THE ROLE OF SYNERGY IN ACHIEVING VALUE FROM BUSINESS ANALYTICS SYSTEMS

Completed Research Paper

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Abstract

Managers rely on Business Analytics (BA) systems to gain insight from organizational data to make better decisions and compete successfully with their rivals. BA systems interact with other organizational systems and provide them with high-quality analytical and reporting tools. When the interaction between BA systems and other organizational systems is synergistic, they create greater organizational value than the sum of the value of the individual systems in isolation. This study explores the enablers and mechanisms of the synergistic interaction between BA systems and other organizational systems and how the value can be realized. A research model is proposed, which explains how BA systems synergize with other organizational systems and create organizational value. The synergistic interaction of BA systems with other organizational systems gives rise to new BA-enabled organizational systems over time. The BA-enabled organizational systems have emergent properties that have the capability to create significant organizational value. The paper concludes by calling for further empirical work to evaluate and refine the research model.

Keywords: Business Analytics, Synergy, Systems theory, Business value
Introduction

Business Analytics (BA) systems use analytical tools and techniques to transform the raw data of an organization into meaningful information and insights. They have become a significant source of organizational value and competitive advantage in recent years (Davenport and Harris 2007; Sharma et al. 2010). Insights from BA systems enable organizational decision makers to take competitive actions that differentiate them from their rivals. Industry studies emphasize the significance of these systems to managers (Chen et al. 2012). Recently, business intelligence (BI) applications were ranked the first technical priority for CEO's (Hagerty et al. 2012) and organizations are investing large amounts of money on BA systems to improve their operational efficiency (Shanks and Bekmamedova 2012). Business analytics also was identified as one of the four major technology trends in 2010 (IBM 2011).

While there is extensive literature on the business value of Information Technology (IT) resources (Aral and Weill 2007; Melville et al. 2004; Mithas et al. 2011; Sambamurthy et al. 2003; Wade and Hulland 2004), there is limited research on the business value of BA systems and how organizations can maximize benefits from these systems. The business value of IT literature suggests that IT resources indirectly influence business value (Bharadwaj 2000; Mithas et al. 2011; Pavlou and El Savy 2006; Tanriverdi 2005). This indirect relationship implies that IT augments other organizational resources. Together, they may be conceptualized as higher-order IT-enabled business resources, which influence firm performance (Bharadwaj 2000). Hence, IT resources are not able to create the business value individually and should be implemented together with other organizational resources (Wade and Hulland 2004). When the IT and other organizational resources are synergistically related, they mutually reinforce each other, leading to outcomes greater than the additive effect of the individual resources. Therefore, synergy of IT resources with other organizational resources is an important source of organizational benefits (Nevo and Wade 2011) and competitive advantage (Bharadwaj 2000; Nevo and Wade 2010). Accordingly, the synergistic combination of BA resources, a subset of IT resources, with other organizational resources may lead to the emergence of BA-enabled organizational resources which have the capability to generate significant business value.

In recent years, several theoretical models have been proposed to explain how value is created from BA systems (Davenport and Harris 2007; Davenport et al. 2010; Elbashir et al. 2011; Isik et al. 2011; Seddon et al. 2012; Shanks and Bekmamedova 2012; Sharma et al. 2010; Wixom and Watson 2001). None of these models considers the synergistic combination of BA resources and other organizational resources. Therefore, the underlying mechanisms through which BA systems interact and synergize with other organizational resources to generate business value are not well understood. Furthermore, the concept of synergy has only been used in IS literature to a limited extent and its merits still remain largely unexplored. Therefore, this paper addresses the following research question:

How do business analytics systems synergistically interact with other organizational systems and contribute to organizational value?

To answer this question, we trace the evolution of the synergy construct in the information system literature and explore how it has been conceptualized, assessed, and used. Based on our analysis, we explore the synergistic interaction between BA resources and other organizational resources. Finally, we use the synergy concept to develop a conceptual model, which explains how BA resources, together with other organizational resources, create business value.

This study has two objectives. First, we demonstrate that synergy is a very important concept in information systems (IS) research, particularly in relation to IS resources synergistically combining with other organizational resources, and contributing to firm performance and competitive advantage (Melville et al. 2004; Roberts et al. 2012; Sambamurthy et al. 2003; Wade and Hulland 2004). Second, we use the synergistic interaction between BA resources and other organizational resources to explain how business value is created. Although there is strong anecdotal evidence that BA systems contribute to business value (Davenport and Harris 2007), the inclusion of synergy is important in providing a satisfactory explanation.

The paper is organized as follows. First we introduce synergy and its theoretical foundations. Next, we review how synergy has been conceptualized and measured in the IS literature. Third, we extend the synergy concept to BA-enabled organizational systems. Finally, we develop a research model that includes
Synergy to explain how BA-enabled organizational systems create business value.

What is Synergy?

The term synergy comes from the Greek word “synergos”, meaning "working together". The concept of synergy refers to the combined effort of resources to generate outcomes greater than the additive impact of individual resources. This outcome is the result of interactions, in which resources enhance each other in accomplishing organizational goals. For example, interaction among individuals in a team may lead to the creation of synergistic knowledge within a group, which is beyond the knowledge initially held by the individual members of the team (Griffith et al. 2003; Potter and Balthazard 2004). Hence, synergy is associated with positive outcomes (Nevo and Wade 2010; Roberts et al. 2012; Tanriverdi 2006). However, negative synergy may also occur when one resource degrades the effect of another leading to less beneficial outcomes. This is referred to as substitution relationship (Titah and Barki 2009).

There is a basic assumption underlying the concept of synergy. Synergy is meaningful only if there are at least two interacting resources. An organizational resource is a combination of assets and capabilities (Aral and Weill 2007). Assets are the technologies that organizations invest in to enable their functional competency. Capabilities are the interlocking systems of competencies and practices within the organization. Synergies can be conceptualized within a resource (e.g. between competencies and practices) or between different organizational resources. The concept of synergy addresses the limitations of the Resource Based View (RBV) in justifying the business value of IT resources. RBV theory conceptualizes organizational resources in isolation and underestimates their business value. In contrast, Systems theory, the theoretical underpinning behind synergy, conceptualizes the interaction among organizational resources, which collectively create greater impact. Systems theory is briefly explained in the following.

Systems Theory

Systems theory deals with systems taken as a whole, rather than individual parts (Ackoff 1971). A system is a composite thing comprising a number of parts (subsystems), which interact to accomplish a set of goals (Churchman 1968). The interactions among parts constitute a whole, which is greater than the sum of the individual parts. The whole system, derived from the synergistic interaction of the parts equals the sum of its parts plus their interactions (Ackoff 1971). However, it is very complex to model exactly how subsystems interact to constitute a whole. According to Corning (2002), rules and laws can never be used to explain the evolution of a system, as there are a large number of options and associated decisions at each point of time. However, the properties, patterns and structure that emerge from the interactions are an effective way of studying the whole. The new properties derived from the subsystem’s interactions are called emergent properties (Gharajedaghi 2011). The emergent properties of a collective system are the things that can be perceived and measured (Corning 2002). The synergistic interactions are associated with positive emergent properties.

An organization, with respect to systems theory, can be conceptualized as a set of interconnected subsystems (Kast and Rosenzweig 1972). This contrasts with the RBV, which views an organization as a bundle of resources (Barney 1991). An organizational system from the systems theory perspective corresponds to a resource from the RBV perspective (Nevo and Wade 2010). The use of systems theory helps model the interactions and synergy among resources, which is not possible using RBV theory. In this study, system and resource are used interchangeably. In the next section, we discuss how the synergy concept is utilized in the IS literature.

Synergy in the IS Literature

Synergy has been used in a diverse range of IS research streams, including the business value of IT assets (Nevo and Wade 2010, 2011), IT-based value in multi-business firms (Tanriverdi 2006), IT-based value in inter-organizational relationships (Venkatesh and Bala 2012), IT value co-creation (Grover and Kohli

1 According to Bunge’s ontology the world is made up of things that have properties with values at any point of time (Wand and Weber 2002)
2012; Sarker et al. 2012), knowledge management (Tanriverdi and Venkatraman 2005), human resource management (Ferratt et al. 2012), mergers and acquisitions (Tanriverdi and Uysal 2011) and information security (Cavusoglu and Raghunathan 2009). Despite many arguments and theoretical explanations about synergy, few papers have focused on synergy as their main phenomenon under study. There is few IS research that addresses the conceptualization and assessment of synergy. Most current empirical research has concerned synergy enablers (Nevo and Wade 2010, 2011), synergy mechanisms (Ferratt et al. 2012; Venkatesh and Bala 2012) and outcomes in isolation. Therefore, a holistic view of synergy is missing.

In order to address this gap in previous IS research, this study introduces a framework that synthesis and integrates different views of synergy. Figure 1 shows the integrative framework that we used to analyze the literature on synergy. The enablers of a synergistic interaction refer to the factors that facilitate synergistic interactions and influence the success of synergy. Mechanisms are the processes and activities that take place to achieve a synergistic interaction. Finally every synergistic interaction is associated with outcomes that are represented by the concept of realization. All the concepts in this framework are described in the following section and summarized in Table 1.

**Synergy Enablers**

The enablers of a synergistic interaction facilitate the interaction among them and influence the success of the relationship. From a systems theory perspective, compatibility and integration effort are two factors to enable the synergy among IT assets and other organizational resources (Nevo and Wade 2010, 2011). Compatibility refers to the degree that systems fit with each other and are in alignment. Compatibility is achieved when systems are able to seamlessly work each other. Compatible systems have compatible people, processes and technologies and are able to use each other’s functionalities within their own tasks. The compatibility between systems will facilitate their synergistic interaction (Nevo and Wade 2010).

Integration effort refers to the effort of management to bring the resources together and encourage and direct their interaction congruent with organizational goals (Nevo and Wade 2010, 2011). Management is responsible for bringing together all parts of an organization into an integrated whole and planning how the interaction among resources will serve the organization. Related management tasks include assigning decision rights, providing adequate training and changing the organizational structure to ensure that the organizational resources are properly combined.

**Synergy Mechanisms**

Mechanisms are the activities that take place among resources to realize their potential synergy. We distinguish between two types of mechanisms: complementarity mechanisms and boundary spanning mechanisms. These two mechanisms and their components are described below.

**Complementary Mechanisms**

Complementary mechanisms refer to the processes and activities by which resources are combined to
enhance and complement each other’s functionalities. These mechanisms have their roots in the strategy and economics literature and are theoretically grounded in the economic theory of complementarities (Milgrom and Roberts 1995). The economic theory of complementarities argues that a set of resources is complementary when the returns from a resource vary in relation to the levels of returns from other resources (Milgrom and Roberts 1995). For example, an increase in any of the resources enhances the returns of the other resources. Complementarity among resources can be utilized to generate super-additive value synergies, implying that the joint effect of resources is greater than the sum of the effect of individual resources (Tanriverdi 2006). That is: \( \text{Effect (A+B)} > \text{Effect (A)} + \text{Effect (B)} \). When the combined effect of two components is less than the sum of each component’s individual effect, a substitutability relationship is realized, also known as Edgeworth-Pareto substitutability (Samuelson 1974). Substitutability leads to negative synergy. This has been observed in attitudes and subjective norms, where an increase in one of these factors will decrease the marginal effect of the other factor (Titah and Barki 2009).

Complementarity relations arise from differences among resources and the fact that resources can mutually support, reinforce and enhance each other’s efficiency (Aral and Weill 2007; Tanriverdi 2006). Resource complementarity has been frequently used in the IS literature as the main source of synergy (Chen and Edgington 2005; Grover and Kohli 2012; Melville et al. 2004; Nevo and Wade 2010, 2011; Roberts et al. 2012; Tanriverdi and Uysal 2011; Tanriverdi 2006). The complementary relations can also enhance the value, rarity, inimitability and non-substitutability (VRIN) properties of resources, providing the organization with competitive advantage (Tanriverdi 2006). Complementary mechanisms for realizing synergy include reinforcement, flanking, and compensation mechanisms. They are also known as horizontal fit mechanisms (Ferratt et al. 2012).

Reinforcement mechanisms occur when resources consistently work with each other, add crucial contributions to each other and enhance each other’s organizational impact (Ferratt et al. 2012; Wade and Hulland 2004). For example, practices and competencies mutually reinforce each other (Aral and Weill 2007). A competency is only realized when is it practiced and practicing contributes to more competency.

Flanking mechanisms occur when one resource creates conditions that enable another resource to improve its effectiveness (Ferratt et al. 2012; Horgan and Mühlau 2006). For example, when one resource lacks the knowledge to perform a task, training can act as a flanking mechanism by changing the inputs of the primary resource and enhancing its effectiveness.

In the case of compensation mechanisms, one resource blocks or diminishes the negative effects of another resource with respect to organizational goals (Ferratt et al. 2012; Wade and Hulland 2004). For example, incentives can act as a compensating practice to address the misalignment of human resource activities with organizational goals and enhance their efficiency in accomplishing organizational tasks (Horgan and Mühlau 2006).

In summary, complementary mechanisms are different types of relations among resources, in which resources may influence each other’s functionalities and complement each other.

**Boundary Spanning Mechanisms**

Boundary spanning mechanisms refer to the processes and activities that help resources to bridge the knowledge gap between domains. These mechanisms help to create a shared field among resources, in which they can cross their boundaries to collaborate and exchange knowledge. Boundary spanning mechanisms assist complementary resources to achieve a shared language for collaboration and mutual understanding of each other’s issues. Therefore, boundary spanners play a critical role in stimulating synergistic interactions among resources (Venkatesh and Bala 2012). Embeddedness, learning and influence are the three components of boundary spanning mechanisms.

Embeddedness has its roots in economics and management. Embeddedness occurs when a firm creates social ties with another based on familiarity, trust and commitment (Granovetter 1985). These social ties connect resources from different contexts to collaborate, share knowledge and develop social capital (Evans 1996). Therefore this mechanism facilitates crossing resource boundaries and interacting with other communities of practice, leading to synergistic outcomes (Venkatesh and Bala 2012; Evans 1996)
Learning is another boundary spanning mechanism and is based on social information processing theory and organizational learning theory (Venkatesh and Bala 2012). The social environment provides an immediate source of information for individuals who can process and act on the information they collect. This mechanism helps the resources to sense the environment and exploit the opportunities offered to them (Chellappa et al. 2010; Venkatesh and Bala 2012). It can also help them to better understand each other’s values and norms and leading to their synergistic interaction (Venkatesh and Bala 2012).

Finally, the influence mechanism, grounded on institutional theory, forces organizations and individuals to conform to norms, traditions and social expectations (Venkatesh and Bala 2012). Based on this mechanism, dominant resources can force their interacting partners to comply with their rules, norms and values. Further, resources can influence each other to develop a shared mental model through their interactions and become aware of each other’s plans and reactions.

In summary, boundary spanning mechanism help the resources to connect, collaborate, share knowledge and learn about each other’s values and norms.

| Table 1. The enablers, mechanisms and realization of a synergistic interaction |
|-------------------------------|---------------------------------|-----------------|
| **Factors** | **Definition** | **Reference** |
| **Enablers** | | |
| Compatibility | Compatibility is achieved when resources are capable of seamlessly working with each other. | (Nevo and Wade 2010) |
| Integration effort | Integration refers to the efforts of management within an organization to initiate, support and maintain interaction among resources. | (Nevo and Wade 2010) |
| **Mechanisms** | | |
| Reinforcement | When one resource is not powerful enough to achieve its organizational goals, a complementary resource can support and reinforce it to accomplish its tasks and goals. | (Ferratt et al. 2012) (Horgan and Mühlau 2006) |
| Flanking | Strengthening the effects of a resource by putting in place resources that create favorable conditions for the success of the focal resource (e.g. training). | (Ferratt et al. 2012) (Horgan and Mühlau 2006) |
| Compensation | When a resource blocks or mitigates the negative or undesirable effects of another resource (e.g. motivating) | (Ferratt et al. 2012) (Horgan and Mühlau 2006) |
| Embeddedness | When a resource collaborates, shares knowledge and develops social capital with other resources in its network. | (Granovetter 1985) (Venkatesh and Bala 2012) (Evans 1996) |
| Learning | When a resource is able to sense, process and act on the information about the other resource. | (Venkatesh and Bala 2012) |
| Influence | Forcing organizations or individuals to conform to norms, traditions, and social expectations in an institutional environment. | (Venkatesh and Bala 2012) |
| **Realization** | | |
| Emergent properties | The properties that emerge from a synergistic interaction among resources. | (Nevo and Wade 2010, 2011) |
**Synergy Realization**

Synergy is associated with outcomes that are greater than the sum of the value of their individual parts. Theoretically, the outcomes are achieved based on the notion of emergence in systems theory. The interaction among resources will give rise to the emergence of new properties which cannot be reduced to individual resources (Nevo and Wade 2010, 2011). Positive emergent properties drive synergistic outcomes and synergistic outcomes provide additional leverage beyond the independent effects of each resource in isolation.

Synergy realization is highly dependent to the existence of certain enablers and mechanisms among resources. Furthermore, the emergent properties gained from synergy realization are highly dependent on the context of the study. The emerged properties can be new properties or the same properties as individual resources but with extended value. In the IS literature, benefits from synergy realization are mostly in the form of improved firm performance (Nevo and Wade 2010; Venkatesh and Bala 2012) and competitive advantage (Nevo and Wade 2011; Tanriverdi 2006).

**Synergy Operationalization and Assessment**

Although synergy has been used in IS research, it has rarely been operationalized as a construct. Most empirical research involving synergy has focused on measuring synergistic outcomes realized from the interaction of the variables, rather than measuring synergy directly. In this section we review synergy operationalization, assessment and level of analysis in the IS literature.

**Conceptualization and Operationalization**

Synergy has been rarely the main concept under study in IS research. Therefore, few extant studies have conceptualized and operationalized synergy as a construct in empirical IS research. Two exceptions are when synergy was recently defined by Nevo and Wade (2010) and operationalized in Nevo and Wade (2011). Nevo and Wade (2010, 2011) conceptualize synergy as positive emergent properties realized from the interaction of IT assets and other organizational resources. They argue that these positive emergent properties have VRIN properties (from RBV theory) and are therefore the source of organizational benefits and competitive advantage. Other scholars believe that measuring synergy in terms of outcomes may be tautological with dependent variables such as firm performance (Tanriverdi and Venkatraman 2005). They suggest focusing on the sources of synergy rather than operationalizing synergy itself (Davis and Thomas 1993; Tanriverdi 2006). Synergy is then measured as a second order reflective construct (Tanriverdi and Uysal 2011; Tanriverdi and Venkatraman 2005; Tanriverdi 2005, 2006) which captures complementary relations among the first-order synergy enablers. For example, synergy can be operationalized as a second-order construct with enablers including compatibility and integration as the second-order constructs.

**Assessing Synergistic Outcomes**

Apart from the few studies that have conceptualized and measured synergy as a construct, most have focused on synergistic outcomes. Synergistic outcomes should be greater than the additive effects of individual resources. Ferratt et al. (2012) examined whether the whole is greater than the sum of its parts in managing IT professionals. They use configurational theory to build ideal-type configurations of human resource practices and examined their impact on the job search behavior of IT professionals. They found two ideal-type configurations in which more value is generated than the additive effect of individual practices in that configuration. Other than this study, statistical interaction tests have been extensively used to test complementary relationships and synergies (Aral and Weill 2007; Titah and Barki 2009; Venkatesh and Bala 2012). Interaction tests add the product-term of the complementary factors to a regression equation. If the coefficient of the product-term is positive, a complementarity relationship exists. If the coefficient is negative, the relationship is substitutability rather than complementarity. Finally, if the coefficient is zero, the factors are independent. Titah and Barki (2009), argue that nonlinear relationships may exist among the complementary factors and that interaction tests rarely partial out the quadratic effects of the interacting variables. Further, omitting nonlinear effects from research
models tends to either understate or overstate the main effects, leading to erroneous, partial, or incomplete interpretations. Thus, to capture the nonlinearities, single or multiple nonlinear product terms should be added to the regression equation (Titah and Barki 2009).

In summary, measuring synergistic outcomes is a challenging task. Understanding the complex relationships among constructs may not be possible due to quadratic effects or higher-order effects. Furthermore, due to research limitations, constructs in a research model may not capture all the possible relationships in the real world. As a result the use of interaction effects may lead to the underestimation of the value of synergy in the real world. Therefore, other approaches such as the use of configurational theory (Ferratt et al. 2012) or complex adaptive system (Nan 2011) may yield more convincing results.

**Level of Analysis**

Synergy has been conceptualized at multiple levels of analysis in the IS literature. Recently, synergy has been investigated at the organizational level, within inter-organizational relationships (Venkatesh and Bala 2012). Synergy within inter-organizational relationships enhances the value co-creation of multiple organizations (Grover and Kohli 2012; Sarker et al. 2012). Other scholars have examined the synergy between different functional or business areas within a single firm (Tanriverdi and Uysal 2011; Tanriverdi andVenkatraman 2005; Tanriverdi 2006). Synergy has also been conceptualized between individuals (Griffith et al. 2003) and also between individuals and their technologies (Nevo and Wade 2010, 2011). Most of these studies focus on assessing the synergistic effects between variables, rather than building and operationalizing a distinct synergy construct.

**Synergy in Business Analytics-enabled Organizational Resources**

The synergistic interaction of BA systems with other organizational systems is critical in generating business value from BA systems. In this section, we extend the synergy concept and conceptualize synergy between BA resources with other organizational resources. We argue that enablers and mechanisms together can affect synergy realization.

**Enablers of Synergy in BA-enabled Organizational Resources**

Compatibility and integration are two critical enablers of synergy between IT assets and other organizational resources (Nevo and Wade 2010, 2011). These enablers can be generalized to the synergistic interaction of BA resources and other organizational resources. Compatibility and integration efforts enable the interaction among BA and other organizational resources.

The compatibility of BA resources with other organizational resources occurs when the functionality of BA resources fits the functionality of the other organizational resources. Consequently, these resources are able to consistently interact and work with each other. Compatibility ensures that the other organizational resources are capable of utilizing the analytical tools and functionalities provided by BA resources in their process and routines. Conversely, the BA tools and functionalities provided should match the decision needs of the other organizational resources, as different organizational resources may need different analytical functionalities (Isik et al. 2011).

The integration effort of management acts as a catalyst in initiating, supporting and guiding the interaction between BA resources and other organizational resources. Without this effort, the organizational resources may not change from their traditional processes to fact-based analytical processes. Management support is a critical success factor in the implementation of BA initiatives (Davenport and Harris 2007; Seddon et al. 2012; Shanks and Bekmamedova 2012, 2013). The management activities may include providing training to users and changing the organizational structure and culture to properly accommodate BA resources in relationships with other organizational resources. Management also should assign the decision rights in these relationships to mitigate the power-based issues between functional areas (Shanks and Bekmamedova 2013).

Compatibility and integration also exists within BA resources (between assets, competencies and practices). Compatibility within BA resources means that there is a fit between BA assets, competencies
and practices. Integration within resources means that management initiates and supports the interaction between BA people, process and technologies.

**Synergistic Mechanisms in BA-enabled Organizational Resources**

The realization of synergy between BA resources and other organizational resources is enhanced by complementary and boundary spanning mechanisms.

**Complementary Mechanisms in BA-enabled Organizational Resources**

Synergy may develop in BA-enabled resources due to complementary mechanisms between BA resources and other organizational resources. Stand-alone BA systems rarely create organizational value individually. BA resources engage in different cross-functional relationships with other organizational resources and provide them with new analytical and high quality reporting capabilities. For example, the use of BA systems in Customer Relationship Management (CRM) helps organizations to collect customer data over time from many different touch points, combine it with other relevant data, analyze the data with different analytical tools and propose a variety of tailored services (Wixom and Watson 2001). This use of BA systems has transformed the role of CRM from an operational tool to a strategic tool for organizations to innovate, compete and gain competitive advantage. Therefore, we argue that BA systems complement other organizational systems by supporting and reinforcing their functionality. Therefore, high-quality BA resources contribute to the improved efficiency of other organizational resources in accomplishing their tasks, which in turn stimulates the repeated use of BA resources. The repeated use will lead to the BA resources collecting more data from the other organizational system over time, to evaluate the success of their BA-enabled initiatives and to customize further initiatives. This mutually reinforcing behavior leads to the creation of complementary synergies.

Complementary relations may also exist within BA resources (between assets, competencies and practices) (Aral and Weill 2007). For example, competencies are necessary for executing a practice and the execution of practices leads to the development of better competencies (learning by doing). Therefore, practices and competencies support and reinforce each other and their interaction may lead to synergistic outcomes within the BA resource.

**Boundary Spanning Mechanisms in BA-enabled Organizational Resources**

Synergy may develop in BA-enabled organizational resources due to boundary spanning mechanisms between BA resources and other organizational resources. Boundary spanning occurs when individuals cross the boundary of one social group and interact with another social group. Three boundary spanning mechanisms relevant to BA-enabled organizational resources are embeddedness, learning and influence.

The embeddedness mechanism enables boundary spanners from the BA functional area to cross their own boundary and make social ties with their counterparts in other functional areas. These social ties can be exploited to develop social capital, and exchange and disseminate knowledge. Embeddedness also leads to the entrenchment of BA resources within the structural, social and cultural aspects of an organization (Grewal and Slotegraaf 2007). BA embeddedness can change the core values, behavior and processes to be based on analytics and spread an evidence-based decision making culture within organizations (Shanks and Bekmamedova 2012). Embedding analytics in the DNA of an organisation helps to realize the benefits from BA resources (Davenport and Harris 2007; Davenport et al. 2010; Shanks and Bekmamedova 2012; Shanks et al. 2012).

The learning mechanism assists BA resources to exploit new opportunities within cross-functional relationships and evaluate the success of these initiatives. BA systems can utilize the learning mechanism to understand different organizational systems and develop a shared language to interact with them. This also helps BA systems to sense and exploit new opportunities to implement BA initiatives in other functional areas. Furthermore, BA systems can evaluate the effectiveness of their initiatives after implementation and learn from their experiences (Shanks and Bekmamedova 2012).

Influence mechanisms enable BA systems to change the core values and norms of their counterpart
functional areas and encourage them to adopt and use BA in their processes and routines. Furthermore, the success of BA initiatives in one functional area of an organization may influence other functional areas to change their values and norms, and therefore adopt analytics (Shanks and Bekmamedova 2012).

**Synergy Realization in BA-enabled Organizational Resources**

The synergetic interaction between BA resources and other organizational resources will give rise to the emergence of new BA-enabled organizational resources. These BA-enabled organizational resources possess emergent functionalities, which do not exist in the individual BA systems or other organizational systems. For example, BA-enabled CRM systems may have emergent properties such as customer behavior analysis, customer profitability analysis, superior customer service (cross selling and up selling), a single view of the customer, and effective targeted marketing to both segments and individuals (Goodhue and Wixom 2002). Each of these emergent properties is the result of the interaction between BA resources and CRM resources and cannot be reduced to either of the individual BA or CRM systems.

Synergies may also be realized within BA resources. The combination of analytical assets, competencies and practices can be synergistically combined into broader BA functionalities. These include data storage, analysis, reporting and interpretation, and cannot be reduced to any individual asset competency or practice.

**Proposed Research Model**

The research model is based on the concepts of synergy and systems theory, and explains how BA resources synergize with other organizational resources to create organizational value. The research model is presented using two different perspectives: a variance model and a systemic model. The systemic representation highlights the emergence of higher-order constructs and impacts from the interaction of lower-level constructs at multiple levels within an organization. According to systems theory, BA resources and other organizational resources are conceptualized as two organizational subsystems. The other organizational resources can be Customer Relationship Management (CRM), Supply Chain Management (SCM) or any other functional area of an organization. BA subsystems interact with other organizational subsystems and if their relationship is synergistic, BA-enabled organizational system will emerge from their interaction. The research model is shown below in Figure 2, and definitions of constructs and hypotheses follow.
1. Organizational Subsystem Quality

Organizational subsystem quality refers to the quality of the properties that emerge from the synergistic interaction between assets, competencies and practices in a functional area of an organization. These properties emerge from the complementary relationships that exist between the assets, competencies and practices and therefore the synergies within the boundaries of this construct (Aral and Weill 2007). For example, a CRM subsystem includes CRM software, competencies and processes. CRM subsystem quality refers to the degree to which a CRM subsystem is able to successfully manage its relationships with customers through marketing, sales and service. This can be achieved through the emergent properties realized from the synergistic combination of CRM assets and capabilities.

2. BA Subsystem Quality

BA subsystem quality refers to the quality of the properties that emerge from the synergistic interaction of assets, competencies and practices. BA assets are the technologies that organizations invest in to enable their analytical capability. BA Capabilities are interlocking systems of BA competencies (BA skills and BA management quality) and BA practices (processes, routines and the culture of BA use). The emergent properties arising from this interaction include the quality of data storage, analyses, reporting and interpretation.

BA subsystems and organizational subsystems are able to create organizational value individually. The dashed lines in the model show the value created from these systems in isolation.

3. Synergistic Interaction

The Synergistic Interaction between BA subsystems and organizational subsystems refers to the joint effort of BA and other organizational subsystems in accomplishing organizational goals and subsequently

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**Figure 2. Achieving organizational value from synergistic interaction of BA and other organizational subsystems**
value. This value is greater than the sum of the individual value achieved by the BA subsystem and organizational subsystem in isolation. A synergistic interaction is only realized when the BA subsystem provides the organizational subsystem with new or modified (emergent) capabilities that enable the BA-enabled organizational system to achieve higher organizational value (Nevo & Wade 2010). The synergistic interaction between the BA subsystem and other organizational subsystems is realized through the enablers and mechanisms discussed in the previous section. The specific enablers and mechanisms include compatibility, integration effort, reinforcement, embeddedness, learning and influence. According to systems theory, the synergistic interaction between BA subsystems and organizational subsystems will lead to the emergence of new BA-enabled organizational systems over time with new properties. Therefore, it is hypothesized that:

**Hypothesis 1:** The greater the synergistic interaction between BA subsystems and organizational subsystems, the greater the emergent properties of BA-enabled organizational systems.

Synergistic interaction can be conceptualized as a formative second-order construct with enablers and mechanisms as first-order indicators.

4. BA-enabled Organizational System Quality

BA-enabled organizational system quality refers to the quality of the emergent properties arising from synergistic interaction between BA subsystems and organizational subsystems. The BA-enabled organizational system is a composite thing, composed of the BA subsystem, organizational subsystem and the synergistic interaction between these two subsystems. The BA-enabled organizational system is the result of the cross-functional integration of BA systems and other organizational systems. This system possesses emergent properties, arising from the complementary synergies between BA subsystems and organizational subsystems. The emergent properties cannot be reduced to any individual BA subsystem or organizational subsystem. As a result, it is hypothesized that:

**Hypothesis 2:** The greater the emergent properties of the BA-enabled organizational system, the greater the value created for organization.

The BA-enabled organizational system is an emergent system, which, according to systems theory, should have greater value to organizations than the sum of the individual BA and organizational subsystems. So, it is hypothesized that:

**Hypothesis 3:** The BA-enabled organizational system generates more organizational value than the sum of the value created by the BA and organizational subsystems.

5. Organizational Value

Organizational value is the benefits that an organization achieves from the use of BA subsystems, organizational subsystems and BA-enabled organizational systems. The organizational value can be realized and measured within three categories: financial, behavioral and perceptual (Wheeler 2002). Financial categories indicate the profit that organization receives from the use of BA-enabled organizational systems. Perceptual indicators measure the beliefs, attitudes and intentions of relevant stakeholders including customers and internal clients (e.g. customer satisfaction). They measure the likely actions stakeholders regarding the organization. Behavioral indicators measure the actual choices and behaviors of customers or internal clients. This can be captured using the frequency of their interactions with the system or the sequence of their actions. Behavioral indicators measure what the customer actually values or what the internal client actually uses (Wheeler 2002). The perceptual and behavioral indicators can be conceptualized as multi-level constructs and measured at both individual and organizational levels (Burton Jones & Gallivan 2007). The organizational-level perceptual measure will be the average of the individuals’ perception and the organizational-level behavioral indicator can be measured as the aggregate of the individuals’ behavior.
Table 2. Definition of constructs in the research model

<table>
<thead>
<tr>
<th>Concept</th>
<th>Definition</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organizational subsystem quality</td>
<td>The degree to which an organizational subsystem is successful in accomplishing its organizational goals.</td>
<td></td>
</tr>
<tr>
<td>Business analytics subsystem quality</td>
<td>The quality of a BA subsystem in storing, analyzing and reporting from high quality data.</td>
<td>(Shanks and Bekmamedova 2012)</td>
</tr>
<tr>
<td>Synergistic interaction</td>
<td>A complementary relationship between BA subsystems and organizational subsystems, in which the outcomes generated are greater than the sum of the individual effects of the BA subsystem and organizational subsystem in isolation.</td>
<td>(Gharajedaghi 2011; Nevo and Wade 2010, 2011)</td>
</tr>
<tr>
<td>BA-enabled organizational system quality</td>
<td>The quality of the emergent properties arising from synergistic interaction between a BA subsystem and an organizational subsystem.</td>
<td></td>
</tr>
<tr>
<td>Organizational value</td>
<td>Benefits an organization receives from the use of BA subsystems, organizational subsystems and BA-enabled organizational systems.</td>
<td>(Wheeler 2002)</td>
</tr>
</tbody>
</table>

Conclusion and Future Work

BA systems contribute significantly to the generation of insight in different functional areas within organizations and in achieving competitive advantage (Davenport and Harris 2007; Davenport et al. 2010; Shanks et al. 2012). The synergy of IT resources with other organizational resources is fundamental in achieving benefits from IT systems (Nevo and Wade 2010, 2011). Thus, the synergy of BA systems with other organizational systems may lead to the generation of significant organizational value from BA-enabled systems. In this study, we explore the merits of synergy in explaining how BA systems generate value.

We propose a general framework of synergy enablers, mechanisms and realization to better understand the synergistic interaction of BA systems and other organizational systems. According to the framework, synergy between BA systems and other organizational systems is realized using specific enablers and mechanisms. The specific enablers are compatibility and integration, which facilitate the interaction of BA systems and other organizational systems. The specific mechanisms are complementarity and boundary spanning, comprised of reinforcement, embeddedness, learning and influence. These mechanisms help BA systems and other organizational systems in developing social capital, shared knowledge, and learning. Furthermore, BA systems will be embedded in the processes and culture of other organisational systems and augment their functionality. Enablers and mechanisms together drive the synergistic interaction of BA systems and other organizational systems.

The synergetic interaction between BA systems and other organizational systems gives rise to BA-enabled organizational systems with emergent properties (for example sophisticated data analysis, high-quality reporting and visualization). The emergent properties cannot be reduced to individual BA systems and organizational systems. We argue that the value created by BA-enabled organizational systems is greater than the sum of the value of BA systems and organizational systems in isolation. Our research model (Figure 2) represents this perspective and answers the research question of how business value is created from BA systems using the concept of synergy.

Our work has a number of implications for BA practitioners and researchers. For BA practitioners, the research model provides a systematic means of understanding the importance of the synergistic interaction of BA systems with other organizational systems. The specific enablers and mechanisms can help practitioners in creating synergies between different systems. These systems must fit well together and BA insights need to be embedded within the processes and routines within organizations, to achieve...
value. For BA researchers, we have extended the BA value literature by including the important concept, synergy. We have also contributed to the business value of IT literature by conceptualizing a path from synergy to emergence. The research model we propose will provide a sound base for further empirical research into understanding the role of synergy in achieving value from business analytics systems. We suggest a number of areas for future research.

First, we have identified a number of enablers and mechanisms for the synergistic interaction of BA resources with other organizational resources. Empirical confirmation and refinement of this conceptualization of synergy is an important research direction to follow. This can be done by conducting interviews and focus groups with BA experts and leaders.

Second, we have proposed a research model, which explains how value is created from BA systems using the synergy concept. However, it is important to investigate the synergy of BA systems with a specific organizational system such as CRM systems. This will help to better understand the emergence of new properties from their interaction over time.

Third, we have developed a research model and three hypotheses, which need to be empirically tested. An important aspect of this empirical research will be testing whether the emergent BA-enabled organizational resources generate greater value that the sum of the value created by BA resources and other organizational resources in isolation. This can be generalized to testing synergy in general, which has been largely overlooked in IS literature.

Finally, we argue that synergy is critical in understanding the role of IT within organizations and in inter-organizational relationships in bringing value to organizations. We have based our understanding of synergy mainly on IS research. It is important to also consider how synergy has been used more generally in management science and other social sciences to enrich our understanding of the synergy concept.

References


