, 14 (2), 201–215.
King, W.R., 1978. Strategic planning for management information systems. MIS Quarterly, 2 (1), 27–37.
King, W.R., 1985. Strategic planning for IS: the state of practice and research. MIS Quarterly, 9 (2), 6–8.
Lederer, A.L., Mendelow, A.L., 1988. Convincing top management of the strategic potential of information systems. MIS Quarterly 12 (4), 525–534.
Lederer, A.L., Sethi, V. The implementation of strategic information systems planning methodologies. MIS Quarterly 7 (3), 445–461.
Lorin, H., Ball, L.D., Eloy, G., 1987. Interconnect technology as a management challenge. MIS Quarterly 11, 4, 433–435.
Maletz, M.C., 1990. KBS circles: a technology transfer initiative that leverages Xerox's ''leadership through quality program''. MIS Quarterly 14 (3), 323–329.
Pyburn, P.J., 1983. Linking the MIS plan with corporate strategy: an exploratory study. MIS Quarterly, 7 (2), 1–14.
Rackoff, N., Wiseman, C., Ullrich, W.A., 1985. Information systems for competitive advantage: implementation of a planning process. MIS Quarterly, 9 (4), 285–294.
Selig, G.J., 1982. Approaches to strategic planning for information resource management (IRM) in multinational corporations. MIS Quarterly 6 (2), 33–45.
Sherif, H., El Sawy, O.A., 1988. Issue-based decision support systems for the Egyptian cabinet. MIS Quarterly 12 (4), 551–569.
Singleton, J.P., McLean, E.R., Altman, E.N., 1988. Measuring information systems performance: experience with the management by results system at security Pacific bank. MIS Quarterly 12 (2), 325–337.
Tavakolian, H., 1989. Linking the information technology structure with organizational competitive strategy: a survey. MIS Quarterly 13 (3), 309–317.
Watson, R.T., Pitt, L.F., Kavan, C.B., 1998. Measuring information systems service quality: lessons from two longitudinal case studies. MIS Quarterly 22 (1), 61–79.
Watson, R.T., 1990. Influences on the IS managers' perceptions of key issues: information scanning and the relationship with the CEO. MIS Quarterly 14 (2), 217–231.

B.2. 1991–2000

Adam, F., Murphy, C., 1995. Information flows amongst executives: their implications for systems development. Journal of Strategic Information Systems 4 (4), 341–355.
Andreu, R., Ciborra, C., 1996. Organisational learning and core capabilities development: the role of IT. Journal of Strategic Information Systems 5 (2), 111–127.
Angell, I.O., Straub, B.H., 1993. 'Though this be madness, yet there is method in't' Journal of Strategic Information Systems 2 (1), 5–14.
Applegate, L.M., Elam, J.J., 1992. New Information Systems Leaders: A Changing Role in a Changing World. MIS Quarterly 16 (4), 469–490.
Atkins, M.H., 1994. Information technology and information systems perspectives on business strategies. Journal of Strategic Information Systems 3 (2), 123–135.

Atkins, M.H., 1998. The role of appropriability in sustaining competitive advantage—an electronic auction system case study. Journal of Strategic Information Systems 7 (2), 131–152.
Avison, D.E., Cuthbertson, C.H., Powell, P., 1999. The paradox of information systems: strategic value and low status. Journal of Strategic Information Systems 8 (4), 419–445.
Bacon, C.J., 1992. The Use of decision criteria in selecting information systems/technology investments. MIS Quarterly 16 (3), 335–353.
Baets, W., 1992. Aligning information systems with business strategy. Journal of Strategic Information Systems 1 (4), 205–213.
Bai, G., 1997. Embryonic approach to the development of information systems. Journal of Strategic Information Systems 6 (4), 299–311.
Baker, B., 1995. The role of feedback in assessing information systems planning effectiveness. Journal of Strategic Information Systems 4 (1), 61–80.
Bakos, J.Y., 1991. A Strategic Analysis of Electronic Marketplaces. MIS Quarterly 15 (3), 295–310.
Banker, R., Kauffman, R.J., 1991. Reuse and productivity in integrated computer-aided software engineering: an empirical study. MIS Quarterly 15 (3), 375–401.
Barua, A., Kriebel, C.H., Mukhopadhyay, T., 1991. An economic analysis of strategic information technology investments. MIS Quarterly 15 (3), 313–331.
Beath, C.M., 1991. Supporting the information technology champion. MIS Quarterly 15 (3), 355–371.
Bergeron, F., Buteau, C., Raymond. L., 1991. Identification of strategic information systems opportunities: applying and comparing two methodologies. MIS Quarterly 15 (1), 89–103.
Blaize H.R., Benbasat, I., 2000. Factors That influence the social dimension of alignment between business and information technology objectives. MIS Quarterly 24 (1), 81–113.
Brady, T., Cameron, R., Targett, D., Beaumont, C., 1992. Strategic IT issues: the views of some major IT investors. Journal of Strategic Information Systems 1 (4), 183–189.
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Cavaye, A., Cragg, P.B., 1993. Strategic information systems research: a review and research framework. Journal of Strategic Information Systems 2 (2), 125–137.
Cavaye, A.L.M., 1998. An exploratory study in investigating transnational information systems. Journal of Strategic Information Systems 7 (1), 17–35.
Chan, Y.E., Huff, S.L., Copeland, D.G., 1997. Assessing realized information systems strategy. Journal of Strategic Information Systems 6 (4), 273–298.
Chan, Y., Huff, S., Barclay, D., Copeland, D.G., 1997. Business strategic orientation, information systems strategic orientation, and strategic alignment. Information Systems Research 8, 125–150.
Chan, Y.E., Huff, S.L., 1992. Strategy: an information systems research perspective. Journal of Strategic Information Systems 1 (4), 191–204.
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Dewan, S., Michael, S.C., Min, C., 1998. Firm characteristics and investments in information technology: scale and scope effects. Information Systems Research 9, 219–232.
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Dutta, S., Doz, Y., 1995. Linking information technology to business strategy at Banco Comercial Português. Journal of Strategic Information Systems 4 (1), 89–110.
Earl, M.J., 1994. The new and the old of business process redesign. Journal of Strategic Information Systems 3 (1), 5–22.
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Grover, V., Segars, A.J., Durand, D., 1994. Organizational practice, information resource deployment and systems success: a cross-cultural survey. Journal of Strategic Information Systems 3 (2), 85–106.
Hasan, H., Lampitsi, S., 1995. Executive access to information systems in Australian public organizations. Journal of Strategic Information Systems 4 (3), 213–223.
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Kettinger, W.J., Grover, V., Guha, S., Segars, A.H., 1994. Strategic information systems revisited: a study in sustainability and performance. MIS Quarterly 18 (1), 31–58.
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